PLANNING AND INVESTMENT DEPARTMENT, MINISTRY OF TRANSPORT
SOCIALIST REPUBLIC OF VIETNAM

DATA COLLECTION SURVEY ON TRAFFIC CONDITIONS OF SOUTHERN ROADS AND BRIDGES

FINAL REPORT

AUGUST 2016

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS GLOBAL CO., LTD.
INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INC.

1 R
J R
16-036

PLANNING AND INVESTMENT DEPARTMENT, MINISTRY OF TRANSPORT
SOCIALIST REPUBLIC OF VIETNAM

DATA COLLECTION SURVEY ON TRAFFIC CONDITIONS OF SOUTHERN ROADS AND BRIDGES

FINAL REPORT

AUGUST 2016

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS GLOBAL CO., LTD.
INTERNATIONAL DEVELOPMENT CENTER OF JAPAN INC.

Location Map of Survey Area

SOCIALIST REPUBLIC OF VIETNAM

DATA COLLECTION SURVEY on TRAFFIC CONDITIONS of SOUTHERN ROADS and BRIDGES

FINAL REPORT

EXECUTIVE SUMMARY

1. INTRODUCTION

1.1 Survey Background

Formed in 2015, the ASEAN Economic Community (AEC) marks the commitment of the ASEAN leaders to building and promoting a single market and production base, a highly competitive economic region tempered with equitable development, and a region fully integrated into the global economy. The AEC creates greater opportunities and challenges to the Socialist Republic of Vietnam (hereinafter referred to as Vietnam). More specifically, the southern region (hereinafter referred to as Ho Chi Minh City Metropolitan Area) serves as a gateway to the east of the Southern Economic Corridor passing through Bangkok, Phnom Penh, and Ho Chi Minh City. This effectuates an increasing traffic demand for Ho Chi Minh City Metropolitan Area, rapid industrial development, and accelerates overall economic growth. However, this rapid development effectuates frequent movement of heavy trucks, truck cargo and private cars significantly, which in turn causes serious traffic congestion, deteriorates existing road/bridge conditions and increases traffic accidents remarkably.

Furthermore, the opening of the north - south highway between Ho Chi Minh City and Trung Luong in February 2010 created rapid traffic demand in the section between Ho Chi Minh City and Can Tho. Therefore, adequate and proper maintenance of the road/bridge infrastructures under the Mekong Delta, a river prone region, becomes essential.

Under such circumstances, the 9th five-year Socio-Economic Development Plan for 2011-2015 underlines a rapid development that should be in close linkage with sustainable development. This plan has concretized and drawn out specific roadmaps and policies with a view to successful implementation of social, economic and environmental development tasks and objectives. It also focuses an important issue on the further development of a transport infrastructure system.

In addition, the business plan along with the Japanese assistance strategy to Vietnam emphasizes the activation and facilitation of the Mekong region, including the East-West Economic Corridor for trunk road network development and urban transport development (cross-border traffic facilitation). It also pays special attention to the ASEAN connectivity improvement. After the opening of the Cai Mep - Thi Vai port, the gateway of Southern Economic Corridor logistics is required in order for its promotion and connection between hinterland and industrial hub.

According to the plans and the strategies stated above, upgrading of the present traffic conditions is urgently necessary in order to cope with future demand. Therefore, improvement of all existing road and bridge infrastructure in Vietnam is becoming an important issue.

1.2 Survey Objectives

Improvement of logistics efficiency for southern Vietnam by;

- Incorporating the increasing traffic demand for Ho Chi Minh City Metropolitan Area and the Mekong Delta Area,
- Ensuring efficient freight transport movement,
- Review of existing road and bridge infrastructure and elaboration of improvement requirements

2. EXISTING CONDITIONS OF SURVEY AREA

2.1 Social and Economic Conditions of Survey Area

2.1.1 Constitution of Survey Area

The Survey Area (SA) is defined to cover Ho Chi Minh City, Dong Nai Province, Ba Ria-Vung Tau (BRVT) Province, Long An Province, Dong Thap Province, Tien Giang Province and Vinh Long Province as shown in Figure 2.1.1.

The first three areas (one city, two provinces) belong to the South East Region and the remaining provinces are part of the Mekong River Delta Region. Those two regions, among the six of the whole country, are located in the southern part of Vietnam.

The Southern Focal Economic Zone (SFEZ) was originally established in 1998 to cover Hồ Chí Minh City, Binh Duong, Đ□ng Nai and Bà Rịa-Vũng Tàu Provinces, and later in 2003 Long An, Binh Phuoc, Tai Ninh Provinces were added. Currently in 2006, Tien Gian Province joined SFEZ to total one city and 7 provinces. SFEZ is the engine of national and in particular regional economic growth in southern Vietnam.

Source: JICA Survey Team

Figure 2.1.1 Location of Survey Area

2.1.2 Population and GRDP in SFEZ and Survey Area

Table 2.1.1 compares the population and Gross Regional Domestic Product (GRDP) of the whole country, the SFEZ and the SA.

As compared in Table 2.1.1, the social and economic profiles of the SFEZ and the SA look similar, because such major economically developed areas as HCMC, Ba Ria-Vung Tau, Dong Nai and Long An Provinces overlap in both areas.

Table 2.1.1 Population in SFEZ and Survey Area

	National	SFEZ	Survey Area
Area ('000 ha)	33,096.7	3,059.5	2,189.6
	100%	9%	7%
Population ('000 persons)	90,728.9	18,983.9	17,796.5
	100%	21%	20%
- Urban	30,035.4	10,424.6	9,075.2
	100%	35%	30%
- Rural	60,693.5	8,559.3	8,721.3
	100%	14%	14%
Urbanization Rate	33.1%	54.9%	51.0%
Population Density (persons/ha)	2.7	6.2	8.1
G(R)DP at current price (bill. Dongs)	3,937,856 (100.0%)	1,979,717 (50.3%)	1,838,299 (46.7%)
Per Capita G(R)DP at current prices (mill. dongs)	43.4	104.3	103.3

Source: General Statistics Office and City/Provincial Statistical Office

However, each area shows different features in their geographical extensions through HCMC. The SFEZ area is principally composed of HCMC and its adjoining provinces and formed along such trunk roads as National Roads No. 1, No. 50, No. 22, No. 13 and No. 51, extending radially from HCMC. Meanwhile, the SA is characterized by such corridors as national roads No. 1 and No. 20 extending in the northeast-southwest direction through HCMC.

The SA occupies 7% of the national territory. The population, urban population and Gross Regional Domestic Product (GRDP) of the SA, however, account for 20% (17.8 million), 30% (9.1 million) and 47% (over 1.8 quadrillion VND at current prices in 2014) of the national totals, respectively. Thus, the area has industrialized and urbanized more than other regions in the country and it agglomerates economic activities of the country and considerably contributes to Vietnam's national economy. GRDP per capita of the SA is more than double the national average.

3. EXISTING DEVELOPMENT PLANS FOR SOUTHERN VIETNAM

3.1 Existing Urban and Regional Development Plans

3.1.1 Overview of Existing Development Plans

Existing development plans relevant to the Survey Area are listed and categorized into such areas as the whole country, Ho Chi Minh Metropolitan Area, Mekong River Delta Region and Provinces in the SA as shown in Table 3.1.1.

Table 3.1.1 Upper Level Plan of Vietnam Government and HCM Metropolitan Area

Policy, Superior Plans, Strategy	Goal, Purpose	remarks
A. National Plans		
a) The 9th Five-year Socio-Economic Development Plan 2011-15 (Congress Decision)	Sustainable development under high economic growth rate, realize the industrialized nation in 2020, improvement in society, science, education, environmental conservation	2011, approved
b) The 10th Five-year Socio-Economic Development Plan 2016-2020	Sustainable development under high economic growth rate, democratization in economy, improvement of enterprise's competitiveness.	planning ongoing
B. Hồ Chí Minh Metropolitan Area (South East Region)		
c) The Master Plan on Socio-Economic Development of Hồ Chí Minh City through 2020, with a Vision towards 2025 (PM Decision)	Developing Ho Chi Minh City as a modern city and taking the lead in industrialization and modernization, contributing more to regional and national developments	2013, approved
d) Revision of Hồ Chí Minh City Construction Plan to 2025 (PM Decision)	Revision of the Master Plan on Construction of the Ho Chi Minh City Region up to 2020, based on the regulation to review the plan every 5 years.	2010, approved
e) The Master Plan on Construction of the Ho Chi Minh Region up to 2020, with a vision toward 2050 (PM Decision)	Adopting the urban development model of multi-polar concentration and HCMC is planned to function as the core of the metropolitan area, neighboring regions, the whole country and the gateway to the world.	2008, approved
f) The Master Plan on Socio-Economic Development of Bà Rịa-Vũng Tàu Province (PM Decision)	Strengthening the partnership with Hồ Chí Minh metropolitan area and Mekong Delta Region as a major port	2007, approved
g) The Master Plan on Socio-Economic Development of Đồng Nai Province (PM Decision)	Developing high-tech and low-tech special economic zone and strengthening the partnership with Hồ Chí Minh metropolitan area and Mekong Delta Region	2015, approved
C. Mekong River Delta Region		
h) The Master Plan on Socio-Economic Development of Mekong Delta Key Economic Region Through 2020, with a vision towards 2030 (PM Decision)	Development of agricultural industry of Cần Thơ City, Cà Mau, An Giang, Kiên Giang province.	2014, approved
i) The Master Plan on Socio-Economic Development of Long An Province (PM Decision)	Strengthening the partnership with Hồ Chí Minh metropolitan area and Mekong Delta Region	2012, approved
j) The Master Plan on Socio-Economic Development of Đồng Tháp Province (PM Decision)	Regional activation by strengthening infrastructure and utilization of border.	2011, approved
k) The Master Plan on Socio-Economic Development of Tiền Giang Province (PM Decision)	Strengthening industrial district, infrastructure, major products, urbanization and human resource.	2015, approved
l) The Master Plan on Socio-Economic Development of Vĩnh Long Province (PM Decision)	Strengthening the partnership with Cần Thơ City	2012, approved

Source: JICA Survey Team

3.1.2 Development Plans for the Ho Chi Minh City Region and HCMC

(1) Spatial Structure of Ho Chi Minh City Region (HCMCR)

Since the Survey Area overlaps with the Ho Chi Minh City Metropolitan Region (equivalent to SFEZ), "Revision of Ho Chi Minh City Construction Plan to 2025", which deals with the review work of "Ho Chi Minh City Metropolitan Region Construction Plan up to 2020 and vision to 2050", provides the regional development context applicable to the development directions of the Survey Area.

The development model of HCMCR is identified as central and multi-centered on the basis of the regional development frame. The regional spatial structure is constructed on the basis of 5 radial axes along the urban economic corridors connecting the regional center with national and international regions.

- HCMC – Moc Bai border gate – Phnom Penh – Bangkok.
- HCMC – Vung Tau City – international transshipment port.
- North – South HCMC expressway axis to national regions.
- NH22 Trang Bang – Xa Mat – Kongpong Cham – Siem Riep
- HCMC – Chon Thanh – Hoa Lu axis connecting to the Trans-Asia frame of the Mekong River sub-region.

(2) Urban system distribution

Ho Chi Minh City is a special city functioning as the nucleus of the HCMC Region, a primary center for economy, culture, science & technology, with an important political status nationwide, being an international exchange node, an industrial, multi-dimensional service and science & technology center in South East Asia.

Urban satellites of Ho Chi Minh City:

- ❖ Independent satellites: Independent satellites are identified within the 30km radius from the nucleus center of Ho Chi Minh City including Bien Hoa City and Thu Dau Mot City.
  - Bien Hoa City: this is a class 1 city functioning as an independent satellite in the center of Dong Nai province, a supplementary industrial and high technology center, an international standard health center.
  - Thu Dau Mot City: this is a class 1 city functioning as an independent satellite and the provincial center of Binh Duong, a technology and educational center at the national level.
- ❖ Dependent satellites: centrally dependent satellites are identified within a 30km radius which is from ring road 3 inwards, including the following urban areas:
  - Nhon Trach new urban area: a city of urban class 2 in Nhon Trach, Dong Nai province functioning as a centrally dependent satellite, an industrial, commercial –service, tourism, educational and science and technology center.

- Tam Phuoc new urban area (Long Thanh airport new urban area in Long Thanh district, Dong Nai province): this is a class 2 urban area functioning as a centrally dependent satellite, this is a specialized urban area, a commercial, tourism, scientific and conferential service center.
- Hiep Phuoc Port urban area: This is a newly constructed class 3 urban area functioning as a centrally dependent satellite specializing in industries and port services.
- North West new urban area (class II urban area in Cu Chi – Hoc Mon, HCMC), this is an ecological urban area, the northwest center of HCMC.
- Other new urban areas: class 4 urban areas: Duc Hoa, Long Thanh, Trang bom, An Lac, Nha Be; Can Gio, Di An – Thuan An.

(3) HCMC General Construction Master Plan

Urban development policies of HCMC itself are collectively given in the General Construction Master Plan up to 2025 as approved by the Prime Minister in 2010 (No.24/QD-TTg). This general plan indicates a compact and multi-centric model. The core center is CBD and is located within a radius of 15 km from the city center and is supported by the following directions:

- Primary eastern direction: the development corridor is the HCMC-Long Than-Dau Giay expressway, while new urban centers are promoted along Hanoi Highway;
- Primary southern direction: The development corridor is Nguyen Huu Tho Road, taking advantage of the river and water space;
- Secondary northwest direction: The development corridor is NH22 (Trans-Asia Highway); and
- Secondary western and southwest directions: The development is promoted along Ngyuen Van Linh Road.

The city is divided into the urban development promoted zone, the industrial development promoted zone, the ecological and tourism development zone, the agricultural production-cum-ecological belt promoted zone, rural residential quarters and the natural reserved zone.

4. TRAFFIC DEMAND FORECAST

4.1 Review of existing traffic demand forecast model

For the estimation and forecasting of present and future traffic demand in the study area, two existing JICA Studies relevant to the study area are available, namely, “The Study on Urban Transport Master Plan and Feasibility Study in Ho Chi Minh Metropolitan Area (HOUTRANS, 2004)” and “The Comprehensive Study on the Sustainable Development of Transport System in Vietnam (VITRANSS2, 2010)”.

Table 4.1.1 Outline of Existing JICA Studies

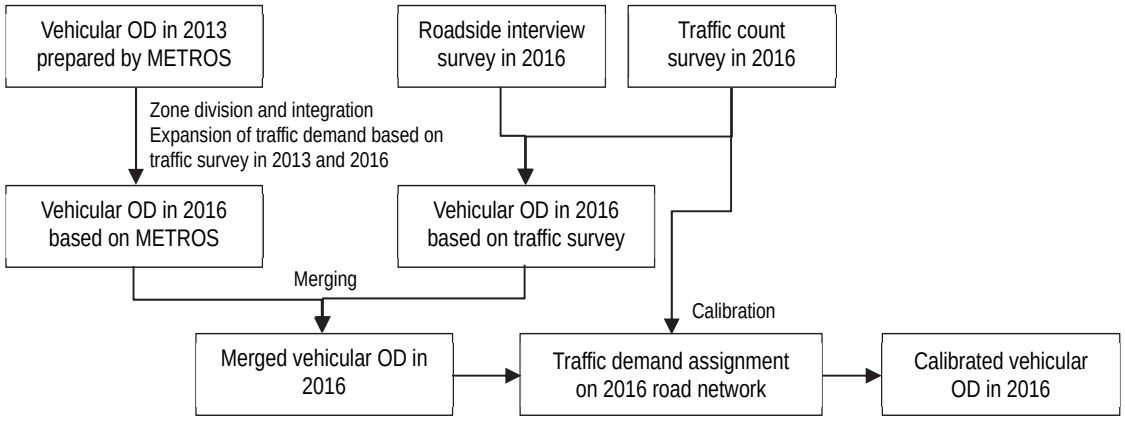
Items	HOUTRANS (2004)	VITRANSS2 (2010)
Study area	HCMC、Dong Nai (3/11 Sub-divisions), Binh Duong (2/9 Sub-divisions, Long An (8/15 Sub-divisions)	The whole of Vietnam
Base year of demand Forecast	2002	2008
Target year	2010, 2020	2020, 2030
Target demand	Person trips, trucks at logistics facilities	Person trips, cargo flow
Transport modes for demand forecast	Bicycle, Motorcycle, Car, Truck and Bus	Car, Bus, Railway and Aviation (Inland water and coastal are only for cargo)
Demand forecast model	Conventional four-step demand forecast model based on person trip (PT) survey by home interview survey (HIS) and other traffic surveys.	Conventional four-step demand forecast model based on traffic surveys relevant to road, railway and other transport modes. (intra-zonal trip and flow is not included)
Traffic analysis zone system	Minimal zone is defined by ward and several wards are integrated in accordance with distance from center of HCMC. Study area consists of 256 zones (HCMC consists of 216 zones).	Traffic analysis zone is defined by Province.
Notes	Same PT survey was carried out on almost the same area in the "Data Collection Survey on Railway in Major Cities in Vietnam (METROS), 2015, JICA".	

Note: Sub-district includes District, District-level Town and Provincial city.

Source: JICA Survey Team

4.2 Estimation of Current Traffic Demand

Current traffic demand in the survey area is estimated using the following workflow. The results of the traffic survey in 2016 are summarized in Appendix-2.



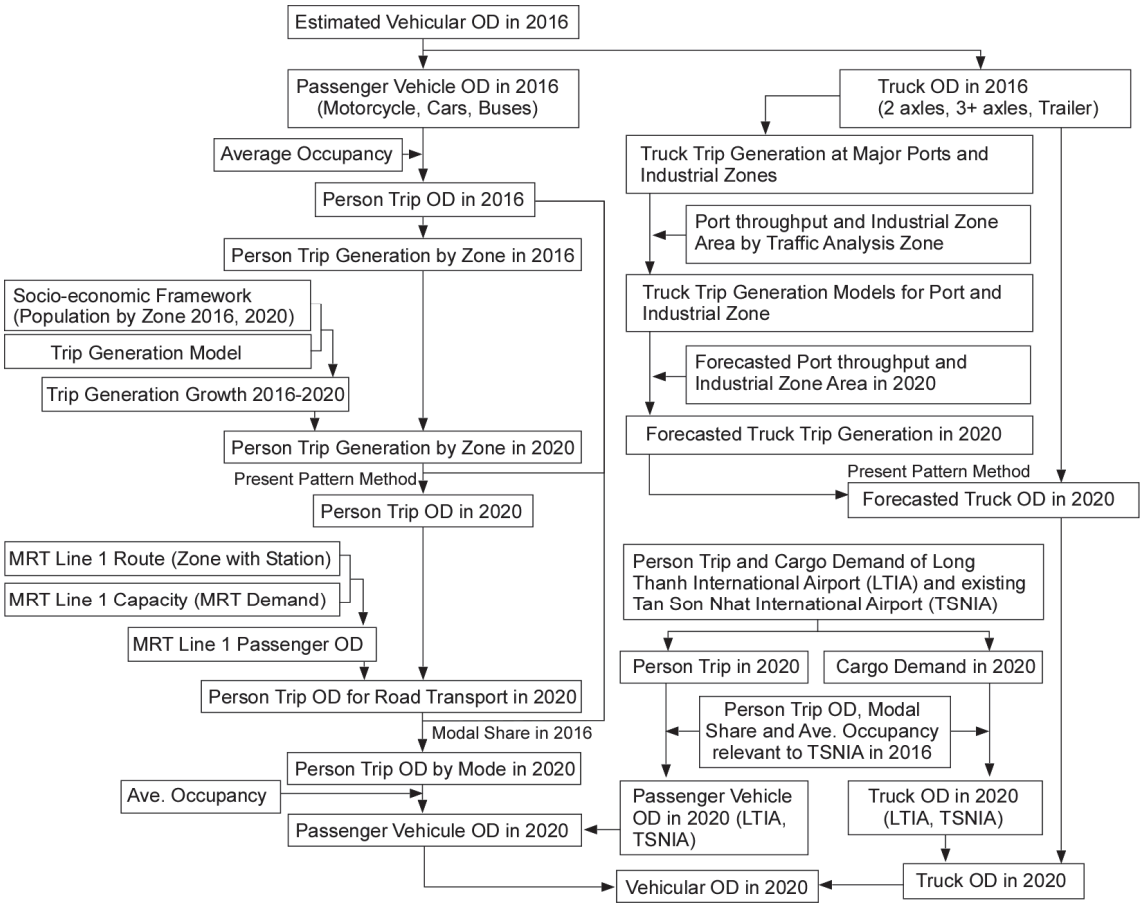
Source: JICA Survey Team

Figure 4.2.1 Work Flow for the Estimation of Current Traffic Demand

4.3 Methodology of Traffic Demand Forecast

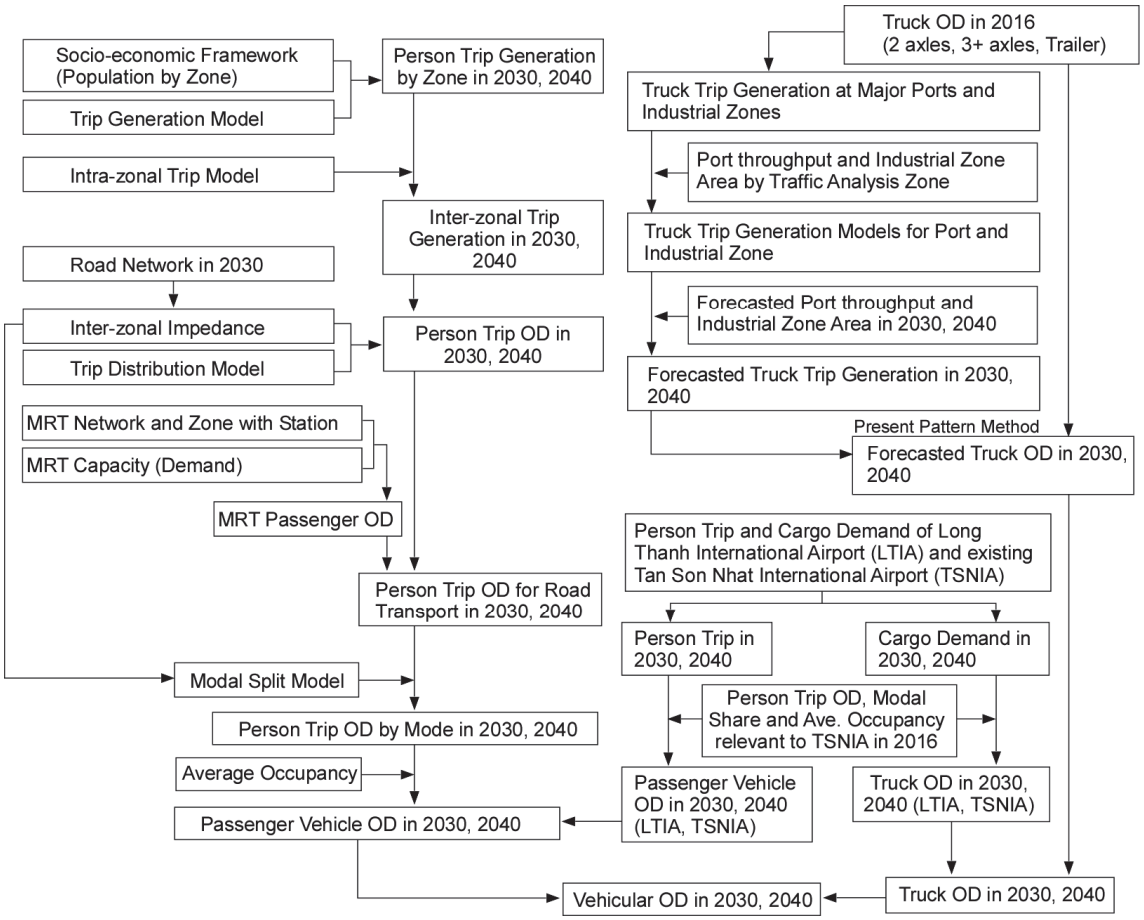
Future traffic demand is forecasted using the following workflows. Basically, passenger vehicle demand for such vehicles as motorcycles, cars and buses in 2020 is computed using the present pattern method based on estimated current vehicular OD in 2016. Future passenger vehicle demand in 2030 (and 2040 for the economic evaluation) is computed using demand forecast models estimated by the METROS PT survey results.

Future demand of trucks is estimated using the present pattern method taking account of truck generation at major seaports and industrial zones.



Source: JICA Survey Team

Figure 4.3.1 Work Flow of Demand Forecast in 2020



Source: JICA Survey Team

Figure 4.3.2 Work Flow of Demand Forecast in 2030 and 2040

4.4 Future Population and Socio-economic Framework

The population of each City/Provinces in the SA is estimated as shown in Tables 4.4.1 and 4.4.2; and the population growth rates in the towns/districts are estimated as shown in Figure 4.4.2.

Table 4.4.1 Population Framework of City/Provinces of the Survey Area

(Unit: '000 persons)

City/ Province	2016			2020			2030		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
HCMC	6,895	1,421	8,316	7,429	1,294	8,723	8,507	984	9,491
Dong Nai	1,016	1,829	2,845	1,241	1,890	3,131	1,911	1,929	3,840
BRVT	571	529	1,100	635	498	1,132	773	402	1,176
Long An	281	1,214	1,495	330	1,248	1,578	472	1,278	1,751
Dong Thap	319	1,389	1,708	350	1,374	1,724	424	1,308	1,732
Tien Giang	275	1,436	1,711	304	1,422	1,726	372	1,359	1,730
Vinh Long	183	861	1,045	211	866	1,077	285	839	1,125
Survey Area	9,540	8,679	18,220	10,499	8,592	19,091	12,744	8,100	20,843

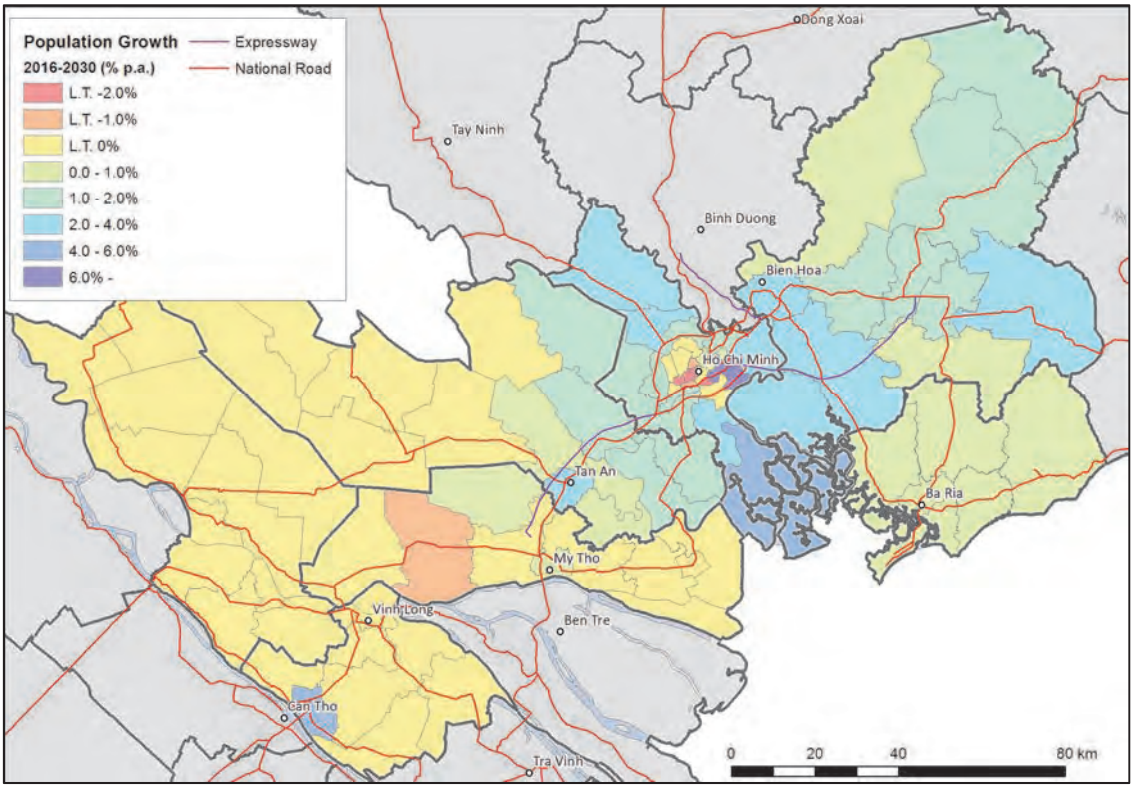
Source: JICA Survey Team

Table 4.4.2 Growth Rates of Future Population Framework in the Survey Area

(Unit: annual rate)

City/ Province	2016-2020			2020-2030		
	Urban	Rural	Total	Urban	Rural	Total
HCMC	1.88%	-2.32%	1.20%	1.36%	-2.70%	0.85%
Dong Nai	5.12%	0.82%	2.42%	4.41%	0.20%	2.06%
BRVT	2.68%	-1.51%	0.73%	2.00%	-2.11%	0.38%
Long An	4.10%	0.70%	1.36%	3.65%	0.24%	1.04%
Dong Thap	2.36%	-0.28%	0.23%	1.92%	-0.49%	0.05%
Tien Giang	2.47%	-0.24%	0.22%	2.05%	-0.46%	0.03%
Vinh Long	3.53%	0.14%	0.76%	3.08%	-0.31%	0.44%
Survey Area	2.42%	-0.25%	1.17%	1.96%	-0.59%	0.88%

Source: JICA Survey Team



Source: JICA Survey Team

Figure 4.4.1 Forecast Future Population Growth by District between 2016 and 2030

4.5 Future Traffic Demand Forecast

Forecasted vehicle demand is combined passenger vehicle OD and truck OD. The following table summarizes future vehicle demand relevant to the survey area.

Table 4.5.1 Forecasted Vehicle Trips

Mode	Vehicle Trips ('000 trip per day)				Annual Growth Rate (% p.a.)		
	2016	Est. 2020	Est. 2030	Est. 2040	2016-2020	2020-2030	2030-2040
Motorcycle	16,894	17,769	16,059	17,782	1.3%	-1.0%	1.0%
Car	413	437	1,210	1,346	1.5%	10.7%	1.1%
Mini Bus	29	31	85	95	1.2%	10.8%	1.1%
Large Bus	53	55	153	170	0.9%	10.9%	1.0%
2 Axle Truck	316	416	769	1,352	7.1%	6.3%	5.8%
3+ Axle truck	40	53	97	170	7.1%	6.2%	5.7%
Trailer	41	65	163	372	11.9%	9.7%	8.6%

Note: Vehicular trip is based on vehicular OD matrices for the traffic assignment and only trips relevant to the survey area.
Source: JICA Survey team

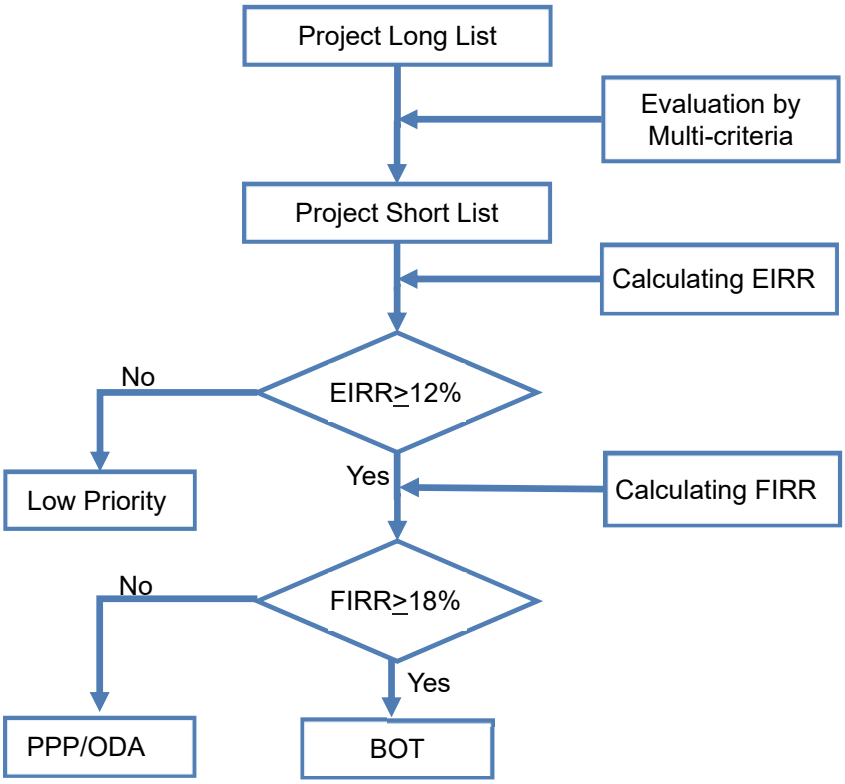
Future vehicular OD in 2020 is estimated by the present pattern method with estimated vehicular OD in 2016 and forecasted vehicular trip generation in 2020. Passenger vehicle OD in 2030 is estimated by trip generation model, trip distribution model and modal split model. Truck OD in 2030 is estimated by forecasted vehicular trip generation and the present pattern method.

5. PRIORITIZATION OF ROAD AND BRIDGE PROJECTS AND NECESSITY OF PUBLIC INVESTMENT

5.1 Prioritization of Road and Bridge Projects

The road and bridge projects are prioritized by multi-criteria, economic analysis and financial analysis to select specific projects that contribute highly to the region and VN.

The flow chart of the prioritization is shown in Figure 5.1.1. STEP 1 is done using multi-criteria. STEP 2 is an economic analysis calculating Economic Internal Rate of Return (EIRR), and STEP 3 is a financial analysis calculating Financial Internal Rate of Return (FIRR). If the projects' EIRR exceeds 12% (EIRR≥12%), the project is judged as a socio-economically



Source: JICA Survey Team

Figure 5.1.1 Flow Chart of Prioritization of Road and Bridge Projects

valuable project in STEP 2. 12% is set after the ODA former projects' study reports. If the projects' FIRR exceeds 18% (FIRR≥18%), the project is judged as a financially valuable project in STEP 3. 18% is set by adding the average lending interest rate of the past 5 years in VN, 12.54%, and VN's Country Risk Premium (CRP), 4.99%, which totals 17.53% and is rounded up to 18%. If FIRR is over 18%, it is recommended to procure the projects' implementation cost through a BOT scheme. If FIRR is below 12.5%, it is not considered financially feasible and it is recommended to seek the possibility of ODA finance procurement. However, the calculated EIRR and FIRR do not represent the analysis result of a detailed study of the projects. It is only to compare the project priority to judge the financial source and possibility of receiving a donation from the Japanese government.

Road and bridge projects are evaluated by their characteristics and quantified by their necessity and contribution to the region and so on. The criteria are set as follows:

1. Contribution to Social and Economic Development
2. Accessibility to Development Nodes / Missing Link
3. Contribution to Improvements of Urban Traffic and Logistics
4. Future Traffic Demand
5. Impacts on Land Use

5.2 Economic Analysis

The results of the economic evaluation of candidate projects are summarized in the following table.

Table 5.2.1 Summary of Economic Evaluation

Project	Section	Project Economic Cost in 2016 (million USD)	Economic Evaluation		
			EIRR	B/C	NPV (Million USD)
3rd Ring Road	Section 3 :Binh Chuan – NH22	442	37.0%	6.29	1,477.5
	Section 4 :NH 22 – Ben Luc	540	25.5%	3.63	849.3
4th Ring Road	Section 4 :Ben Luc-Hiep Phuoc	346	16.7%	2.62	306.2
Bien Hoa - Vung Tau Expressway	Phase 1: Bien Hoa – Phu My	456	14.7%	1.85	178.8
	Phase 2: Phu My – Vung Tau	397	12.1%	1.26	2.6
HCMC - Moc Bai Expressway		375	14.0%	1.57	77.9
2nd My Thuan Bridge		696	13.7%	1.67	193.3
Phuoc An Bridge and Access + I/C		379	16.5%	3.04	448.3

Source: JICA Survey Team

All of these 6 projects (8 sections) are evaluated as socio-economically feasible, since the EIRR of these projects exceeds 12% (EIRR≥12%). Therefore, the FIRR is calculated for all 6 projects (8 sections) in the next clause.

5.3 Financial Analysis

The relations among the results of the economic analysis, financial analysis and the study results of the selection of project scheme and financial source is shown in Table 5.3.1.

Table 5.3.1 Relations among Results of Economic Analysis, Financial Analysis and Selection of Project Scheme and Financial Source

Project	Section	EIRR	B/C	NPV (Mil. USD)	FIRR	Selection of Project Scheme and Financial Source
3rd Ring Road	Section 3 : Binh Chuan – NH22	37.0%	6.29	1,477.5	15.9%	ODA/PPP
	Section 4 : NH 22 – Ben Luc	25.5%	3.63	849.3	17.9%	BOT
4th Ring Road	Section 4 : Ben Luc-Hiep Phuoc	16.7%	2.62	306.2	Negative	ODA
Bien Hoa - Vung Tau Expressway	Phase 1: Bien Hoa – Phu My	14.7%	1.85	178.8	18.8%	BOT
	Phase 2: Phu My – Vung Tau	12.1%	1.26	2.6	12.4%	ODA/PPP
HCM-Moc Bai Expressway		14.0%	1.57	77.9	15.2%	ODA/PPP
2nd My Thuan Bridge		13.7%	1.67	193.3	Negative	ODA
Phuoc An Bridge (with access road and IC)		16.5%	3.04	448.3	1.4%	ODA/PPP

Source: JICA Survey Team

6. STUDY ON EFFECTIVE ASSISTANCE PROGRAM

6.1 Applicability of Official Development Assistance (ODA)

Table 6.1.1 shows the result of the study on applicability of ODA

Table 6.1.1 Applicability of ODA to 6 candidate projects (8 sections)

	Project	Section	Cost (Mil. USD)	EIRR	FIRR	1)	2)	3)	4)	5)	Applied condition	Applicability of ODA
1	3rd Ring Road	Section 3 : Binh Chuan – NH22	442	37.0%	15.9%	○	-	○	-	-	2	Medium
2		Section 4 : NH 22 – Ben Luc	540	25.5%	17.9%	○	-	○	-	-	2	Medium
3	4th Ring Road	Section 4 : Ben Luc – Hiep Phuoc	346	16.7%	Negative	○	○	-	-	○	3	High
4	Bien Hoa - Vung Tau Expressway	Phase 1: Bien Hoa – Phu My	456	14.7%	18.8%	○	-	○	-	-	2	Medium
5		Phase 2: Phu My – Vung Tau	397	12.1%	12.4%	-	-	○	-	-	1	Low
6	HCM-Moc Bai Expressway		375	14.0%	15.2%	○	-	○	-	○	3	High
7	2nd My Thuan Bridge		696	13.7%	Negative	-	○	○	○	-	3	High
8	Phuoc An Bridge (with access road and IC)		379	16.5%	1.4%	○	-	○	○	-	3	High

Source: JICA Survey Team

6.2 Confirmation of Variable Feasibility

Many projects still suffer in improving financial feasibility. Table 6.2.1 shows the Problems and Current Status of the 6 Candidate Projects (8 Sections).

Table 6.2.1 Problems and Current Status of 6 Candidate Projects (8 Sections)

Project	Section	I.V.G*1	Financial Feasibility	Current Status	Applicability of ODA*3	R.F.S*2	I/A
3rd Ring Road	Section 3: Binh Chuan – NH22	BOT	Medium	I/A is intending to implement by BOT scheme but there is very small possibility to realize only by toll income assumed in this survey.	Medium	ODA/ PPP	Cuu-Long CIPM
	Section 4: NH 22 – Ben Luc	ODA	High	I/A is intending to implement by ODA but the survey results show relatively high financial feasibility and possibility to implement by BOT scheme. Since ADB and JICA are studying to co-finance the project a PPP scheme will increase the financial feasibility even more.	Medium	BOT	Cuu-Long CIPM
4th Ring Road	Section 4: Ben Luc – Hiep Phuoc	Undeci ded	Low	No particular donor shows an interest in providing the fund yet but logistics from Mekong Delta Region will benefit by an effiective access to the planned Hiep Phuoc Port. Increase of the future traffic deman will be a key for fund raising.	High	ODA	Cuu-Long CIPM
Bien Hoa - Vung Tau Expressway	Phase 1: Bien Hoa – Phu My	BOT	High	I/A is intending to implement by BOT scheme and it has sufficient financial feasibility. There is high possibility to be implemented by BOT scheme.	Medium	BOT	PMU 85
	Phase 2: Phu My – Vung Tau	BOT	Medium	I/A is intending to implement by BOT scheme but there is very small possibility to realize only by toll income assumed in this survey.	Low	ODA/ PPP	PMU 85
HCM-Moc Bai Expressway		BOT	Medium	I/A is internding to implement by BOT scheme but there is very small possibility to realize only by toll income assumed in this survey. Meanwhile, it is expected to facilitate the development of crossborder traffic and trunk roads.	High	ODA/ PPP	TSP MU
2nd My Thuan Bridge		ODA	Low	I/A is intending to implement by ODA and Japanese government has undertaken F/S for the preparation of implementation.	High	ODA	PMU 7
Phuoc An Bridge (with access road and IC)		BOT	Medium	I/A is intending to implement by BOT scheme. Though the FIRR is very low agaist the toll rate assumed in this survey, it is possible to raise the toll rate. Besides, the bridge will validate easier access to the Cai Mep-Thi Vai port and alleviation of heavy traffic from NH 51.	High	ODA/ PPP	Ba Ria – Vung Tau DOT

*1: Intent of Virtnamese Government

*2: Recommended Financial Scheme by JICA Survey Team

*3: Refer to "Table 6.1.1"

Source: JICA Survey Team

7. SELECTION AND ARRAMGEMENT CANDIDATE PROJECT SUPPORTED BY JAPANESE ODA

7.1 Selection of Candidate Projects

In regard to the project, which is highly evaluated to be applicable to Japanese ODA, the validity of its selection as a candidate project shall be verified.

Table 7.1.1 Selection of Candidate Projects by Japanese ODA

Project	Traffic Demand (pcu/day)	Economic Effectiveness (EIRR)	Possibility of PPP-BOT/ Financial Effectiveness (FIRR)	Superiority of Japanese Technology	Supporting Schedule by Other Donors	Project Urgency	Evaluation
	L:T>90,000 S:T<90,000	H: >18% M: 15~18% L: 12~15%	L: <13% M: 13~18% H: >18%				
4th Ring Road Section4: Ben Luc–Hiep Phuoc	0 (38,000)	1 (16.7%)	2 (Negative)	1 (Medium)	2 (NO)	0	6
HCMC-Moc Bai Expressway	2 (99,000)	0 (14.0%)	1 (15.2%)	1 (Medium)	1 (YES*1)	2	7
2nd My Thuan Bridge	0 (61,000)	0 (13.7%)	2 (Negative)	2 (High)	2 (NO)	2	8
Phuoc An Bridge	0 (21,000)	1 (16.5%)	2 (1.4%)	2 (High)	0 (NO*2)	0	5

*1: KOICA has scheduled the Pre-F/S, GOV has been considering other donors to accelerate the implementation of the project, including F/S.

*2: Ba Ria – Vung Tau Province pursues a course to proceed with implementation by BOT.

Source: JICA Survey Team

The result of selection by Japanese ODA stated in Table 7.1.1 suggests the two projects, excluding the Phuoc An bridge and 4th Ring Road (Section4), have been highly evaluated.

Regarding the Phuoc An bridge, (1) Ba Ria – Vung Tau Province has pursued policy to continue as BOT. MOT also has agreed that the province will implement this project. (2) Although the FIRR shows a low rate, the EIRR (16.5%) is 4% more than the standard rate (12%). It can be expected that revising up the toll rate initially set improves the profitability because NPV is 1.2 times more than the initial investment. (3) There are port facilities including Cai Mep port, Thi Vai port and Phuoc An port as well as freight distribution centers, factories and power plants in the south of the Phuoc An bridge. The Inter-port Road connecting the ports is under construction, which is access road to the Phuoc An bridge. (4) In Dong Nai Province located to the north of the Phuoc An bridge, this project will contribute to the development around the access road section from the Phuoc An bridge to the Ben Luc – Long Thanh Expressway and the development of the industrial park in Long Thanh. Therefore, the beneficiaries of this project are expected to join as BOT. (5) On the other hand, even though Ba Ria – Vung Tau Province is taking the initiative to proceed with this bridge construction, it will take a long time to adjust between Ba Ria – Vung Tau Province and Dong Nai Province and with BOT investors, because the bridge across in Dong Nai Province as well.

Regarding the 4th Ring Road (Section 4), "Department of Transport, Ho Chi Minh City" and "Cuu Long CIPM" deem it a high importance project, however, it deems it premature to maintain the road because the 3rd Ring Road has not been completed and the ongoing project of upgrading and utilizing of Cai Mep - Thi Vai port should be prioritized as a policy issue. Therefore, the priority of the aforesaid project seen as important for the access to the port seems low.

Hence, the following two projects are recommended as the selected candidate projects for Japanese ODA.

- HCMC – Moc Bai Expressway
- 2nd My Thuan Bridge

8. PROJECT OPERATION AND EFFECT INDICATOR

8.1 Project Operation and Effect Indicator

Definitions of the Operation and Effect Indicators are as follows:

- Operation Indicator: A quantitative indicator to measure the operational status of a project
- Effect Indicator: A quantitative indicator to measure the effects generated by a project

For quantitative evaluation of the project effectiveness, the criteria have been set based on available data and consultation with related organizations. Project monitoring and evaluation shall be held after two years of the project completion.

Table 8.1.1 Selection of Project Operation and Effect Indicator

Indicator		
Operation	Traffic Volume	Total traffic volume (pcu/day)
		Freight vehicle traffic volume (pcu/day)
		Bus & Passenger vehicle traffic volume (pcu/day)
Effect	Traveler's Time	Traveler's time at morning peak hour, 8:00 am (minutes)
	Average Speed	Average speed at morning peak hour, 8:00 am (km/hour)

Source: JICA Survey Team

9. SYNOPSIS AND RECOMMENDATIONS

9.1 Synopsis and Recommendations

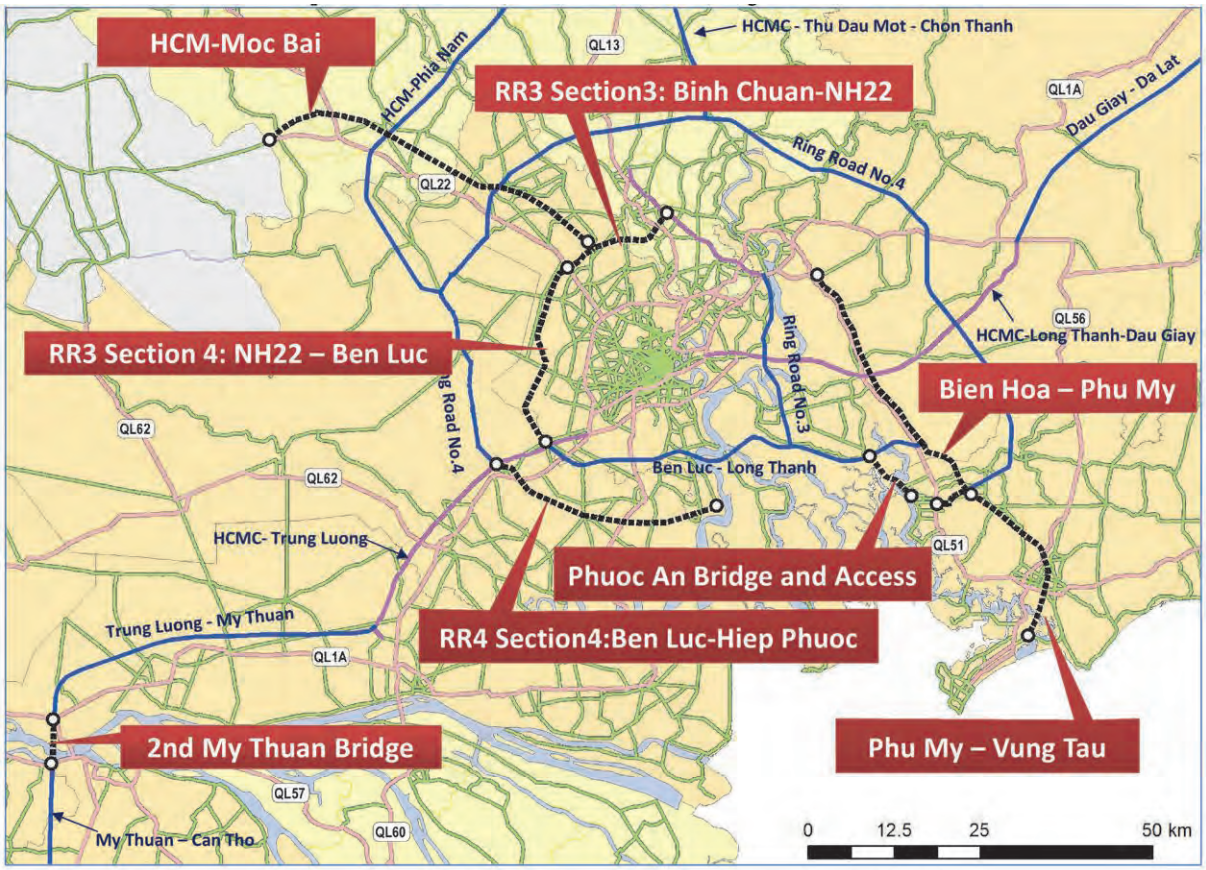
The Survey that began with the data/information gathering and traffic surveys in February 2016 has come to this final stage in July 2016 to summarize major tasks and recommendations for the Survey. After going through several screening steps, recommendations were prepared as follows:

- First of all, 22 long-list projects were selected after confirming the current status of road and bridge projects, which were collected by interviewing relevant authorities or enumerated from such plans as national, regional, provincial, urban development plans and transport development plans.
- Subsequently, the long-list projects were scrutinized by the multi-criteria method, which resulted in the shortlist of projects (6 projects or 8 sections, as presented in Figure 9.1.1) as the first priority group of projects.
- All short-list projects whose EIRR exceeded 12% were found economically feasible.
- Financial analysis of the shortlist projects revealed their financial viability. That is, Section 4 of the 3rd Ring Road (NH 22 – Ben Luc section) and Phase 1 (Bien Hoa – Phu My section) of Bien Hoa – Vung Tau Expressway are financially feasible (FIRR>18%) and worth pursuing implementation by BOT method. Especially, the implementation method of Bien Hoa – Phu My section project is compatible with the intention of the project executing authority.
- On the contrary, Section 4 of the 4th Ring Road (Ben Luc – Hiep Phuoc section) and the 2nd My Thuan Bridge projects were found financially not feasible. That is, those are not suitable for the BOT method.
- Section 3 of the 3rd Ring Road (Binh Chuan – NH 22 section) shows a FIRR of 15.9%, which is a little lower than the feasibility criterion of 18%. Meanwhile, its economic feasibility indicators, such as EIRR (37.0%) and B/C (6.29) are significantly high, and especially, the NPV exceeds more than 3-fold the cost, which could imply that the project users could afford to pay a tariff higher than those assumed in this survey. It is therefore recommendable that a more detailed investigation should be carried out to examine the possibility to apply either PPP or BOT for this project implementation.
- As the consequence of applicability analysis on the ODA financing (regardless of Japanese ODA), the following 4 projects were selected: (1) Section 4 of the 4th Ring Road (Ben Luc – Hiep Phuoc), (2) HCMC – Moc Bai Expressway, (3) the 2nd My Thuan Bridge, and (4) Phuoc An Bridge.
- Among the 4 projects mentioned above, Section 4 of the 4th Ring Road (Ben Luc – Hiep Phuouc) is eliminated from the ODA project candidates because of its immaturity of planned linkages with the 3rd Ring Road and Hiep Phuoc Port developments.
- Similar to Section 3 of the 3rd Ring Road, the FIRR of Phuoc An Bridge shows a very low rate of 1.4% but its economic feasibility indicators show relatively high rates, such as 16.5% EIRR and 3.0 B/C, and especially the NPV exceeds more than 1.2 times the cost. In addition, since the area adjacent to the project bridge is to include such development plans as industrial parks and new ports, the project cost could be affordable by PPP/BOT method or covered by the overall costs for the area development and shared by all the development beneficiaries.

The intention of the DOT of Ba Ria – Vung Tau Province is to implement the project by BOT and therefore, BOT is recommended for this project.

- Further, the possibility of employing Japanese technology is discussed when selecting potential priority projects relevant to the Japanese ODA. As a consequence, the following 2 projects are recommended but it should be noted that HCMC – Moc Bai Expressway project needs to confirm that the MOT's intention is in line with commitments made by other donors.

  1. HCMC – Moc Bai Expressway
  2. The 2nd My Thuan Bridge



Source: JICA Survey Team

Figure 9.1.1 Location Map of Shortlisted Projects

Data Collection Survey on Traffic Conditions of Southern Roads and Bridges

Draft Final Report

Table of Contents

List of Tables

Page

List of Figures

Page

List of Abbreviations

AADT	:	Annual Average Daily Traffic
ADB	:	Asian Development Bank
AEC	:	ASEAN Economic Community
ASEAN	:	Association of South East Asian Nations
B/C	:	Benefit / Cost
BOT	:	Build Operate Transfer
BRT	:	Bus Rapid Transit
BRVT	:	Ba Ria-Vung Tau
BTO	:	Build Transfer Operate
CBD	:	Central Business District
CBTA	:	Cross Border Transport Facilitation Agreement
C/P	:	Counterpart
CRP	:	Country Risk Premium
DPI	:	Department of Planning & Investment
ECF Strand	:	Epoxy coated and filled strand
EIRR	:	Economic Internal Rate of Return
ETC	:	Electronic Toll Collection
ETD	:	Estimated Traffic Demand
FIRR	:	Financial Internal Rate of Return
F/S	:	Feasibility Study
GDP	:	Gross Domestic Product
GOV	:	Government of Vietnam
GRDP	:	Gross Regional Domestic Product
HCMC	:	Ho Chi Minh City
HCMCR	:	Ho Chi Minh City Region
HIS	:	Home Interview Survey
HMA	:	Ho Chi Minh Metropolitan Area
HOUTRANS	:	The Study on Urban Transport Master Plan and Feasibility Study in Ho Chi Minh Metropolitan Area
I/A	:	Implementation Agency
ITS	:	Intelligent Transport Systems
JETRO	:	Japan External Trade Organization
JICA	:	Japan International Cooperation Agency
KOICA	:	Korea International Cooperation Agency
LCC	:	Life Cycle Cost
MDR	:	Mekong Delta Region
METI	:	Ministry of Economy, Trade and Industry
METROS	:	Data Collection Survey on Railways in Major Cities in Vietnam

MLIT	:	Ministry of Land, Infrastructure, Transport and Tourism
MOT	:	Ministry of Transport
NETIS	:	New Technology Information System
NMT	:	Non-Motorized Trip
NPV	:	Net Present Value
O&M	:	Operation & Maintenance
OD	:	Origin - Destination
ODA	:	Official Development Assistance
PC	:	Pre-stressed concrete
PCU	:	Passenger Car Unit
PPP	:	Public Private Partnership
PT Survey	:	Person Trip Survey
Q-V	:	Quantity - Velocity
ROD	:	Record of Discussion
SA	:	Survey Area
SEC	:	Southern Economic Corridor
SEZ	:	Special Economic Zone
SFEZ	:	Southern Focal Economic Zone
STEP	:	Special Terms for Economic Partnership
TAZ	:	Traffic Analysis Zone
TSPMU	:	Traffic Safety Projects Management Unit
VAT	:	Value-Added Tax
VITRANSS2	:	The Comprehensive Study on the Sustainable Development of Transport System in Vietnam
VND	:	Vietnam Dong
VOC	:	Vehicle Operating Cost
WB	:	World Bank

1 INTRODUCTION

1.1 Survey Background

Formed in 2015, the ASEAN Economic Community (AEC) marks the commitment of the ASEAN leaders to building and promoting a single market and production base, a highly competitive economic region tempered with equitable development, and a region fully integrated into the global economy. The AEC creates greater opportunities and challenges to the Socialist Republic of Vietnam (hereinafter referred to as Vietnam). More specifically, the southern region (hereinafter referred to as Ho Chi Minh City Metropolitan Area) serves as a gateway to the east of the Southern Economic Corridor passing through Bangkok, Phnom Penh, and Ho Chi Minh City. This effectuates an increasing traffic demand for Ho Chi Minh City Metropolitan Area, rapid industrial development, and accelerates overall economic growth. However, this rapid development effectuates frequent movement of heavy trucks, truck cargo and private cars significantly, which in turn causes serious traffic congestion, deteriorates existing road/bridge conditions and increases traffic accidents remarkably.

Furthermore, the opening of the north - south highway between Ho Chi Minh City and Trung Luong in February 2010 created rapid traffic demand in the section between Ho Chi Minh City and Can Tho. Therefore, adequate and proper maintenance of the road/bridge infrastructures under the Mekong Delta, a river prone region, becomes essential.

Under such circumstances, the 9th five-year Socio-Economic Development Plan for 2011-2015 underlines a rapid development that should be in close linkage with sustainable development. This plan has concretized and drawn out specific roadmaps and policies with a view to successful implementation of social, economic and environmental development tasks and objectives. It also focuses an important issue on the further development of a transport infrastructure system.

In addition, the business plan along with the Japanese assistance strategy to Vietnam emphasizes the activation and facilitation of the Mekong region, including the East-West Economic Corridor for trunk road network development and urban transport development (cross-border traffic facilitation). It also pays special attention to the ASEAN connectivity improvement. After the opening of the Cai Mep - Thi Vai port, the gateway of Southern Economic Corridor logistics is required in order for its promotion and connection between hinterland and industrial hub.

According to the plans and the strategies stated above, upgrading of the present traffic conditions is urgently necessary in order to cope with future demand. Therefore, improvement of all existing road and bridge infrastructure in Vietnam is becoming an important issue.

1.2 Survey Area and Authority Concerned

1.2.1 Survey Area

The survey area is Ho Chi Minh City and 6 neighboring provinces in southern Vietnam as shown by the following.

- Ho Chi Minh Metropolitan Area (HMA)

Ho Chi Minh City, Dong Nai Province, Ba Ria - Vung Tau Province

- Mekong Delta Region (MDR)

Long An Province, Dong Thap Province, Thien Giang Province, Vinh Long Province

1.2.2 Authority Concerned

- Department of Planning and Investment (DPI), Ministry of Transport (MOT)
- City and People's Committee concerned with this JICA Study

1.3 Survey Objectives

Improvement of logistics efficiency for southern Vietnam by:

- Incorporating the increasing traffic demand for Ho Chi Minh City Metropolitan Area and the Mekong Delta Area,
- Ensuring efficient freight transport movement,
- Review of existing road and bridge infrastructure and elaboration of improvement requirements

1.4 Scope of the Survey

The scope of the survey is as follows:

- Confirmation of socio-economic conditions in Ho Chi Minh Metropolitan Area and Mekong Delta and collection and arrangement of map information for these areas
- Collection and arrangement of information for development plan for roads and bridges in the southern part of Vietnam and analysis of current situation
- Confirmation of current study for development assistance by other donor
- Confirmation of current development plan for roads and bridges by public involvement scheme such as Build Operate Transfer (BOT) and Public Private Partnership (PPP)
- Revision of traffic demand forecast
- Selection and arrangement candidate project supported by Japanese Official Development Assistance (ODA)
- Proposal of index for operation and effectiveness
- Confirmation of qualitative effect

- Economic and financial analysis
- Prioritization of candidate projects
- Study on methodology for effective support

2 EXISTING CONDITIONS OF SURVEY AREA

2.1 Social and Economic Conditions of Survey Area

2.1.1 Constitution of Survey Area

The Survey Area (SA) is defined to cover Ho Chi Minh City, Dong Nai Province, Ba Ria-Vung Tau (BRVT) Province, Long An Province, Dong Thap Province, Tien Giang Province and Vinh Long Province as shown in Figure 2.1.1.

The first three areas (one city, two provinces) belong to the South East Region and the remaining provinces are part of the Mekong River Delta Region. Those two regions, among the six of the whole country, are located in the southern part of Vietnam.

The Southern Focal Economic Zone (SFEZ) was originally established in 1998 to cover Hồ Chí Minh City, Binh Duong, Đồng Nai and Bà Rịa-Vũng Tàu Provinces, and later in 2003 Long An, Binh Phuoc, Tai Ninh Provinces were added. Currently in 2006, Tien Gian Province joined SFEZ to total one city and 7 provinces. SFEZ is the engine of national and in particular regional economic growth in southern Vietnam.

Source: JICA Survey Team

Figure 2.1.1 Location of Survey Area

2.1.2 Population and GRDP in SFEZ and Survey Area

Table 2.1.1 compares the population and Gross Regional Domestic Product (GRDP) of the whole country, the SFEZ and the SA.

As compared in Table 2.1.1, the social and economic profiles of the SFEZ and the SA look similar, because such major economically developed areas as Ho Chi Minh City (HCMC), Ba Ria-Vung Tau, Dong Nai and Long An Provinces overlap in both areas.

Table 2.1.1 Population in SFEZ and Survey Area

	National	SFEZ	Survey Area
Area ('000 ha)	33,096.7	3,059.5	2,189.6
	100%	9%	7%
Population ('000 persons)	90,728.9	18,983.9	17,796.5
	100%	21%	20%
- Urban	30,035.4	10,424.6	9,075.2
	100%	35%	30%
- Rural	60,693.5	8,559.3	8,721.3
	100%	14%	14%
Urbanization Rate	33.1%	54.9%	51.0%
Population Density (persons/ha)	2.7	6.2	8.1
G(R)DP at current price (bill. Dongs)	3,937,856 (100.0%)	1,979,717 (50.3%)	1,838,299 (46.7%)
Per Capita G(R)DP at current prices (mill. dongs)	43.4	104.3	103.3

Source: General Statistics Office and City/Provincial Statistical Office

However, each area shows different features in their geographical extensions through HCMC. The SFEZ area is principally composed of HCMC and its adjoining provinces and formed along such trunk roads as National Roads No. 1, No. 50, No. 22, No. 13 and No. 51, extending radially from HCMC. Meanwhile, the SA is characterized by such corridors as national roads No. 1 and No. 20 extending in the northeast-southwest direction through HCMC.

The SA occupies 7% of the national territory. The population, urban population and Gross Regional Domestic Product (GRDP) of the SA, however, account for 20% (17.8 million), 30% (9.1 million) and 47% (over 1.8 quadrillion VND at current prices in 2014) of the national totals, respectively. Thus, the area has industrialized and urbanized more than other regions in the country and it agglomerates economic activities of the country and considerably contributes to Vietnam's national economy. GRDP per capita of the SA is more than double the national average.

2.1.3 Population and GRDP by City and Provinces of Survey Area

(1) Population

1. HCMC dominates, in terms of population, urban population and GRDP of the SA as detailed in Table 2.1.2, Figures 2.1.2, and 2.1.3; and summarized below:

   - The population of HCMC (8.0 million in 2014) accounts for 45% of that of the SA (17.8 million).
   - The urban population of HCMC (6.6 million) accounts for 72% of that of the SA (9.1 million).
   - Urbanization of HCMC (82%) has progressed much faster than the SA average (36%).

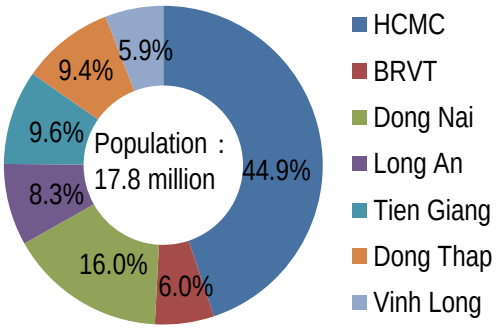
Table 2.1.2 Population and G(R)DP of Survey Area in 2014

	National Total	Survey Area							
		HCMC	BRVT	Dong Nai	Long An	Tien Giang	Dong Thap	Vinh Long	Total
Area ('000 ha)	33,096.7	209.6	199.0	590.7	449.5	250.9	337.9	152.0	2,189.6
		9.6%	9.1%	27.0%	20.5%	11.5%	15.4%	6.9%	100.0%
Population ('000 persons)	90,728.9	7,982.0	1,059.6	2,838.7	1,477.3	1,716.1	1,681.3	1,041.5	17,796.5
		44.9%	6.0%	16.0%	8.3%	9.6%	9.4%	5.9%	100.0%
・Urban	30,035.4	6,554.8	535.3	978.2	266.3	264.4	301.0	175.2	9,075.2
		72.2%	5.9%	10.8%	2.9%	2.9%	3.3%	1.9%	100.0%
・Rural	60,693.5	1,427.2	524.3	1,860.5	1,211.0	1,451.7	1,380.3	866.3	8,721.3
		16.4%	6.0%	21.3%	13.9%	16.6%	15.8%	9.9%	100.0%
Urbanization Rate	33%	82%	51%	34%	18%	15%	18%	17%	36%
Population Density (persons/ha)	2.7	38.1	5.3	4.8	3.3	6.8	5.0	6.9	3.1

Source: General Statistics Office and City/Provincial Statistical Office

2. The Dong Nai population follows after HCMC and contributes 16% of the SA total, whereas that of other provinces ranges from 6% to 10% of the SA total.

3. Following HMC, the urbanization progresses relatively fast in BRVT (51%) and Dong Nai (34%). Urbanization of other provinces is rather slow, compared to the area average of 36% and ranges from 15% to 18%.



Source: General Statistics Office and City/Provincial Statistical Office

Figure 2.1.2 Share of Population by City/Provinces of Survey Area in 2014

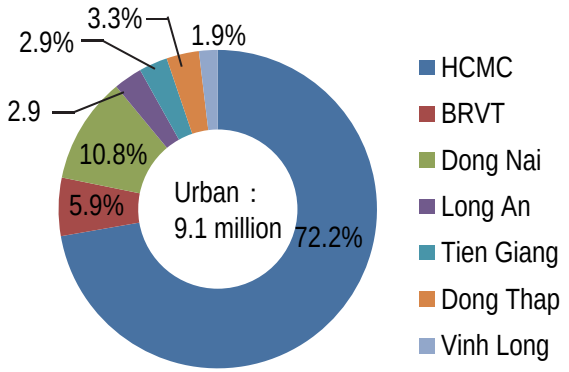


Figure 2.1.3 Share of Urban Population by City/Provinces of Survey Area in 2014

(2) GRDPs

1. The average economic growth of the SA between 2010 and 2014 is 6.7% per year as shown in Table 2.1.3 and is 1% point higher than the national average. Meanwhile, an average GRDP growth of the respective city/provinces shows more than 9% per year in most of the city/provinces, with the exception of BRVT (3.7% per year).

Table 2.1.3 GRDP, Composition by Economic Sector of Provinces in Survey Area

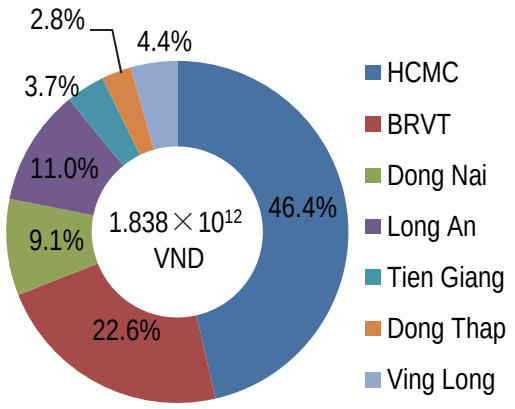
		National Total	HCMC	BRVT	Dong Nai	Long An	Tien Giang	Dong Thap	Vinh Long	Total
GRDP VND Billion (current prices)	Year 2010	2,157,828	463,295	248,570	76,025	96,103	35,267	30,537	48,044	997,840
	Year 2014	3,937,856 (214.2%)	852,523 (46.4%)	415,032 (22.6%)	167,992 (9.1%)	201,954 (11.0%)	68,575 (3.7%)	51,727 (2.8%)	80,496 (4.4%)	1,838,300 (100.0%)
Per Capita GRDP VND Million	Year 2014	43.4	106.8	391.7	59.2	136.7	40.0	30.8	77.3	163.7
GRDP VND Billion (2010 const. prices)	Year2014	2,695,796	667,712	286,983	117,924	159,517	49,925	44,488	62,247	1,388,796
Real AGR (%/year)	2010 - 2014	5.7%	9.6%	3.7%	11.6%	13.5%	9.1%	9.9%	6.7%	8.6%
% Share of GRDP by Economic Sector at Current Prices in 2010	Primary	18.4%	1.1%	2.2%	8.6%	22.2%	44.2%	40.9%	36.0%	8.4%
	Secondary	32.1%	43.0%	84.3%	57.2%	62.1%	28.1%	18.9%	35.5%	54.6%
	Tertiary	49.5%	56.0%	13.5%	34.2%	15.7%	27.7%	40.3%	28.5%	37.1%
% Share of GRDP by Economic Sector at Current Prices in 2014	Primary	17.70%	1.0%	2.7%	6.0%	15.8%	39.4%	37.7%	31.5%	7.3%
	Secondary	33.20%	39.4%	83.9%	56.9%	68.9%	31.1%	22.1%	39.0%	53.5%
	Tertiary	49.10%	59.6%	13.4%	37.1%	15.2%	29.5%	40.2%	29.5%	39.3%

Source: General Statistics Office and City/Provincial Statistical Office

2. GRDP of HCMC shares 46% of that of the SA total, which is almost the same share as the population (45%), as shown in Figure 2.1.4.

3. After HCMC, large contributors of GRDP to the SA are BRVT (22.6%), Long An (11.0%) and Dong Nai (9.1%). Contributions of GRDP by other provinces are confined to small ranges from 3% to 5% of the area total.

4. Per capita GRDP of BRVT is remarkably high, because of the large share of oil & gas production in the secondary sector.



Source: General Statistics Office and City/Provincial Statistical Office

Figure 2.1.4 Share of Total GRDP by Respective City/Provinces of SA in 2014

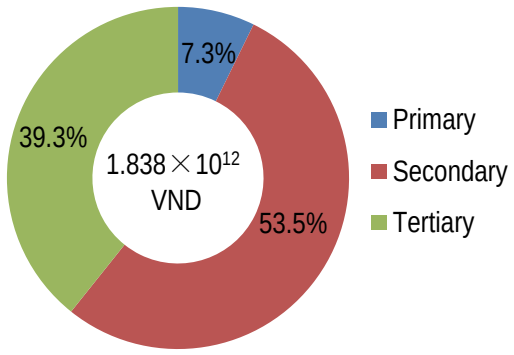


Figure 2.1.5 GRDP by Economic Sector of SA in 2014

(3) GRDP by Economic Sector

1. GRDP at current prices of the SA is composed of primary sector[1] at 7.3%, secondary sector[2] at 53.5% and tertiary sector[3] at 39.3% in 2014 as shown in Table 2.1.3 and Figure 2.1.5. A share of the secondary sector is over 50% of the GRDP and is much higher than the national average of 33.2% in 2014. On the contrary, a GRDP share of the primary sector in the SA (7.3%) is much lower than that of the national average of 17.7%.

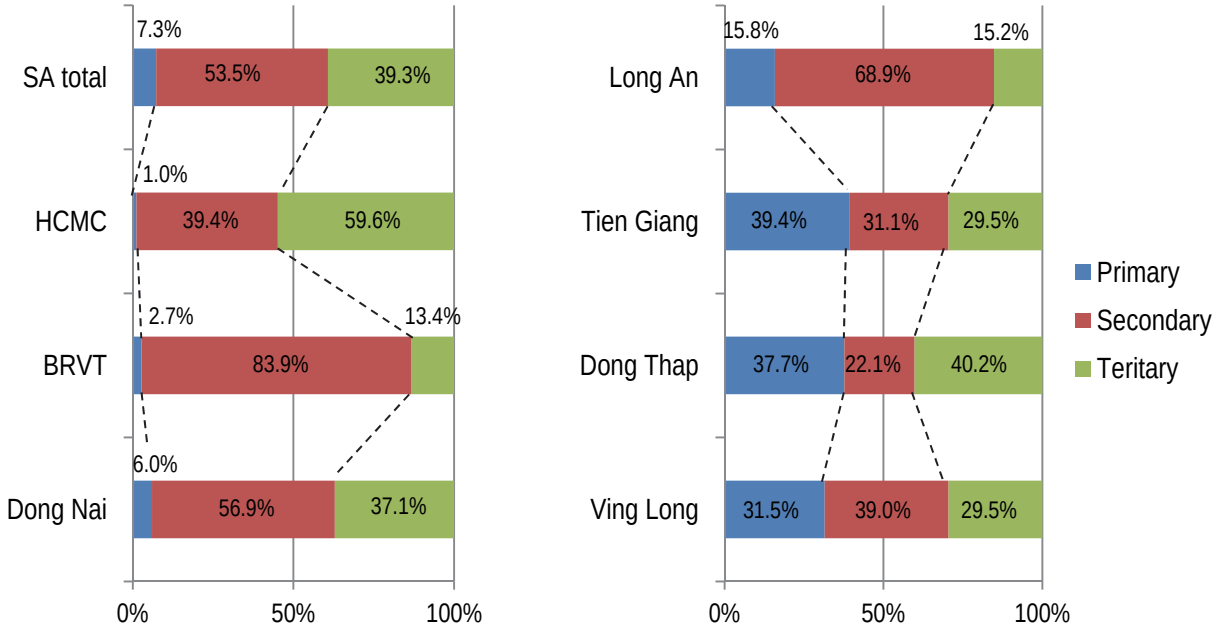
Note1: Agriculture, forestry and fishery

Note2: Mining, quarrying, manufacturing, electricity, gas, steam and air conditioning supply, water supply, sewerage, waste management, remediation activities and construction

Note3: Wholesale and retail trade; repair of motor vehicles and motorcycles, transportation, storage, accommodation, food service activities, information and communication, financial, banking, insurance activities, real estate activities, professional, scientific and technical activities, administrative and support service activities, activities of Communist Party, socio-political organizations; public administration and defence; compulsory security, education, training, human health, social work activities, arts, entertainment, recreation, other service activities, activities of households as employers; undifferentiated goods and service producing activities of households for own use and products taxes less subsidies on production

2. GRDP by economic sector of the respective city/provinces is characterized as shown in Figure 2.16 as summarized below:

- HCMC's tertiary sector (59.6%) dominates its total GRDP and secondary sector (39.4%) follows after.
- BRVT's secondary sector accounts for a high proportion (83.9%) of the total GRDP, and it is believed that the oil and gas production in the province contributes a lot in the secondary sector.
- The secondary sectors of Long An and Dong Nai share more than 50%, that is 68.9% and 56.9%, of the total provincial GRDPs, respectively. Both provinces are developed currently with industrial parks/clusters that attract foreign direct investments thereto.
- GRDP shares of the secondary sector in Tien Gian, Dong Thap and Vinh Long range from 22% to 39%. GRDP shares of the primary and secondary sectors of those provinces each fall in the 30~40% range and the economic structure looks similar among them.



Source: General Statistics Office and City/Provincial Statistical Office

Figure 2.1.6 Composition of GRDP by Economic Sector for Respective City/Provinces of SA

(4) Changes in Economic Structure

Changes in the economic structures of the respective city/provinces during 2010-2014 will be summarized as follows:

- In general, the portion of the primary sector decreases, while that of the tertiary sector increases to balance from the viewpoint of the agglomeration of GRDP in the SA.
- When looking at individual city/provinces of the SA, the tertiary sector of HCMC has increased by 3.6% points but the secondary sector reduced the same portion on the contrary.
- Regarding Long An Province, the primary sector has reduced by 6.4% points but in contrast the secondary sector increased by 6.8% points, which indicates a rapid industrialization taking place in that area during 2010-2014.
- In Tien Giang, Dong Thap and Vinh Long, their primary sectors are reducing by about 4% points but their secondary sectors are increasing by more than 3%, which also indicates a steady trend of industrialization in those areas.

2.1.4 Land Uses of the Survey Area

(1) Land uses in 2014

Land use information in this study is very limited to such data as those exhibited in the provincial statistical yearbooks.

The total land area of the SA is 2,190 million hectares, as shown in Table 2.1.4, and is dominated by agricultural production land (60%), followed by forestry land (14%), specially used land (10%), homestead land (5%) and other land uses (11%) as shown in Table 2.1.5 and Figure 2.1.7.

Table 2.1.4 Land Uses in the Survey Area in 2014

(Unit: '000 ha)

	HCMC	BRVT	Dong Nai	Long An	Tien Giang	Dong Thap	Vinh Long	Total
Agricultural Production Land [1]	71,272	105,403	276,457	313,262	179,248	258,892	117,938	1,322,472
Forestry Land	33,987	32,352	181,503	38,838	4,138	11,475	981	303,274
Specially Used Land [2]	33,550	36,115	50,606	44,469	21,536	24,534	10,564	221,375
Homestead Land [3]	24,311	5,963	16,938	24,942	9,440	16,907	6,273	104,776
Others [4]	46,435	19,113	65,219	28,038	36,572	26,068	16,262	237,706
Total	209,555	198,946	590,724	449,550	250,934	337,876	152,018	2,189,603

Note: Data of HCMC, Dong Thap and Vinh Long are those in 2013

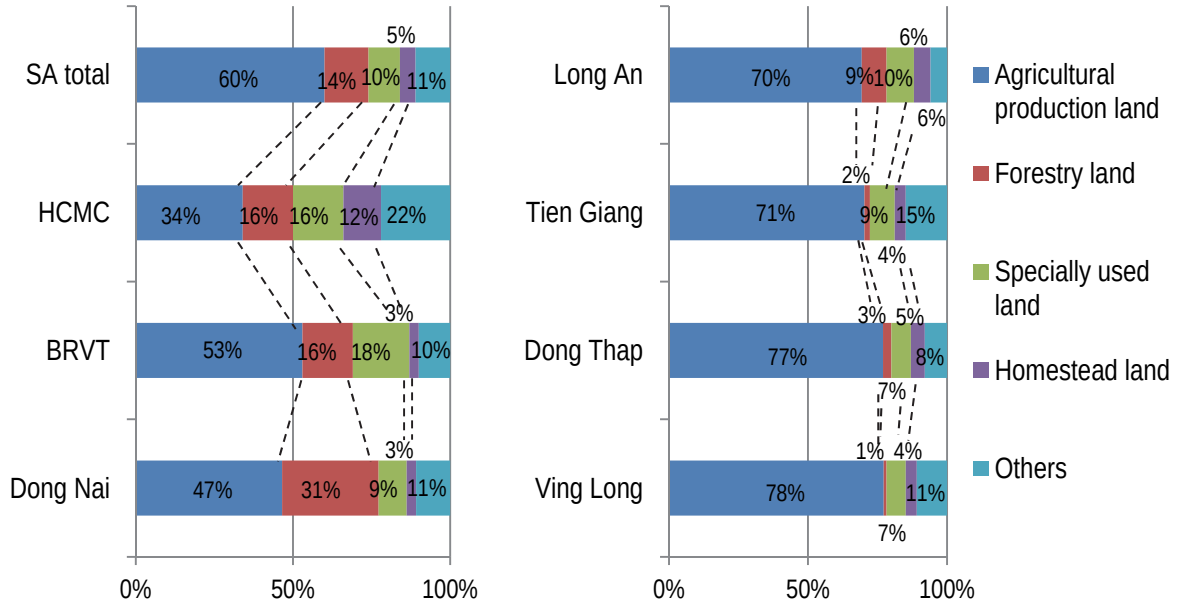
Notes 1: including annual and perennial crop land, 2: land used by offices and non-profit agencies, security and defense land, land for non-agricultural production and businesses and public land, 3: urban and rural residential area, 4: water surface land for fishing, salt production, religious land, cemeteries, rivers and specialized water surface, others and unused land.

Source: Statistical Yearbook of City/Provinces 2014 in the Survey Area

Table 2.1.5 Land Use Composition by City/Provinces of Survey Area in 2014

	HCMC	BRVT	Dong Nai	Long An	Tien Giang	Dong Thap	Vinh Long	Total
Agricultural Production Land	34%	53%	47%	70%	71%	77%	78%	60%
Forestry Land	16%	16%	31%	9%	2%	3%	1%	14%
Specially Used Land	16%	18%	9%	10%	9%	7%	7%	10%
Homestead Land	12%	3%	3%	6%	4%	5%	4%	5%
Others	22%	10%	11%	6%	15%	8%	11%	11%
Total	100%	100%	100%	100%	100%	100%	100%	100%

Source: JICA Survey Team



Source: JICA Survey Team

Figure 2.1.7 Land Use Composition by City/Provinces of Survey Area in 2014

The areas of Long An, Tien Giang, Dong Thap and Vinh Long are occupied by agricultural production land at more than 70%, and BRVT (53%) follows after them.

The land use of HCMC is characterized by homestead land (12%) which is the highest percentage among the SA city/provinces, followed by Long An (6%). The specially used land of HCMC also shows a high percentage of 16% but that of BRVT exceeds it by 2% points over HCMC.

The land use in Dong Nai features the highest share of forestry land among the city/provinces of the SA and has a relatively lower share of agricultural production land.

(2) Composition of City/Provinces by Land Uses in the Survey Area

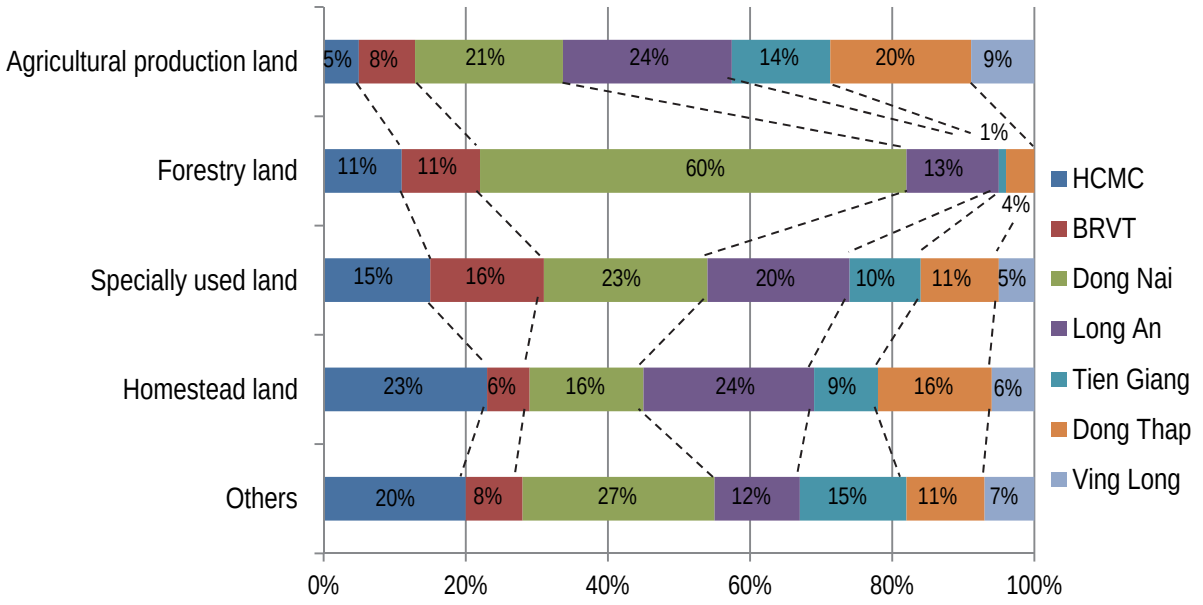
The Survey Area is composed largely of Dong Nai (27%) followed by Long An (21%), Dong Thap (15%) and HCMC (10%), which in total accounts for 73% of the total area of the SA as shown in Table 2.1.6 and Figure 2.1.8.

Table 2.1.6 Contribution of City/Province to Land Uses in Survey Area

	HCMC	BRVT	Dong Nai	Long An	Tien Giang	Dong Thap	Vinh Long	Total
Agricultural production land	5%	8%	21%	24%	14%	20%	9%	100%
Forestry land	11%	11%	60%	13%	1%	4%	0%	100%
Specially used land	15%	16%	23%	20%	10%	11%	5%	100%
Homestead land	23%	6%	16%	24%	9%	16%	6%	100%
Others	20%	8%	27%	12%	15%	11%	7%	100%
Total	10%	9%	27%	21%	11%	15%	7%	100%

Note: Data of HCMC, Dong Thap and Vinh Long are those in 2013

Source: JICA Survey Team



Source: JICA Survey Team

Figure 2.1.8 Contribution of City/Provinces to Land Uses in Survey Area, 2014

Agricultural production land is almost evenly shared by Long An (24%), Dong Nai (21%) and Dong Thap (20%).

Forestry land is largely dominated by Dong Nai (60%), while HCMC, BRVT and Long An range between 11% and 13%. Other provinces occupy very minor shares of the total forestry land in the SA.

Specially used land is occupied largely by Dong Nai (23%) followed by Long An (20%), BRVT (16%) and HCMC (15%). Other provinces, Dong Thap, Tieng Giang and Vinh Long, share a minor portion of the total area of said land use.

Long An (24%), HCMC (23%), Dong Nai (16%) and Dong Thap (16%) largely contribute in their agglomeration (79%) to the total homestead land use in the SA.

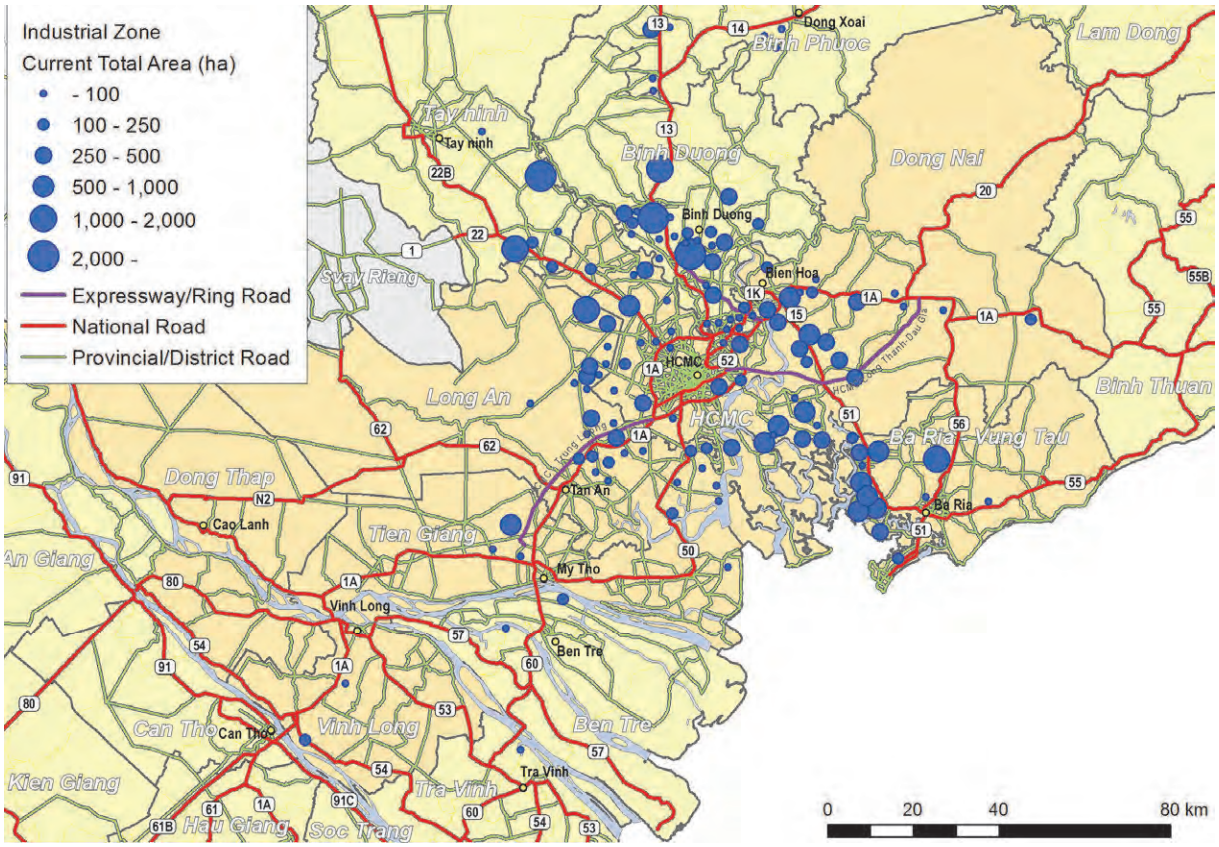
2.2 Current Conditions of Logistics and Road Traffic in Survey Area

2.2.1 Port Traffic and International Cargo Movements

The Survey Area, especially HCMC, drives the economic growth of Vietnam. Per Capita GRDP of HCMC reached 106.8 million VND (5,100 USD) in 2014, which is more than double the average (43.4 million VND or 2,053 USD) of Vietnam.

In the Survey Area centering around HCMC is Ho Chi Minh Port, which handles 5,060 thousand TEU in 2012, equivalent to more than 2/3 of containers handled in Vietnam, and Cai Mep-Thi Vai International Port (937 thousand TEU in 2012), which is projected to supersede HCM Port in the near future and to support many industrial parks in its hinterlands.

In Cambodia near the border of Vietnam, large scale industrial parks such as Manhattan Special Economic Zone (SEZ) (310 ha) are constructed and operated, and infrastructures for the industrial parks such as roads and electricity depend on Vietnam. Cargo flowing between Phnom Penh and Cai Mep-Thi Vai Port, which constitutes the Southern Economic Corridor in Indochina, is not required to stop and transship at the country border by the Cross Border Transport Facilitation Agreement (CBTA).



Source: JICA Survey Team

Figure 2.2.1 Industrial Parks and International Transport Corridor in the Survey Area

Concerning the cargo transport, including international cargoes, in HCMC and its surrounding area, the most important problem is the concentration of cargo into HCM Port. HCM Port is located in the highly urbanized area of the city, therefore, mixed traffic consisting of heavy goods vehicles and daily traffic such as home-based motorcycle and passenger car trips to workplaces and schools cause serious traffic congestion and traffic accidents. The port facilities of HCM Port also have a problem with extensibility in accordance with increasing cargo demand. Cai Mep-Thi Vai Port is expected to develop as one of the most important international ports in Southern Vietnam instead of HCM Port. Cai Mep-Thi Vai Port, however, has such problems as shortage of warehouses along access roads to the port and higher road transport costs to the port, and thus cargoes as a consequence still concentrate to HCM Port.

For the improvement of accessibility and convenience of cargo transport relevant to Cai Mep-Thi Vai Port, Cai Mep-Thi Vai Inter - Port Road, Phuoc An Bridge, North - South Expressway (Ben Luc - Long Thanh Section) and HCM 3rd Ring Road are expected to contribute to improving the connectivity with Can Tho and the Mekong Delta Region, Cambodia and the north of the survey area. Those projects increase the importance of Cai Mep-Thi Vai Port, promote growth of international

cargo transport, divert heavy vehicle traffic from the urbanized area of HCMC and alleviate road congestion in HCMC.

In terms of international cargo transport, for strengthening of the international logistics network, the Southern Economic Corridor (SEC) between Bangkok and HCMC has been developed. In the SEC, Cai Mep-Thi Vai Port is expected to be the gateway in Vietnam, therefore, National Road No. 22 connecting Cambodia and HCMC is important as well as the access road to Cai Mep-Thi Vai Port.

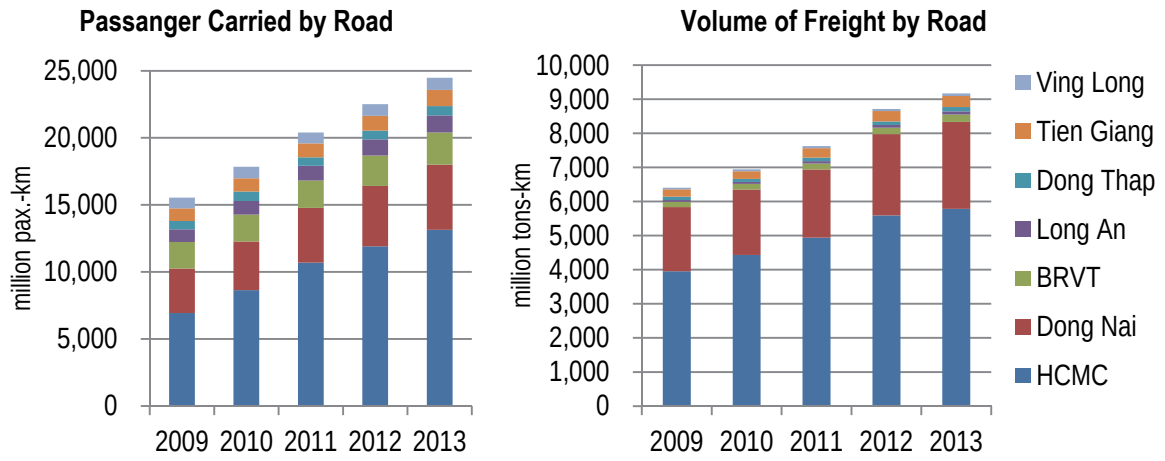
2.2.2 Passenger and Freight Traffic by Mode of Transport in Survey Area

Traffic Congestion in HCMC

The population of HCMC in 2014 is estimated at 8.0 million and the population of the SA was about 17.8 million, which is similar to the Bangkok Metropolitan Area. In accordance with its population and economic growth, person trips and cargo flows in the SA have been increasing rapidly, especially in the way it causes serious traffic congestion in HCMC. To alleviate urban traffic congestion, various transport projects such as plans and construction of metro, monorail and Bus Rapid Transit (BRT) are promoted based on "The Study on Urban Transport Master Plan and Feasibility Study in Ho Chi Minh Metropolitan Area (HOUTRANS, 2004, JICA)" and currently by the "Data Collection Survey on Railways in Major Cities in Vietnam (METROS, in 2016, JICA).

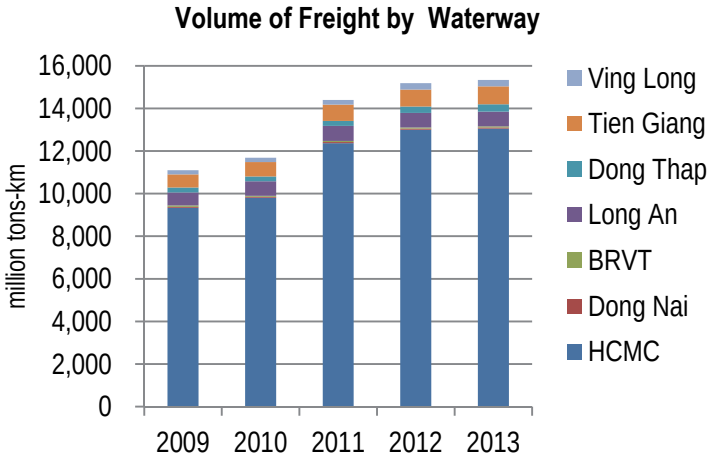
Passenger and freight traffic in the SA are largely concentrated to HCMC (63%) as seen in Figure 2.2.2, followed by Dong Nai Province (28%). Provinces that belong to the Mekong River Delta Region, namely Vinh Long, Tien Giang, Dong Thap and Long An provinces, share, in terms of freight volume-kms by road, a minor portion (less than 7%), even as their agglomeration against the SA total, though their total population accounts for one third of the SA total population.

Compared to freight transport by road, those Mekong River Delta provinces largely depend on waterways (more than 70% of each provincial demand for freight transport) for freight transport. Similar to roads, HCMC still maintains a dominant portion (85%) of the total demand of waterway freight transport in the SA as shown in Figure 2.2.3.



Source: Statistical Yearbook of Vietnam 2014

Figure 2.2.2 Passenger and Cargo Transport by Road in Survey Area



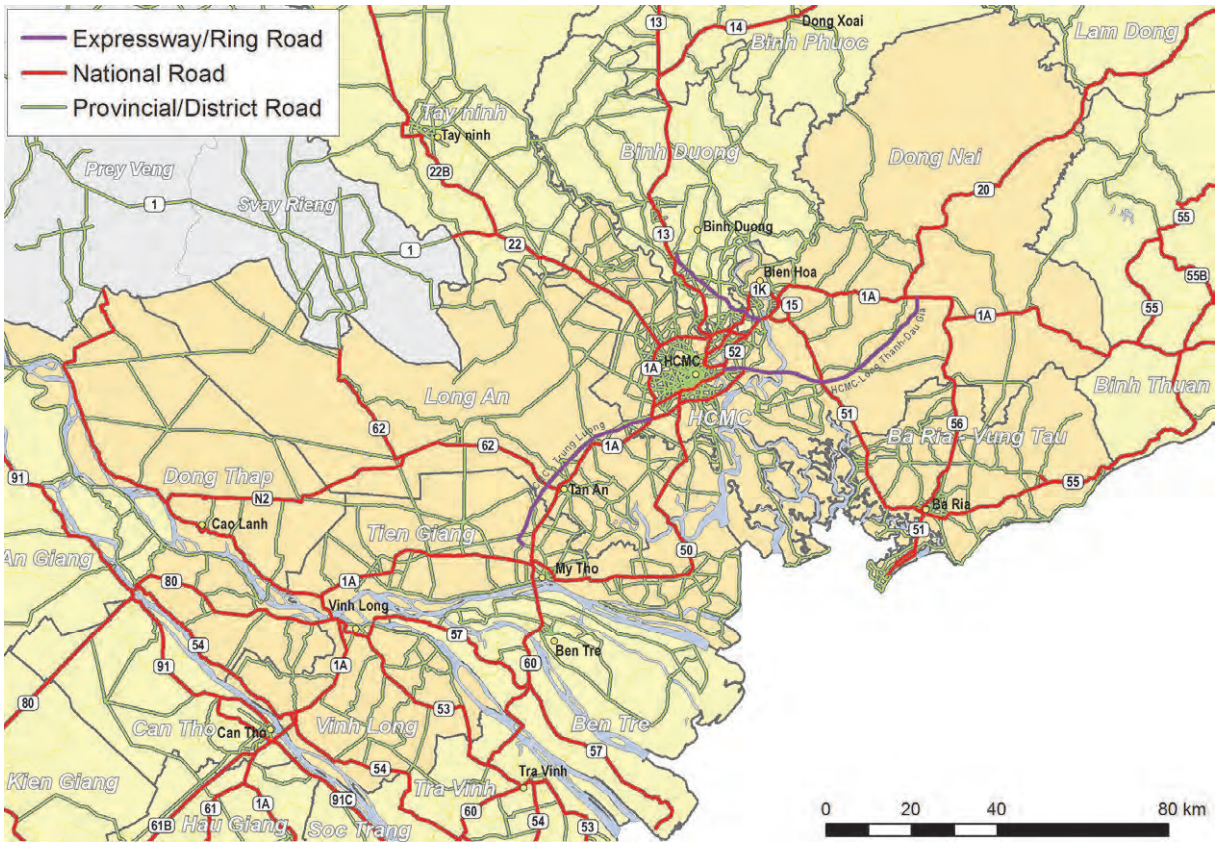
Source: Statistical Yearbook of Vietnam 2014

Figure 2.2.3 Freight Transport by Waterway in Survey Area

2.2.3 Major Road Network in Survey Area

Major roads in the SA consist of expressway, national highways, provincial roads and urban roads in HCMC and each province of the SA. The expressway and national roads currently operated are HCM-Trung Luong-My Thuan Expressway and national highways Nos. 1, 13, 20, 22, 50 and 56 as shown in Figure 2.2.4.

The expressway and the national roads extend radially from HCMC. Linkages between the provinces adjoining HCMC are relatively poor or not properly connected. Therefore, inter-provincial traffic needs to pass through HCMC inevitably. Connectivity between HCMC and the Mekong River Delta Region in particular depends solely on National Highway No. 1, HCMC-Trung Luong and the currently extended Trung Luong-My Thuan section.



Source: JICA Survey Team

Figure 2.2.4 Existing Major Road Network in Survey Area

The Mekong River Delta Region is comprised of a city and 12 provinces, has a population of approximately 17.5 million and shared accounted for 18% of the nation's GDP in 2014. Thus, it has high development potential as an economic growth area; however, infrastructure building is running late. Therefore, the Vietnamese government has instituted the Mekong Delta Area Transportation Improvement Plan (Prime Minister Decision/2012) and announced improvement of the following 5 routes.

Table 2.2.1 Expressway Improvement Plan in Mekong Delta Area

No.	Section	Length
1	North-South Expressway Eastern Route (Trung Luong - My Thuan - Can Tho)	Approx. 92 km
2	North-South Expressway Eastern Route (Can Tho – Ca Mau)	Approx. 150 km
3	North-South Expressway Western Route (Ngoc Hoi - Chon Thanh - Rach Gia)	Approx. 864 km
4	Chau Doc - Can Tho – Soc Trang	Approx. 200 km
5	Ha Tien - Rach Gia - Bac Lieu	Approx. 225 km

Source: Prime Minister Decision/2012

North-South Expressway Eastern Route (Trung Luong - My Thuan - Can Tho), which runs parallel to National Highway No. 1, is the most important route among the above 5 routes. Although a part of the route is supposed to be improved by PPP scheme, a funding scheme of the second My Thuan Bridge is not decided yet.

3 EXISTING DEVELOPMENT PLANS FOR SOUTHERN VIETNAM

3.1 Existing Urban and Regional Development Plans

3.1.1 Overview of Existing Development Plans

Existing development plans relevant to the Survey Area are listed and categorized into such areas as the whole country, Ho Chi Minh Metropolitan Area, Mekong River Delta Region and provinces in the SA as shown in Table 3.1.1.

Table 3.1.1 Upper Level Plan of Vietnam Government and HCM Metropolitan Area

Policy, Superior Plans, Strategy	Goal, Purpose	remarks
A. National Plans		
a) The 9th Five-year Socio-Economic Development Plan 2011-15 (Congress Decision)	Sustainable development under high economic growth rate, realize the industrialized nation in 2020, improvement in society, science, education, environmental conservation	2011, approved
b) The 10th Five-year Socio-Economic Development Plan 2016-2020	Sustainable development under high economic growth rate, democratization in economy, improvement of enterprise's competitiveness.	planning ongoing
B. Hồ Chí Minh Metropolitan Area (South East Region)		
c) The Master Plan on Socio-Economic Development of Hồ Chí Minh City through 2020, with a Vision towards 2025 (PM Decision)	Developing Ho Chi Minh City as a modern city and taking the lead in industrialization and modernization, contributing more to regional and national developments	2013, approved
d) Revision of Hồ Chí Minh City Construction Plan to 2025 (PM Decision)	Revision of the Master Plan on Construction of the Ho Chi Minh City Region up to 2020, based on the regulation to review the plan every 5 years.	2010, approved
e) The Master Plan on Construction of the Ho Chi Minh Region up to 2020, with a vision toward 2050 (PM Decision)	Adopting the urban development model of multi-polar concentration and HCMC is planned to function as the core of the metropolitan area, neighboring regions, the whole country and the gateway to the world.	2008, approved
f) The Master Plan on Socio-Economic Development of Bà Rịa-Vũng Tàu Province (PM Decision)	Strengthening the partnership with Hồ Chí Minh metropolitan area and Mekong Delta Region as a major port	2007, approved
g) The Master Plan on Socio-Economic Development of Đồng Nai Province (PM Decision)	Developing high-tech and low-tech special economic zone and strengthening the partnership with Hồ Chí Minh metropolitan area and Mekong Delta Region	2015, approved
C. Mekong River Delta Region		
h) The Master Plan on Socio-Economic Development of Mekong Delta Key Economic Region Through 2020, with a vision towards 2030 (PM Decision)	Development of agricultural industry of Cần Thơ City, Cà Mau, An Giang, Kiên Giang province.	2014, approved
i) The Master Plan on Socio-Economic Development of Long An Province (PM Decision)	Strengthening the partnership with Hồ Chí Minh metropolitan area and Mekong Delta Region	2012, approved
j) The Master Plan on Socio-Economic Development of Đồng Tháp Province (PM Decision)	Regional activation by strengthening infrastructure and utilization of border.	2011, approved
k) The Master Plan on Socio-Economic Development of Tiền Giang Province (PM Decision)	Strengthening industrial district, infrastructure, major products, urbanization and human resource.	2015, approved
l) The Master Plan on Socio-Economic Development of Vĩnh Long Province (PM Decision)	Strengthening the partnership with Cần Thơ City	2012, approved

Source: JICA Survey Team

3.1.2 Development Plans for the Ho Chi Minh City Region and HCMC

(1) Spatial Structure of Ho Chi Minh City Region (HCMCR)

Since the Survey Area overlaps with the Ho Chi Minh City Metropolitan Region (equivalent to SFEZ), "Revision of Ho Chi Minh City Construction Plan to 2025", which deals with the review work of "Ho Chi Minh City Metropolitan Region Construction Plan up to 2020 and vision to 2050", provides the regional development context applicable to the development directions of the Survey Area.

The development model of HCMCR is identified as central and multi-centered on the basis of the regional development frame. The regional spatial structure is constructed on the basis of 5 radial axes along the urban economic corridors connecting the regional center with national and international regions.

- HCMC – Moc Bai border gate – Phnom Penh – Bangkok.
- HCMC – Vung Tau City – international transshipment port.
- North – South HCMC expressway axis to national regions.
- NH22 Trang Bang – Xa Mat – Kongpong Cham – Siem Riep
- HCMC – Chon Thanh – Hoa Lu axis connecting to the Trans-Asia frame of the Mekong River sub-region.

(2) Urban system distribution

Ho Chi Minh City is a special city functioning as the nucleus of the HCMC Region, a primary center for economy, culture, science & technology, with an important political status nationwide, being an international exchange node, an industrial, multi-dimensional service and science & technology center in South East Asia.

Urban satellites of Ho Chi Minh City:

- Independent satellites: Independent satellites are identified within the 30 km radius from the nucleus center of Ho Chi Minh City, including Bien Hoa City and Thu Dau Mot City.
  - Bien Hoa City: this is a class 1 city functioning as an independent satellite in the center of Dong Nai province, a supplementary industrial and high technology center, an international standard health center.
  - Thu Dau Mot City: this is a class 1 city functioning as an independent satellite and the provincial center of Binh Duong, a technology and educational center at the national level.
- Dependent satellites: centrally dependent satellites are identified within a 30 km radius, which is from Ring Road 3 inwards, including the following urban areas:
  - Nhon Trach new urban area: a city of urban class 2 in Nhon Trach, Dong Nai province functioning as a centrally dependent satellite, an industrial, commercial –service, tourism, educational and science and technology center.

- Tam Phuoc new urban area (Long Thanh airport new urban area in Long Thanh district, Dong Nai province): this is a class 2 urban area functioning as a centrally dependent satellite, this is a specialized urban area, a commercial, tourism, scientific and conferential service center.
- Hiep Phuoc Port urban area: This is a newly constructed class 3 urban area functioning as a centrally dependent satellite specializing in industries and port services.
- North West new urban area (class II urban area in Cu Chi – Hoc Mon, HCMC), this is an ecological urban area, the northwest center of HCMC.
- Other new urban areas: class 4 urban areas: Duc Hoa, Long Thanh, Trang Bom, An Lac, Nha Be; Can Gio, Di An – Thuan An.

The spatial structure and urban system distribution of the HCMC Region are presented in Figure 3.1.1.

Source: Revision of Ho Chi Minh City Construction Plan to 2025

Figure 3.1.1 Spatial Structure and Urban System Distribution of HCMC Region

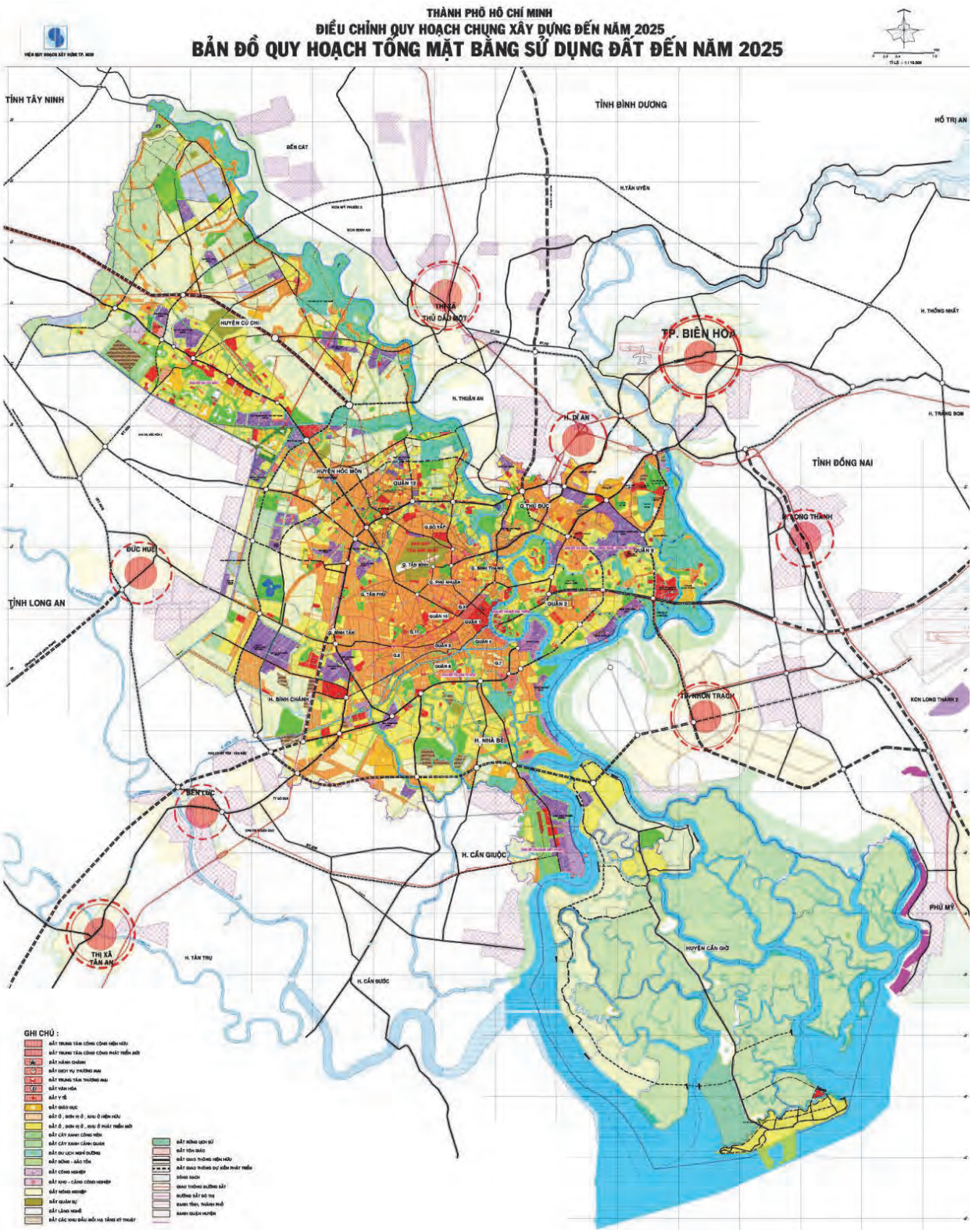
(3) HCMC General Construction Master Plan

Urban development policies of HCMC itself are collectively given in the General Construction Master Plan up to 2025 as approved by the Prime Minister in 2010 (No.24/QD-TTg). This general plan indicates a compact and multi-centric model. The core center is Central Business District (CBD) and is located within a radius of 15 km from the city center and is supported by the following directions:

- Primary eastern direction: the development corridor is the HCMC-Long Than-Dau Giay expressway, while new urban centers are promoted along Hanoi Highway;
- Primary southern direction: The development corridor is Nguyen Huu Tho Road, taking advantage of the river and water space;
- Secondary northwest direction: The development corridor is NH22 (Trans-Asia Highway); and
- Secondary western and southwest directions: The development is promoted along Ngyuen Van Linh Road.

The city is divided into the urban development promoted zone, the industrial development promoted zone, the ecological and tourism development zone, the agricultural production-cum-ecological belt promoted zone, rural residential quarters and the natural reserved zone.

Consequently, the land use plan of HCMC in 2025 is prepared as seen in Figure 3.1.2.



Source: Decision No. 24/QD-TTg of the Prime Minister on Approval of Ho Chi Minh City General Construction Plan to 2025, 6th January 2010

Figure 3.1.2 Land Use Plan of HCMC in 2025

3.1.3 Existing Transport Master Plan

Other than the transport development plans covered by the above-mentioned master plans, the transport sector or road development plans are prepared as shown in Table 3.1.2.

Table 3.1.2 Existing Transport Sector or Road Development Plans

a) The Vietnam Expressway Network Developing and Planning until 2020 and the view for post-2020 (PM Decision)	Based on the traffic demand forecast derived from the socio-economic development until 2020 and the view for post-2020, the plan defines Vietnam's expressway network, including 22 expressways with a total length of 5,873 km.	2008, approved
b) Adjusted Planning for Road Traffic Development in Vietnam by 2020, and the Orientation towards 2030 (PM Decision)	The development plan of road traffic infrastructure, which is an engine of socio-economic development. In addition to industrialization and modernization, constructing inter-regional, international network and contribute to national security. (target year, 2020 and 2030)	2013, approved
c) Traffic Development Plan of Mekong Delta Key Economic Region Through 2020 (PM Decision)	Development of 5 corridors targeting the activation of regional development. Hồ Chí Minh - Cần Thơ - Cà Mau, Hồ Chí Minh - Long Xuyên - Rạch Giá, Hồ Chí Minh - Hà Tiên, Hồ Chí Minh - Cần Thơ, Cần Thơ - Long Xuyên - Châu Đốc - Hà Tĩnh - Rạch Giá - Cà Mau	2012, approved

Source: JICA Survey Team

Transport master plans relevant to the current SA were prepared under the technical assistance of JICA in 2004 and 2011; they are "The Study on Urban Transport Master Plan and Feasibility Study in HCM Metropolitan Area" (HOUTRANS) and "The Comprehensive Study on the Sustainable Development of Transport System in Vietnam" (VITRANSS 2), respectively.

HOUTRANS deals with the urban transport development in the HCM Metropolitan area and focuses on passenger movements, and which analysis is largely based on the person trip survey.

HOUTRANS proposes the urban transport master plan for the target years of 2010 and 2020. The study provided a basic structure for the future urban transport system consisting of primary roads (including Ring Roads 2, 3 and 4), secondary roads and urban expressways. The study also proposes urban mass rapid transit Lines 1,2,3 and 4, though the current urban mass transit plan comprises Lines 1, 2, 3a, 3b, 4, 4b, 5 and 6; and additionally tramway/monorail and BRT.

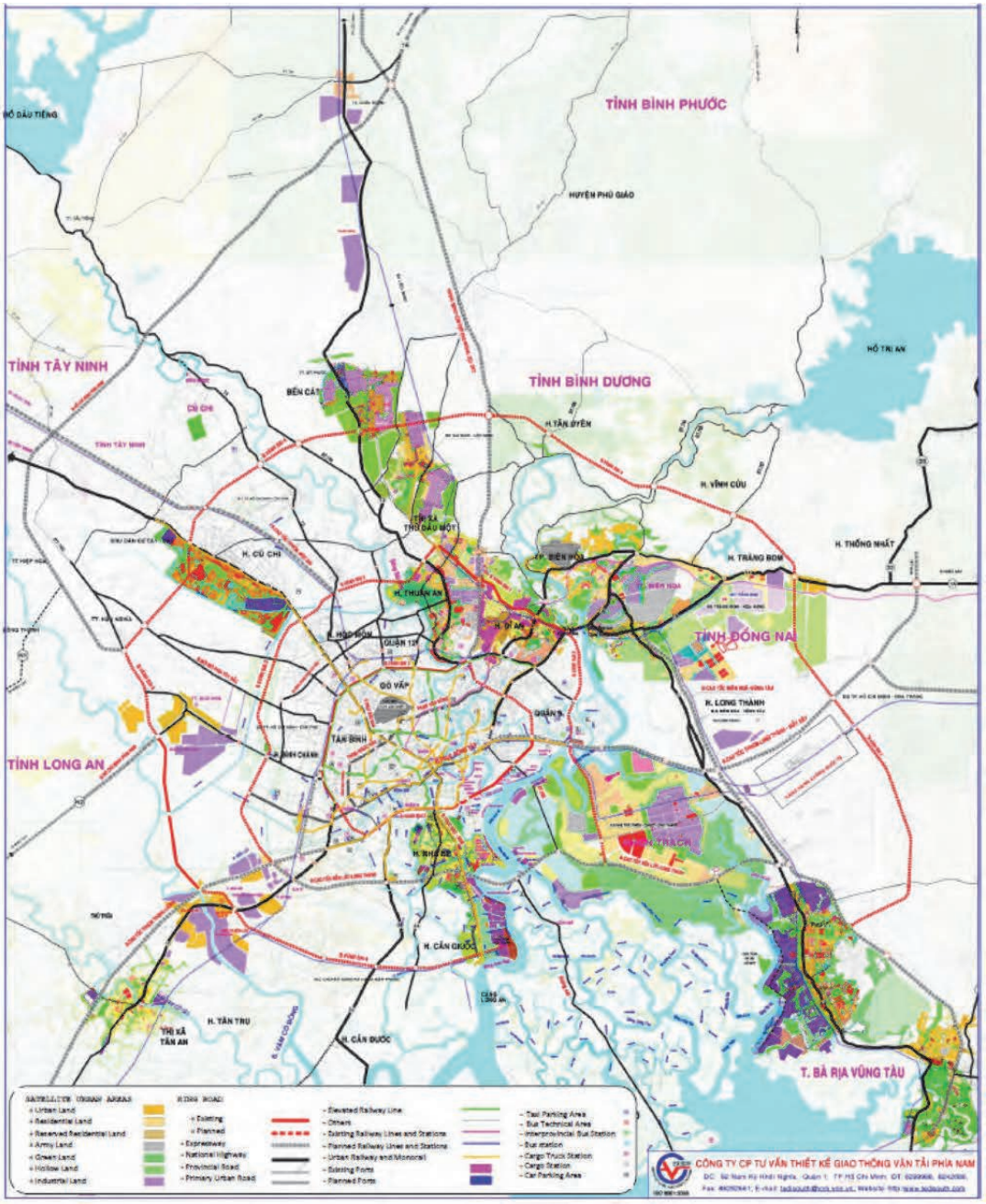
It is therefore believed that the HOUTRANS plan is duly adopted and reflected in the current transport master plan authorized by the HCMC People's Committee as shown in Figure 3.2.1.

VITRANS 2 was conducted from December 2007 to May 2011. The study covers the whole country and focuses on roads, national highways and expressways. The study takes a corridor management approach and categorizes the road network into such main transport corridors as National Backbone, International Gateway Corridor, Land Bridge Corridor, Regional Corridor and Metropolitan Ring Corridor. Those corridors relevant to the current Survey are proposed as follows:

National Backbone: 1. North-South Coastal Corridor (HCMC-Hanoi),
2. North-South Upland (HCMC-Hanoi)

International Gateway Corridor:	4. SFEZ Gatewaay (HCMC-Ba Ria-Vung Tau)
Land Bridge Corridor:	10. HCMC-NH22-Cambodia Border (HCMC-Moc Bai)
Regional Corridor:	27. HCMC-My Tho-Cambodia Border (HCMC-Tan Chau)
	29. South Delta Spine (HCMC-Ca Mau)
	30. Upper South Delta (HCMC-Rach Gia)
Metropolitan Ring Corridor:	32. HCMC Outer Ring

Those corridors listed above are all included in the current road master plan prepared by Cuu Long CIPM as shown in Figure 3.2.2.



Source: HCMC Peoples Committee

Figure 3.1.3 HCMC Transport Development Master Plan to 2020 by HCMC PC

Source: Cuu Long CIPM

Figure 3.1.4 Transport Development Master Plan for HCMC Metropolitan Area and Mekong River Delta Region

3.2 Road and Bridge Improvement Plan of Southern Vietnam

3.2.1 The Status of Existing Road/Bridge Improvement Plan

The upper level plan of HCMC and objective provinces are shown in Table 3.2.1~Table 3.2.4.

Table 3.2.1 Expressway Network (Ring Road)

Road Category	Project Name	Road Length (km)	No. of Lanes/ width (m)	Planning/ Implementation Progress	Traffic Demand Forecast, 2030 (pcu/day)	Data and Information Source (date, etc.)
Ring Road	**2nd Ring Road:**		4 lanes			Under operation except for the following 2 sections
	Southwest Section	5.0	4 lanes			Missing Link
	Northeast Section	9.0	6 lanes			Missing Link
	Viaduct No. 5	30.4	4 lanes	Planned on the 2nd Ring Road		
	3rd Ring Road:	–	–	–	–	TOR of ADB financed F/S for Sections 3 and 4, issued in 2015. TOR of ADB F/S Hearing from Cuu Long CIPM on 16/03/2016
	Section 1: Nhon Trach - Tan Van	34.3	4 lanes/ 19.5 m	F/S financed KEXIM completed.	247,963	
	Section 2: Tan Van – Binh Chuan	16.7	Varies	Operation Construction has been completed by BOT of a state owned enterprise in 2014.	352,198	
	Section 3: Binh Chuan – NH22	17.5	8 lanes (4-Urban, 4-Express)/ 74.5 m	ADB-financed Pre-F/S completed	340,820	
	Section 4: NH 22 – Ben Luc	29.2	Ditto	Fund for Const. by ADB or JICA expected for either one of the two sub-sections.	217,155	
	4th Ring Road:	–	–	–	–	Cuu Long CIPM http://cuulongcipm.com.vn/Home/investor/00269f.aspx
	Section 1: Trang Bom-NH No.13	51.9	4 lanes/ 27.0 m (viaduct), 74.5 m (embankment)		188,886	
	Section 2: Tan Uyen-Binh Duong	22.8	4 lanes/ 27.0 m (viaduct), 74.5 m (embankment)		149,596	
	Section 3: NH No.22-Ben Luc	41.6	4 lanes/ 27.0 m (viaduct), 74.5 m (embankment)		153,061	
	Section 4: Ben Luc-Hiep Phuoc	34.7			70,595	
	Section 5: Trang Bom-Phu My	TBD			83,278	

Source: JICA Survey Team

Table 3.2.2 Expressway Network (HCM Metropolitan Area)

Road Category	Project Name	Road Length (km)	No. of Lanes/ width (m)	Planning/ Implementation Progress	Traffic Demand Forecast, 2030 (pcu/day)	Data and Information Source (date, etc.)
HCM Region Regional Expressway	HCMC-Long Thanh-Dau Giay	55.0	4-lane (designed 6-8 lanes)	Completed	138,365 (71,410)	
	Bien Hoa – Vung Tau	(46.8)	(6-lane)	PMU 85 proposed to MOT in Apr., 2016		
	Section 1: Bien Hoa – Phu My			Pre FS by PMU85 done	135,359	
	1-1: Bien Hoa –Long Thanh Dau Giay	38.0	6-lane/ 32.25~34.5 m			
	1-2: Long Thanh Dau Giay ex – Ben Luc Long Thanh ex		8-lane/ 39.75~42 m			
	1-3: Bem Luc Long Thanh ex – Tan Thanh (JCT)		6-lane/ 32.25~34.5 m			
	Section 2: Phu My (JCT) – Cai Mep Thi Vai Port	8.8	6-lane/ 30.5~33 m		76,488	
	Section 3: Tan Thanh (JCT) – Vung Tau	30.8	4-lane/ 24.75~27 m		55,951	
	Ben Luc – Long Thanh			Under construction		
	Section 1: Package A1 – A3	18.7	4 lane/ 25~26.5		182,071	
	Section 2: Package A4, J1 – J3	13.7	4 lane/ 21.75	Almost all elevated	219,953	
	Section 3: Package A5 – A7	25.3	4 lane/ 25~26.5		149,101	
	HCMC – Moc Bai	55.0	4~6 lanes	FS is committed by KOICA	99,141	
	HCMC – Thu Dau Mot – Chon Thanh	69.0	6~8 lanes		116,478	
	HCMC – Trung Luong	61.9	4 lanes /24.5 m	Completed	146,530	CIENCO5 http://www.cienco5.vn/tabid/82/CID/46/ItemID/237/default.aspx

Source: JICA Survey Team

Table 3.2.3 General Road (HCM Metropolitan Area)

Road Category	Project Name	Road Length (km)	No. of Lanes/ width (m)	Planning/ Implementation Progress	Traffic Demand Forecast, 2030 (pcu/day)	Data and Information Source (date, etc.)
Connecting Links in HCM Region	Tan Tao Expressway	10.5	4 lanes		193,645	Known as "Tan Tao – Cho Dem Road"
	Missing Link 1 (Access road between TL10 and TL10B)	4.5	6 lanes /16 m			
	Missing Link 2 (Access road between Tan Tao Expressway and East-West Road.	3.0	4 lanes			
	East –West Road	22	6 lanes			-
	Phuoc An Bridge and Access + I/C	12	6 lanes/ 66 m		25,149	DOT, BA RIA VUNG TAU Cong Ty Phouc An Port is under Petro VN.

Source: JICA Survey Team

Table 3.2.4 General Road (Mekong Delta Area)

Road Category	Project Name	Road Length (km)	No. of Lanes/ width (m)	Planning/ Implementation Progress	Traffic Demand Forecast, 2030 (pcu/day)	Data and Information Source (date, etc.)
Mekong Delta Region	Trung Luong – My Thuan	54.3	4 lanes	Under construction	79,287	JICA PPP Study
	My Thuan – Can Tho	32.3	4 lanes		36,201	JICA PPP Study
	Can Tho – Ca Mau				N/A	
	2nd My Thuan Bridge	North: 1.98 m South: 1.04 m	1st Stage Br:6 lanes /32 m 2nd Stage 4 lanes /25.5 m 6 lanes /33 m	METI FS has been completed.	61,278	METI FS
	2nd Can Tho Bridge				N/A	
	Second Southern Highway Tuyen N2					Technical assistance consultant's report [ADB] N2: Ho Chi Minh Road (popular name)
	Second Southern Highway Cao Lanh Bridge	7.8	4 lanes/24.5 m	Technical assistance consultant's report has been completed by ADB.	25,149	
	Second Southern Highway Cao Lanh – Vam Cong	15.7	4 lanes/33 m		20,348	
	Second Southern Highway Vam Cong Bridge	5.8	4 lanes/24.5 m		31,772	

Source: JICA Survey Team

3.2.2 Confirmation of Road/Bridge Improvement Plan by Private Scheme

The Vietnamese Government announced decree 15/2015/ND-CP (PM-D 15) on the 14th of Feb. 2015, and executed it on the 10th of Apr. 2015. This decree is a decision to stipulate and maximize the use of the private sector's capability to implement social infrastructure. It is also a legal evidence of PPP investment in social infrastructure, which the Vietnam Government has been encouraging to compensate for the lack of national and local governmental budget for realizing the social development master plans.

The road and bridge sector is on the list of recommended projects for the PPP scheme in PM-D 15 mentioned above, and not only the central government but also the local government, including municipalities (including HCMC) and provinces (including 6 C/P provinces). Therefore, many Implementation Agency (I/A) are intending to find the BOT investor for the project which can be expected to have rather large scale traffic demand with rather low initial investment (e.g. project without long viaduct/bridge and soft ground)

There are findings from the Road & Bridge implementation that many of the projects targeted by the Master Plan to be opened in 2020 are in the process of finding BOT investors and the I/A of the projects are trying to implement by BOT scheme. This is because they still do not have any decided or specific financial source from the government or international donor. Considering the procedure and time schedule of approving budget in those organizations, the I/A has nearly given up on implementing the project by public finance source and is instead trying to realize it using a source that has a relatively higher possibility of finding BOT investors.

For Road & Bridge projects, it is generally very difficult to make a profit only by collecting toll fees from road users. However, Vietnam I/A for road & highway projects with relatively low financial feasibility are proceeding with BOT schemes. These projects are designed to make profit by offering the development rights along the project roads and bridges to the BOT investor. BOT investors will develop the roadside area and earn income to recover their investment, and furthermore to make profit. Moreover, the cash flow of these projects is improved by reducing the land acquisition cost, increasing indirect income from developing the roadside. More often the land acquisition is prepared by the government and the development rights are offered to the BOT investor from the government, and so on. In other words, it is called BOT but in reality the scheme is PPP, for the project's financial procurement is not done only by the BOT investor and the governmental budget is usually put into the project at various rates according to the results of the project's cash flow analysis.

The 3rd Ring Road, Section 1 and 2, is planned to be implemented as a co-financed project by the Korean Government's ODA and private finance by a Korean BOT investor. They have selected the best part to maximize the project's financial feasibility for the BOT investor and also the contribution to the business of the Korean Manufacturers that operates the factories along the roadside area. They are not planning to complete Section 1 and 2, and the unimplemented sections will be left to VN I/A to handle. They will construct a high-cost, long bridge section by ODA, and a low-cost embankment section by private finance. Both sections will be operated by the BOT investor and the initial

investment will be recouped by collecting a toll from the road users. This scheme is a so-called two-tiered system of developing infrastructure by PPP scheme, and it will be one of the first examples of a road and bridge project that is implemented as a two-tiered system.

On the other hand, KOICA (Korea International Cooperation Agency) has signed the Record of Discussion (ROD) with the Ministry of Transport, Vietnam (MOT) on the 14th of June, 2016, about cooperation in developing the road and railway transportation sector in Vietnam. One of the topics agreed to in the ROD is the execution of the study that will review the F/S and propose a PPP model for the HCMC – Moc Bai expressway project. The implementation schedule shown in the ROD says that the results would by prepared by the end of June 2017, and the possibility that Korea will have the initiative for implementing the HCMC – Moc Bai expressway project is increasing gradually.

The table below (Table 3.2.5) shows the Main Road and Bridge Projects in Table 3.2.1~Table 3.2.4, which Vietnam I/A plans to finance by BOT.

Table 3.2.5 List of Main Road and Bridge Projects that Vietnam I/A plans to finance by BOT

Road Category	Project Name	Length (km)	Current Status
Ring Road	2nd Ring Road: Viaduct No. 5	30.4	Looking for BOT investor but no specific candidate.
	3rd Ring Road:	—	—
	Section 1: Nhon Trach - Tan Van	34.3	It is planned to be financed by Korean ODA and BOT by Korean private sector, only the section that contributes traffic access to the industrial park with many Korean enterprises. The O&M will be done by same private sector. (F/S approved)
	Section 2: Tan Van – Binh Chuan	16.7	
	Section 3: Binh Chuan – NH22	17.5	It is part of the study area of F/S executing by ADB. Vietnam I/A is planning to finance by BOT.
	4th Ring Road:	191.0	Looking for BOT investor but no specific candidate for any section.
HCM Metropolitan Area Regional Expressway	Bien Hoa – Vung Tau:	—	—
	Phase 1: Bien Hoa – Phu My / Cai Mep	46.8	Negotiating with specific BOT investor (Vietnamese)
	Phase 2: Tan Thanh (JCT) – Vung Tau	31.0	Looking for BOT investor but no specific candidate.
	HCMC – Moc Bai	55.0	Pre-F/S was done by VN government budget. KOICA is planning to review it from July 2016. It is possible that the project will be implemented by PPP scheme initiated by Korea.
	HCMC – Thu Dau Mot – Chon Thanh	69.0	Listed on Master Plan only, specific I/A is not assigned yet
Connecting Links in HCM Metropolitan Area	Missing Link 2	3.0	Negotiating with specific BOT investor (Vietnamese)
	Phuoc An Bridge and Access + I/C	12.0	Looking for BOT investor, withdraw the request to JICA.
Mekong Delta Region	My Thuan – Can Tho	32.3	Negotiating with specific BOT investor (Vietnamese)

Source: JICA Survey Team

3.2.3 Status of Assistance by Other Donors

There are only 2 projects that have specific donors preparing the implementation in Table 3.2.1~Table 3.2.4. One is the 3rd Ring Road, Section 1 and 2 by KOICA and the other is F/S of the 3rd Ring Road, Section 3 and 4 by Asian Development Bank (ADB).

Korea is showing the initiative in the implementation of the 3rd Ring Road, Section 1 and 2. The starting point is at the west side of the industrial park in Nhon Trach district, Dong Nai province. The route goes northward crossing the Dong Nai River, HCMC – Long Thanh – Dau Giay expressway, and turns west in district No. 9, HCMC, and continues toward the intersection of NH1 and NH52. The original plan of the 3rd Ring Road did not include the section from the turning point in district No. 9 to the intersection of NH1 and NH52. However KOICA intends to implement this section because they consider it a very important section for their industry. The section was listed in the Master Plan of HCMC road network and is now called Section 1-A by VN I/A. As it is described in 3.2.2, this project is planned to be implemented by co-finance of Korean ODA and private finance of a Korean BOT investor. The BOT investor aims to construct the section of the north bank of the Dong Nai River, and ODA is planning the long bridge crossing of the Dong Nai River and its left bank section, and it is planned as PPP of a two-tiered scheme that the operation of the entire section will be done by the BOT investor.

The 3rd Ring Road, Section 3 and 4, is now at the F/S stage of consultant selection. ADB said, in the interview conducted by the survey team in Apr. 2016 that they intend to invest in Section. They have also mentioned that their forecast of the project cost could be over their budget and are asking JICA for co-financing. However, the details will be studied carefully in the F/S from the second half of 2016 to the first half of 2017.

Also as mentioned in 3.2.5, review of the F/S of the HCMC – Moc Bai expressway is planned to be executed by KOICA by Jun. 2017. They will also propose the PPP model of the project and would have the initiative to implement the project after the completion of the review.

3.2.4 Prioritization of Phuoc An Bridge and Second My Thuan Bridge in Upper Level Plan

The Feasibility Studies (F/S) of the Phuoc An Bridge and the 2nd My Thuan Bridge have both been conducted by the Ministry of Economy, Trade and Industry (METI).

The Phuoc An Bridge, which is located in Ba Ria – Vung Tau province, will be constructed by BOT scheme according to the result of meeting with the province. Besides, the province is not supposed to apply for ODA fund because they aim to construct by BOT.

However, Vinh Long province and Tien Giang province aim to construct the 2nd My Thuan Bridge by ODA fund. They expect that the bridge will be constructed by Japanese ODA fund as a result of the F/S by METI. Besides, the expressway between HCMC and Trung Luong has already been opened and the one between Trung Luong and My Thuan will be completed in 2018. Thus, DPI has acknowledged the importance of the 2nd My Thuan construction in order to resolve the missing link.

4 TRAFFIC DEMAND FORECAST

4.1 Review of existing traffic demand forecast model

For the estimation and forecasting of present and future traffic demand in the study area, two existing JICA Studies relevant to the study area are available, namely, "The Study on Urban Transport Master Plan and Feasibility Study in Ho Chi Minh Metropolitan Area (HOUTRANS, 2004)" and "The Comprehensive Study on the Sustainable Development of Transport System in Vietnam (VITRANSS2, 2010)".

Table 4.1.1 Outline of Existing JICA Studies

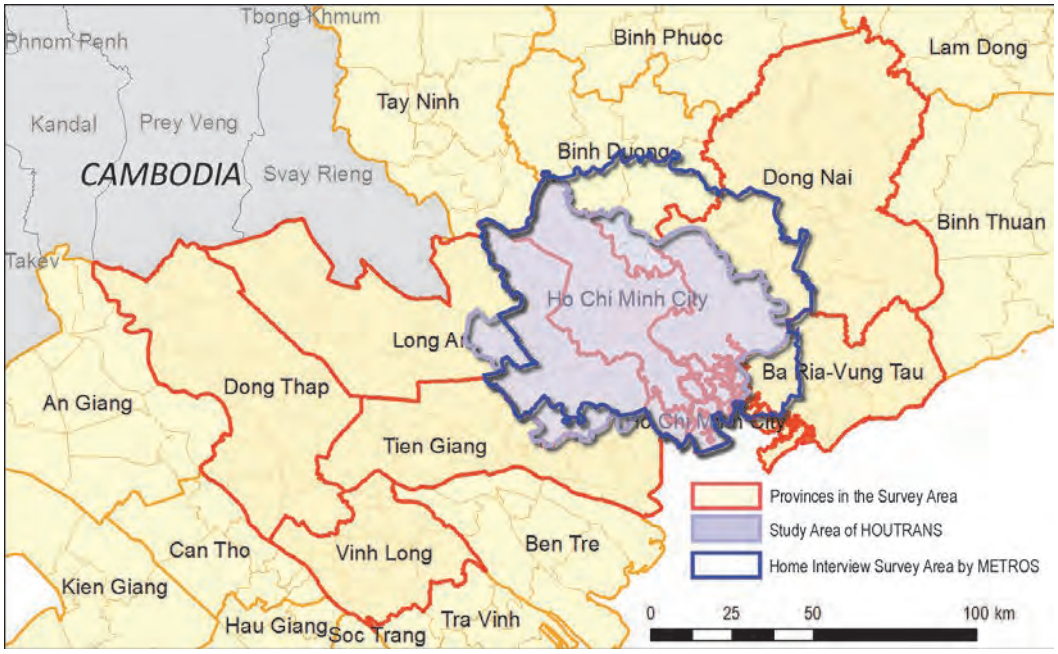
Items	HOUTRANS (2004)	VITRANSS2 (2010)
Study area	HCMC, Dong Nai (3/11 Sub-divisions), Binh Duong (2/9 Sub-divisions, Long An (8/15 Sub-divisions)	The whole of Vietnam
Base year of demand Forecast	2002	2008
Target year	2010, 2020	2020, 2030
Target demand	Person trips, trucks at logistics facilities	Person trips, cargo flow
Transport modes for demand forecast	Bicycle, Motorcycle, Car, Truck and Bus	Car, Bus, Railway and Aviation (Inland water and coastal are only for cargo)
Demand forecast model	Conventional four-step demand forecast model based on person trip (PT) survey by home interview survey (HIS) and other traffic surveys.	Conventional four-step demand forecast model based on traffic surveys relevant to road, railway and other transport modes. (Intra-zonal trip and flow is not included)
Traffic analysis zone system	Minimal zone is defined by ward and several wards are integrated in accordance with distance from center of HCMC. Study area consists of 256 zones (HCMC consists of 216 zones).	Traffic analysis zone is defined by province.
Notes	Same PT survey was carried out on almost the same area in the "Data Collection Survey on Railway in Major Cities in Vietnam (METROS), 2015, JICA".	

Note: Sub-district includes district, district-level town and provincial city.

Source: JICA Survey Team

The demand forecast model prepared by VITRANSS2 is the model for nation-wide and inter-provincial person trip / cargo flow demand forecasting to evaluate national and regional projects such as North–South Expressway and North–South Railway. For the evaluation of road/bridge projects in the survey area such as HCMC Ring Roads, the demand forecast model by VITRANSS2 is inappropriate. Therefore, the traffic demand forecast in the survey should be based on the demand forecast model built by HOUTRANS and on the results of the person trip survey carried out by METROS in 2013. However, as shown in the following figure, the study areas of HOUTRANS and

METROS are a part of the HCMC Metropolitan Area and some provinces and districts of the survey area are not included. Therefore, it is difficult to prepare some parameters in the existing demand forecast model, such as household by vehicle ownership, and number of employees and students.



Source: JICA Survey Team

Figure 4.1.1 Survey Area and PT Survey Area of Existing Studies

Based on the results of the review of the existing demand forecast model built by HOUTRANS and the analysis of the results of the person trip survey carried out by METROS, a traffic demand forecast model is rebuilt for the survey. A detailed review of the existing demand forecast model is described in Appendix-1.

4.1.1 Trip Generation Model

In the survey, the Traffic Analysis Zone (TAZ) system is defined by sub-division level such as district in order to collect socio-economic information in the survey area. The trip generation model is estimated by linear regression of trip production, attraction and population in urban/rural areas based on the PT database in 2013 prepared by METROS.

$$G_i = \alpha \cdot PopU_i + \beta \cdot PopR_i + C$$

Where,

G_i : Trip production or attraction of zone i,

$PopU_i$: Urban population of zone i,

$PopRi$: Rural population of zone i,

α, β : Coefficients, and

C : Constant.

Table 4.1.2 Parameters of Generation Model

	α	*B*	*C*	Adj.R^2
Trip production	2.87 (16.5)	2.33 (8.57)	131,200 (2.10)	0.897
Trip attraction	2.87 (16.4)	2.33 (8.49)	131,691 (2.09)	0.900

Note: t-value is in parentheses.
Source: JICA Survey Team

4.1.2 Trip Distribution Model

(1) Model for intra-zonal trips

Based on the results of the PT survey prepared by METROS, the intra-zonal trip ratio is estimated using the following formula.

$$I_i = \alpha \cdot \ln(Z_i) + \beta$$

Where,

I_i : Intra-zonal trip ratio for zone *i*,

Z_i : Area (km^2) of zone *i*, and

α, β : Parameters

Table 4.1.3 Estimated Intra-zonal Distribution Model Parameters

Parameters	Coefficient	t-value
α	0.0745	9.8
β	0.496	16.0
adjusted R^2	0.754	

Source: JICA Survey Team

(2) Model for inter-zonal trips

Based on the results of the PT survey prepared by METROS in 2013, inter-zonal trips, zonal trip production and attraction, and distance between origin and destination by sub-division level zone system are computed and the following trip distribution model for inter-zonal trips is estimated.

$$T_{ij} = \kappa \cdot P_i^{\alpha} \cdot A_j^{\beta} \cdot d_{ij}^{\gamma}$$

Where,

T_{ij} : Number of inter-zonal trips between zone *i* and *j*,

d_{ij} : Inter-zonal impedance (km) between zone *i* and zone *j*,

P_i : Inter-zonal trip production of zone *i*,

A_j : Inter-zonal trip attraction of zone *j*, and

$\kappa, \alpha, \beta, \gamma$: Parameters

Table 4.1.4 Estimated Inter-zonal Distribution Model Parameters

Parameters	Coefficient	t-value
κ	0.0647	-3.86
α	0.498	15.21
β	0.503	15.19
γ	-0.508	-9.11
adjusted R^2	0.517	

Source: JICA Survey Team

4.1.3 Modal Split Model

For the estimation of the modal split model, intra-zonal trips and inter-zonal trips are considered separately.

The modal split model for intra-zonal trips is estimated by METROS PT survey results as shown in the following formula.

$$P_i = \alpha \cdot \ln(Z_i) + \beta$$

Where,

P_i : Modal share of zone i,

Z_i : Area (km^2) of zone i, and

α, β : Parameters

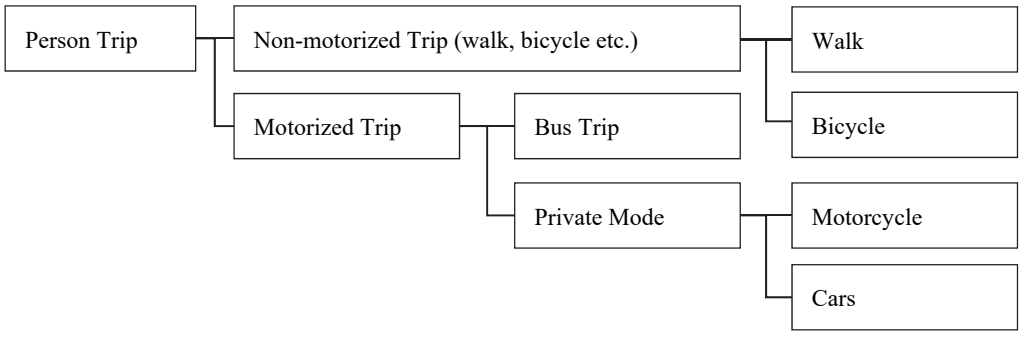
Table 4.1.5 Modal Split Model Parameters for Intra-zonal Trips

Parameter	Non-motorized	Motorcycle	Bus
α	0.514	0.469	-0.00024
t-value	22.253	21.893	-0.119
B	-0.052	0.047	0.0034
t-value	-7.784	7.611	6.878
Adj. R^2	0.722	0.712	0.768

Note: Share of cars is estimated by other three modes

Source: JICA Survey Team

Modal split model for inter-zonal trips is estimated using the following model structure.



Source: JICA Survey Team

Figure 4.1.2 Modal Split Model Structure for Inter-zonal Trips

Modal split model for inter-zonal Non-Motorized Trip (NMT), such as walking and bicycling, is estimated by the METROS PT survey results as shown in the following aggregated logit model.

$$P_{ij}^{NMT} = \frac{\alpha}{1 + \beta \cdot e^{\gamma \cdot d_{ij}}}$$

$$P_{ij}^{MT} = 1 - P_{ij}^{NMT}$$

Where,

P^{NMT}_{ij} :Probability of NMT between zone *i* and zone *j*,

P^{MT}_{ij} : Probability of motorized mode between zone *i* and zone *j*,

d_{ij} : Distance (km) between zone *i* and zone *j*, and

α, β, γ : Parameters

Table 4.1.6 Modal Split Model Parameters for NMT

Parameters	Coefficient
α	1.141
β	0.107
γ	-0.918
Adj. R^2	0.798

Source: JICA Survey Team

Modal split model for bicycle in NMT is estimated by the following aggregated logit model.

$$P_{ij}^{Bc} = \frac{\alpha}{1 + \beta \cdot e^{\gamma \cdot d_{ij}}}$$

$$P_{ij}^{Wk} = 1 - P_{ij}^{Bc}$$

Where,

P^{Bc}_{ij} :Probability of bicycle between zone *i* and zone *j*,

P^{Wk}_{ij} :Probability of walk trip between zone *i* and zone *j*,

d_{ij} : Distance between zone *i* and zone *j*, and

α, β, γ : Parameters

Table 4.1.7 Modal Split Model Parameters for Bicycle

Parameters	Coefficient
α	1.000
β	62.908
γ	0.670
Adj. R^2	0.654

Source: JICA Survey Team

The modal split model for buses in the motorized trips is estimated using the following aggregated logit model based on the results of the PT survey of METROS.

$$P_{BS} = \frac{\exp(U_{BS})}{\exp(U_{BS}) + \exp(U_{PM})}$$

$$P_{PM} = 1 - P_{BS}$$

Where,

P_{BS} : Probability of bus,

P_{PM} : Probability of private vehicle (motorcycle and car),

U_{BS} : Utilities of bus, and

U_{PM} : Utilities of private vehicle.

Utilities of bus and private vehicle are estimated as follows,

$$U_{BS} = 0.489 \times T_{BS} - 0.0007 \times C_{BS} \qquad \text{(R2=0.650)}$$

$$U_{PM} = 0.489 \times T_{PM} - 0.0007 \times C_{PM} + 1.294$$

Where,

T_{BS} : Travel time by bus,

C_{BS} : Bus fare (VND),

T_{PM} : Travel time by private vehicle, and

C_{PM} : VOC and parking fee of private vehicle (VND).

The modal split model for motorcycles is also estimated using the aggregated logit model.

$$P_{MC} = \frac{\exp(U_{MC})}{\exp(U_{MC}) + \exp(U_{PC})}$$

$$P_{PC} = 1 - P_{MC}$$

Where,

P_{MC} : Probability of motorcycle,

P_{PC} : Probability of car,

U_{MC} : Utilities of motorcycle, and

U_{PC} : Utilities of car.

Utilities of motorcycle and car are estimated using the following formula.

$$U_{MC} = -0.191 \times T_{MC} - 0.00035 \times C_{MC} + 2.167 \qquad \text{(R2=0.690)}$$

$$U_{PM} = -0.191 \times T_{PM} - 0.00035 \times C_{PM}$$

Where,

T_{MC} : Travel time by motorcycle,

C_{MC} : VOC and parking fee of motorcycle (VND),

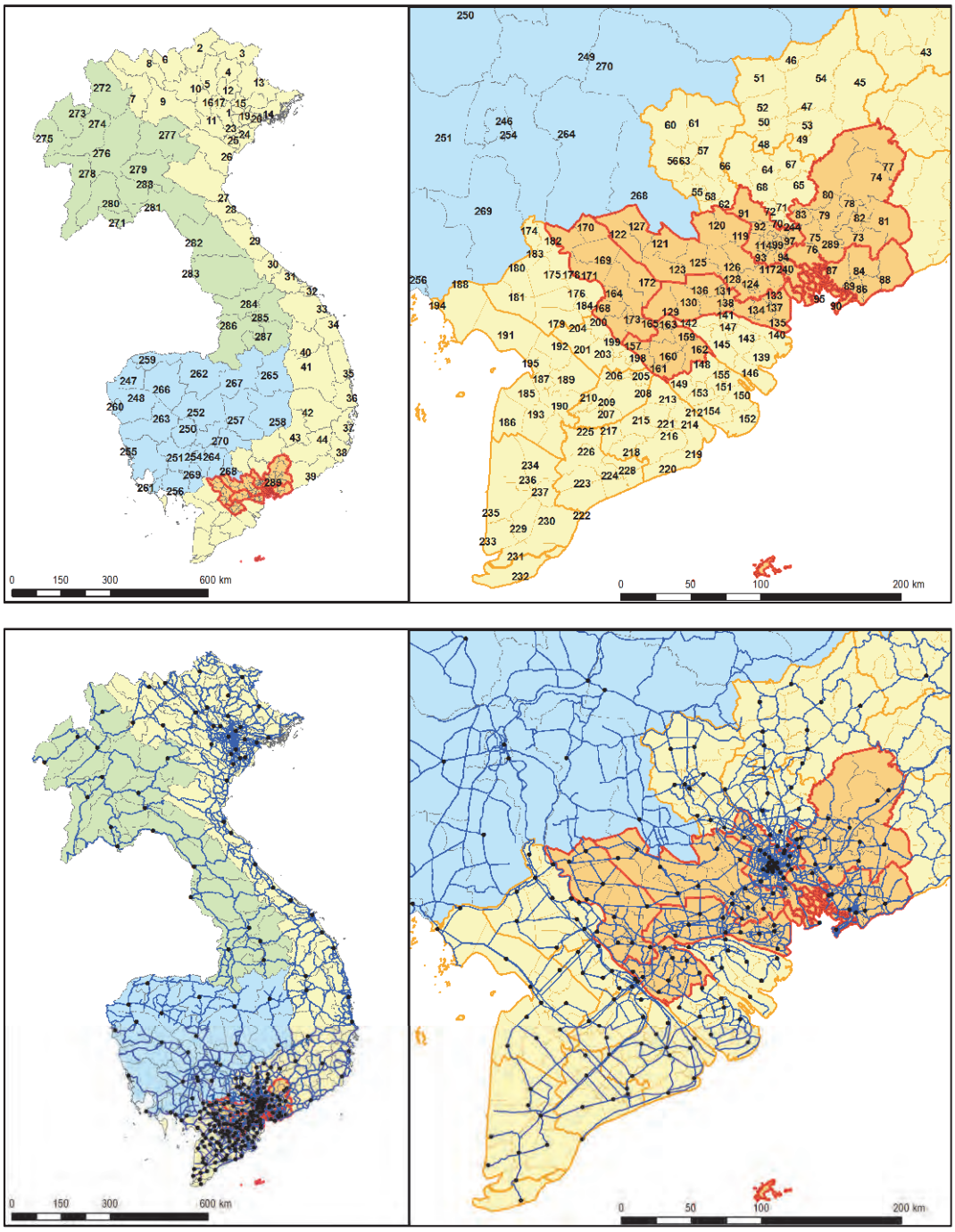
T_{PC} : Travel time by car, and

C_{PC} : VOC and parking fee of car (VND).

4.1.4 Assignment Model

(1) Traffic Analysis Zone

In the survey, the Traffic Analysis Zone (TAZ) System covers Vietnam, Cambodia and Laos. Basically, the TAZ is defined by the survey area and vicinity province, and nine (9) major transport facilities in the survey area such as seaport and airport. In total, the TAZ consists of 289 zones as shown in following table.



Source: JICA Survey Team

Figure 4.1.3 Traffic Analysis Zone (upper), Road Network and Zone Centroid (lower)

Table 4.1.8 Traffic Analysis Zone System

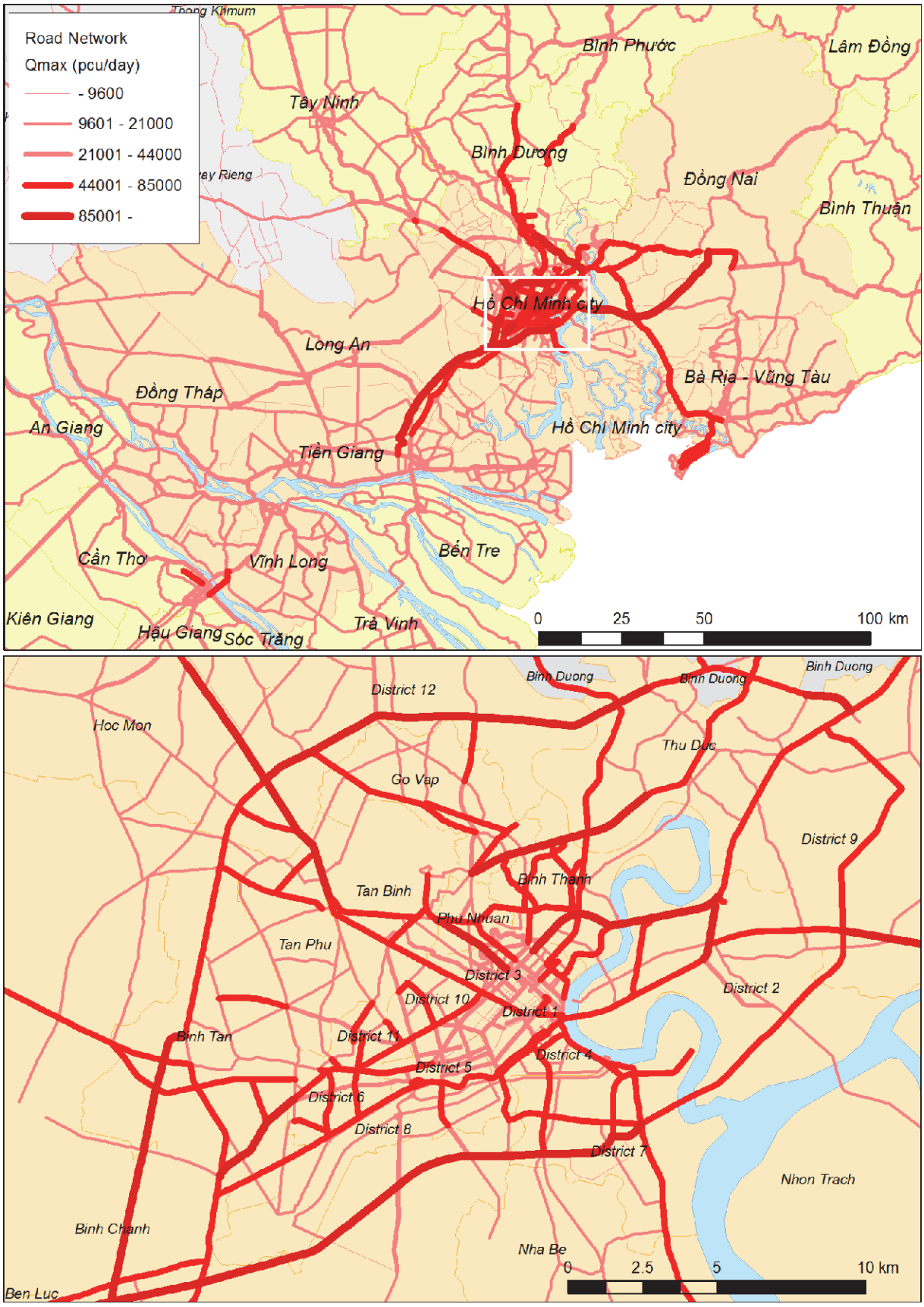
TAZ	Survey Area	Country	Province	District	TAZ	Survey Area	Country	Province	District
1		Vietnam	Ha Noi		76	X	Vietnam	Dong Nai	Nhon Trach
2		Vietnam	Ha Giang		77	X	Vietnam	Dong Nai	Tan Phu
3		Vietnam	Cao Bang		78	X	Vietnam	Dong Nai	Thong Nhat
4		Vietnam	Bac Kan		79	X	Vietnam	Dong Nai	Trang Bom
5		Vietnam	Tuyen Quang		80	X	Vietnam	Dong Nai	Vinh Cuu
6		Vietnam	Lao Cai		81	X	Vietnam	Dong Nai	Xuan Loc
7		Vietnam	Dien Bien		82	X	Vietnam	Dong Nai	Long Khanh
8		Vietnam	Lai Chau		83	X	Vietnam	Dong Nai	Bien Hoa
9		Vietnam	Son La		84	X	Vietnam	Ba Ria Vung Tau	Chau Duc
10		Vietnam	Yen Bai		85	X	Vietnam	Ba Ria Vung Tau	Dat Do
11		Vietnam	Hoa Binh		86	X	Vietnam	Ba Ria Vung Tau	Long Dien
12		Vietnam	Thai Nguyen		87	X	Vietnam	Ba Ria Vung Tau	Tan Thanh
13		Vietnam	Lang Son		88	X	Vietnam	Ba Ria Vung Tau	Xuyen Moc
14		Vietnam	Quang Ninh		89	X	Vietnam	Ba Ria Vung Tau	Ba Ria
15		Vietnam	Bac Giang		90	X	Vietnam	Ba Ria Vung Tau	Vung Tau
16		Vietnam	Phu Tho		91	X	Vietnam	HCMC	Cu Chi
17		Vietnam	Vinh Phuc		92	X	Vietnam	HCMC	Hoc Mon
18		Vietnam	Bac Ninh		93	X	Vietnam	HCMC	Binh Chanh
19		Vietnam	Hai Duong		94	X	Vietnam	HCMC	Nha Be
20		Vietnam	Hai Phong		95	X	Vietnam	HCMC	Can Gio
21		Vietnam	Hung Yen		96	X	Vietnam	HCMC	District 1
22		Vietnam	Thai Binh		97	X	Vietnam	HCMC	District 2
23		Vietnam	Ha Nam		98	X	Vietnam	HCMC	District 3
24		Vietnam	Nam Dinh		99	X	Vietnam	HCMC	District 4
25		Vietnam	Ninh Binh		100	X	Vietnam	HCMC	District 5
26		Vietnam	Thanh Hoa		101	X	Vietnam	HCMC	District 6
27		Vietnam	Nghe An		102	X	Vietnam	HCMC	District 7
28		Vietnam	Ha Tinh		103	X	Vietnam	HCMC	District 8
29		Vietnam	Quang Binh		104	X	Vietnam	HCMC	District 9
30		Vietnam	Quang Tri		105	X	Vietnam	HCMC	District 10
31		Vietnam	Thua Thien Hue		106	X	Vietnam	HCMC	District 11
32		Vietnam	Da Nang		107	X	Vietnam	HCMC	District 12
33		Vietnam	Quang Nam		108	X	Vietnam	HCMC	Go Vap
34		Vietnam	Quang Ngai		109	X	Vietnam	HCMC	Tan Binh
35		Vietnam	Binh Dinh		110	X	Vietnam	HCMC	Tan Phu
36		Vietnam	Phu Yen		111	X	Vietnam	HCMC	Binh Thanh
37		Vietnam	Khanh Hoa		112	X	Vietnam	HCMC	Phu Nhuan
38		Vietnam	Ninh Thuan		113	X	Vietnam	HCMC	Thu Duc
39		Vietnam	Binh Thuan		114	X	Vietnam	HCMC	Binh Tan
40		Vietnam	Kon Tum		115	X	Vietnam	Long An	Ben Luc
41		Vietnam	Gia Lai		116	X	Vietnam	Long An	Can Duoc
42		Vietnam	Dak Lak		117	X	Vietnam	Long An	Can Giuoc
43		Vietnam	Dak Nong		118	X	Vietnam	Long An	Chau Thanh
44		Vietnam	Lam Dong		119	X	Vietnam	Long An	Duc Hoa
45		Vietnam	Binh Phuoc	Bu Dang	120	X	Vietnam	Long An	Duc Hue
46		Vietnam	Binh Phuoc	Bu Dop	121	X	Vietnam	Long An	Moc Hoa
47		Vietnam	Binh Phuoc	Bu Gia Map	122	X	Vietnam	Long An	Tan Hung
48		Vietnam	Binh Phuoc	Chon Thanh	123	X	Vietnam	Long An	Tan Thanh
49		Vietnam	Binh Phuoc	Dong Phu	124	X	Vietnam	Long An	Tan Tru
50		Vietnam	Binh Phuoc	Hon Quan	125	X	Vietnam	Long An	Thanh Hoa
51		Vietnam	Binh Phuoc	Loc Ninh	126	X	Vietnam	Long An	Thu Thua
52		Vietnam	Binh Phuoc	Binh Long	127	X	Vietnam	Long An	Ving Hung
53		Vietnam	Binh Phuoc	Dong Xoai	128	X	Vietnam	Long An	Tan An
54		Vietnam	Binh Phuoc	Phuoc Long	129	X	Vietnam	Tien Giang	Cai Be
55		Vietnam	Tay Ninh	Ben Cau	130	X	Vietnam	Tien Giang	Cai Lay
56		Vietnam	Tay Ninh	Chau Thanh	131	X	Vietnam	Tien Giang	Chau Thanh
57		Vietnam	Tay Ninh	Duong Minh Chau	132	X	Vietnam	Tien Giang	Cho Gao
58		Vietnam	Tay Ninh	Go Dau	133	X	Vietnam	Tien Giang	Go Cong Dong
59		Vietnam	Tay Ninh	Hoa Thanh	134	X	Vietnam	Tien Giang	Go Cong Tay
60		Vietnam	Tay Ninh	Tan Bien	135	X	Vietnam	Tien Giang	Tan Phu Dong
61		Vietnam	Tay Ninh	Tan Chau	136	X	Vietnam	Tien Giang	Tan Phuoc
62		Vietnam	Tay Ninh	Trang Bang	137	X	Vietnam	Tien Giang	Go Cong
63		Vietnam	Tay Ninh	Tay Ninh	138	X	Vietnam	Tien Giang	My Tho
64		Vietnam	Binh Duong	Bau Bang	139		Vietnam	Ben Tre	Ba Tri
65		Vietnam	Binh Duong	Bac Tan Uyen	140		Vietnam	Ben Tre	Binh Dai
66		Vietnam	Binh Duong	Dau Tieng	141		Vietnam	Ben Tre	Chau Thanh
67		Vietnam	Binh Duong	Phu Giao	142		Vietnam	Ben Tre	Cho Lach
68		Vietnam	Binh Duong	Ben Cat	143		Vietnam	Ben Tre	Giong Trom
69		Vietnam	Binh Duong	Di An	144		Vietnam	Ben Tre	Mo Cay Bac
70		Vietnam	Binh Duong	Thuan An	145		Vietnam	Ben Tre	Mo Cay Nam
71		Vietnam	Binh Duong	Tan Uyen	146		Vietnam	Ben Tre	Thanh Phu
72		Vietnam	Binh Duong	Thu Dau Mot	147		Vietnam	Ben Tre	Ben Tre
73	X	Vietnam	Dong Nai	Cam My	148		Vietnam	Tra Vinh	Cang Long
74	X	Vietnam	Dong Nai	Dinh Quan	149		Vietnam	Tra Vinh	Cau Ke
75	X	Vietnam	Dong Nai	Long Thanh	150		Vietnam	Tra Vinh	Cau Ngang

TAZ	Survey Area	Country	Province	District	TAZ	Survey Area	Country	Province	District
151		Vietnam	Tra Vinh	Chau Thanh	226		Vietnam	Bac Lieu	Phuoc Long
152		Vietnam	Tra Vinh	Duyen Hai	227		Vietnam	Bac Lieu	Vinh Loi
153		Vietnam	Tra Vinh	Tieu Can	228		Vietnam	Bac Lieu	Bac Lieu
154		Vietnam	Tra Vinh	Tra Cu	229		Vietnam	Ca Mau	Cai Nuoc
155		Vietnam	Tra Vinh	Tra Vinh	230		Vietnam	Ca Mau	Dam Doi
156	X	Vietnam	Vinh Long	Binh Minh	231		Vietnam	Ca Mau	Nam Can
157	X	Vietnam	Vinh Long	Binh Tan	232		Vietnam	Ca Mau	Ngoc Hien
158	X	Vietnam	Vinh Long	Long Ho	233		Vietnam	Ca Mau	Phu Tan
159	X	Vietnam	Vinh Long	Mang Thit	234		Vietnam	Ca Mau	Thoi Binh
160	X	Vietnam	Vinh Long	Tam Binh	235		Vietnam	Ca Mau	Tran Van Thoi
161	X	Vietnam	Vinh Long	Tra On	236		Vietnam	Ca Mau	U Minh
162	X	Vietnam	Vinh Long	Vung Liem	237		Vietnam	Ca Mau	Ca Mau
163	X	Vietnam	Vinh Long	Ving Long	238	X	Vietnam	Cat Lai Container Terminal	
164	X	Vietnam	Dong Thap	Cao Lanh	239	X	Vietnam	Cai Mep -Thi Vai Port	
165	X	Vietnam	Dong Thap	Chau Thanh	240	X	Vietnam	Hiep Phuoc Port	
166	X	Vietnam	Dong Thap	Hong Ngu	241	X	Vietnam	Dong Nai Port	
167	X	Vietnam	Dong Thap	Lai Vung	242	X	Vietnam	Tan Son Nhat International Airport	
168	X	Vietnam	Dong Thap	Lap Vo	243	X	Vietnam	Saigon Station	
169	X	Vietnam	Dong Thap	Tam Nong	244	X	Vietnam	Bien Hoa Station	
170	X	Vietnam	Dong Thap	Tan Hong	245	X	Vietnam	Di An Station	
171	X	Vietnam	Dong Thap	Thanh Binh	246		Cambodia	Phnom Penh	
172	X	Vietnam	Dong Thap	Thap Muoi	247		Cambodia	Banteay Meanchey	
173	X	Vietnam	Dong Thap	Sa Dec	248		Cambodia	Battambang	
174		Vietnam	An Giang	An Phu	249		Cambodia	Kampong Cham	
175		Vietnam	An Giang	Chau Phu	250		Cambodia	Kampong Chhnang	
176		Vietnam	An Giang	Chau Thanh	251		Cambodia	Kampong Speu	
177		Vietnam	An Giang	Cho Moi	252		Cambodia	Kampong Thom	
178		Vietnam	An Giang	Phu Tan	253		Cambodia	Kampot	
179		Vietnam	An Giang	Thoai Son	254		Cambodia	Kandal	
180		Vietnam	An Giang	Tinh Bien	255		Cambodia	Koh Kong	
181		Vietnam	An Giang	Tri Ton	256		Cambodia	Kep	
182		Vietnam	An Giang	Tan Chau	257		Cambodia	Kratie	
183		Vietnam	An Giang	Chau Doc	258		Cambodia	Mondulkiri	
184		Vietnam	An Giang	Long Xuyen	259		Cambodia	Oddar Meanchey	
185		Vietnam	Kien Giang	An Bien	260		Cambodia	Pailin	
186		Vietnam	Kien Giang	An Minh	261		Cambodia	Preah Sihanouk	
187		Vietnam	Kien Giang	Chau Thanh	262		Cambodia	Preah Vihear	
188		Vietnam	Kien Giang	Giang Thanh	263		Cambodia	Pursat	
189		Vietnam	Kien Giang	Giong Rieng	264		Cambodia	Prey Veng	
190		Vietnam	Kien Giang	Go Quao	265		Cambodia	Ratanakiri	
191		Vietnam	Kien Giang	Hon Dat	266		Cambodia	Siem Reap	
192		Vietnam	Kien Giang	Tan Hiep	267		Cambodia	Stung Treng	
193		Vietnam	Kien Giang	U Minh Thuong	268		Cambodia	Svay Rieng	
194		Vietnam	Kien Giang	Ha Tien	269		Cambodia	Takeo	
195		Vietnam	Kien Giang	Rach Gia	270		Cambodia	Tboung Khmum	
196		Vietnam	Can Tho	Binh Thuy	271		Lao PDR	Vientian Capital	
197		Vietnam	Can Tho	Cai Rang	272		Lao PDR	Phongsaly	
198		Vietnam	Can Tho	Ninh Kieu	273		Lao PDR	Luangnamtha	
199		Vietnam	Can Tho	O Mon	274		Lao PDR	Oudomxay	
200		Vietnam	Can Tho	Thot Not	275		Lao PDR	Bokeo	
201		Vietnam	Can Tho	Co Do	276		Lao PDR	Luangprabang	
202		Vietnam	Can Tho	Phong Dien	277		Lao PDR	Huaphanh	
203		Vietnam	Can Tho	Thoi Lai	278		Lao PDR	Xayabury	
204		Vietnam	Can Tho	Vinh Thanh	279		Lao PDR	Xiengkhuang	
205		Vietnam	Hau Giang	Chau Thanh	280		Lao PDR	Vientiane	
206		Vietnam	Hau Giang	Chau Thanh A	281		Lao PDR	Borikhamxay	
207		Vietnam	Hau Giang	Long My	282		Lao PDR	Khammuane	
208		Vietnam	Hau Giang	Phung Hiep	283		Lao PDR	Savannakhet	
209		Vietnam	Hau Giang	Vi Thuy	284		Lao PDR	Saravane	
210		Vietnam	Hau Giang	Vi Thanh	285		Lao PDR	Sekong	
211		Vietnam	Soc Trang	Chau Thanh	286		Lao PDR	Champasack	
212		Vietnam	Soc Trang	Cu Lao Dung	287		Lao PDR	Attapeu	
213		Vietnam	Soc Trang	Ke Sach	288		Lao PDR	Xaisomboun	
214		Vietnam	Soc Trang	Long Phu	289	X	Vietnam	LTIA	
215		Vietnam	Soc Trang	My Tu					
216		Vietnam	Soc Trang	My Xuyen					
217		Vietnam	Soc Trang	Nga Nam					
218		Vietnam	Soc Trang	Thanh Tri					
219		Vietnam	Soc Trang	Tran De					
220		Vietnam	Soc Trang	Ving Chau					
221		Vietnam	Soc Trang	Soc Trang					
222		Vietnam	Bac Lieu	Dong Hai					
223		Vietnam	Bac Lieu	Gia Rai					
224		Vietnam	Bac Lieu	Hoa Binh					
225		Vietnam	Bac Lieu	Hong Dan					

Source: JICA Survey Team

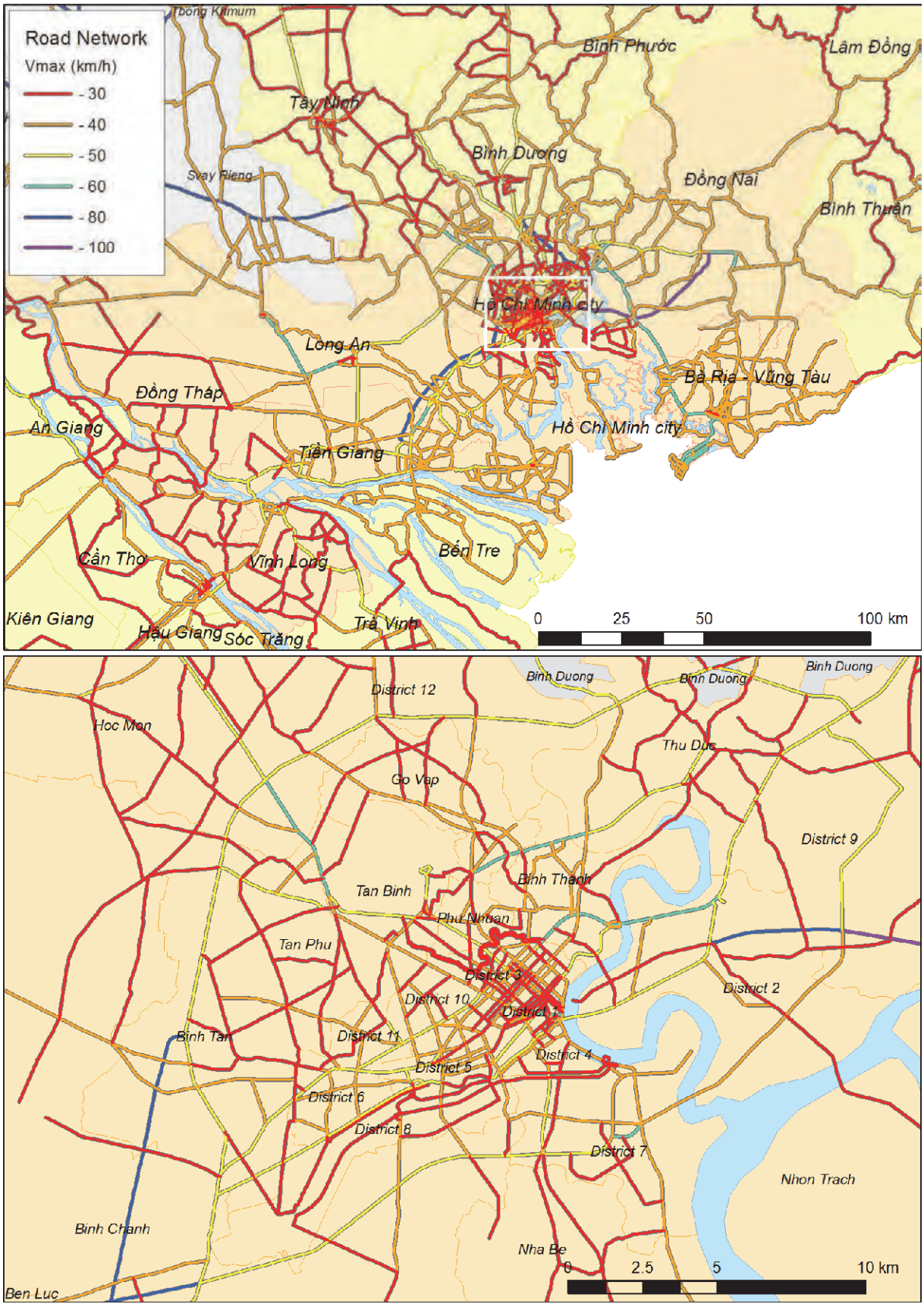
(2) Road Network for Traffic Assignment

The road network for the demand forecast in the survey is comprised of the current road network including expressways, national roads and major provincial roads in Vietnam and national roads in Cambodia and Laos. The Quantity - Velocity (Q-V) conditions of the road link are basically defined by the Q-V conditions of METROS with updating of the road network.



Source: JICA Survey Team

Figure 4.1.4 Current Road Capacity in 2016



Source: JICA Survey Team

Figure 4.1.5 Free Flow Speed in 2016

(3) Passenger Car Unit

Considering the existing Passenger Car Unit (PCU) prepared by the existing studies relevant to the survey area, the PCUs used in the HCMC Outer Ring Road Study (ADB, 2010) are adopted as the basis because of the vehicle classification of the survey. The following table shows the PCUs in the survey and the average vehicle occupancy based on the roadside interview survey performed in 2016.

Table 4.1.9 PCU and Average Vehicle Occupancy in 2016

Mode	PCU	Ave. Occupancy
Bicycle	0.2	1.1
Motorcycle	0.3	1.5
Car	1.0	2.9
Mini bus	1.5	15.2
Standard bus	2.5	30.0
2 Axle truck	2.0	1.8
3+ Axle truck	2.5	1.8
Trailer	2.75	1.6

Source: JICA Survey Team

(4) Time Value

Time value for vehicle passengers in the survey is calculated by personal monthly income by trip mode based on the PT database in 2013 prepared by METROS, and the estimated time value in 2016 by GDP deflator. In terms of trucks, the average time value of loading cargo considering empty truck ratio is included in time value per vehicle.

Table 4.1.10 Time Value in 2016

Mode	Value of Time (USD/hour/passenger)		Ave. vehicle occupancy (2016)	Gross Time value of cargo (USD/hour/vehicle)	Value of Time (USD/hour/vehicle)
	2013	2016			
Bicycle	0.72	0.71	1.1	-	0.8
Motorcycle	1.61	1.58	1.5	-	2.4
Car	3.79	3.72	2.9	-	10.8
Mini bus	1.18	1.16	15.2	-	17.6
Large bus			30.0	-	34.8
2 Axle truck	2.41	2.37	1.8	1.1	5.4
3+ Axle truck			1.8	5.5	9.7
Trailer			1.6	6.9	10.7

Note: Time value of vehicle passenger is calculated using same method as HCMC Outer Ring Road (ADB, 2010), namely, 22 working days per month and 8 working hours per day.

Source: JICA Survey Team

The time value of loading cargo of trucks is computed using the following formula to estimate the opportunity cost of cargo. The interest rate is 0.26% for USD transactions based on the overnight rate of the State Bank of Vietnam.

$$OC = \frac{Vc}{Wc} \times Lw \times Ir$$

Where,

OC: Opportunity cost of cargo per truck,

Vc: Value of cargo,

Wc: Weight of cargo,

Lw: Average gross loading weight per truck, and

Ir: Interest rate (short-term prime lending rates of banks).

Table 4.1.11 Time Value of Cargo per Truck

Type of Commodity		USD/ton (2016)	Loading weight based on commodity share by truck			Average value of cargo per ton by commodity		
			2 axle truck	3+ axle truck	Trailer	2 axle truck	3+ axle truck	Trailer
1	Live Animal & Animal Products	3,291	5%	2%	1%	158	69	30
2	Fish and Aquatic Products	5,970	5%	1%	4%	298	39	238
3	Vegetables and Fruits	2,403	7%	6%	4%	178	139	90
4	Grain and Grain Products	396	1%	1%	1%	5	4	2
5	Other Agricultural Products (ex. plantation product)	835	9%	7%	7%	72	57	54
6	Foodstuff, Beverages and Animal Food	1,185	20%	8%	5%	239	95	60
7	Petroleum, Oil and Gas	596	4%	19%	6%	27	114	34
8	Coal, Ore, Stone and Sand	89	3%	5%	2%	2	4	2
9	Cement, Construction Material (incl. steel - frame)	741	9%	10%	19%	67	71	142
10	Fertilizer (incl. urea)	339	2%	2%	0%	6	7	1
11	Garment, Textiles and Fabric	11,154	2%	27%	2%	243	3,016	257
12	Wood and Wood Products	1,040	7%	3%	11%	77	35	115
13	Paper and Printed Matter	1,128	4%	1%	1%	46	10	9
14	Metal and Metal Products (excl. construction material)	1,035	4%	3%	24%	43	32	253
15	Industrial Material, Chemicals	2,499	8%	2%	5%	205	50	114
16	Household Articles, Miscellaneous	3,783	6%	1%	3%	239	48	121
17	Machinery and Parts, Transportation	32,595	3%	2%	5%	903	807	1,720
Average value of loading cargo (USD/ton)			100%	100%	100%	2,807	4,596	3,243
Gross loading cargo per truck (ton/truck including empty truck)						3.7	11.0	19.7
Average value of loading cargo (USD/vehicle including empty truck)						10,316	50,552	63,814
Time value of cargo per truck (incl. empty truck) USD/hour						1.1	5.5	6.9

Note: Value of cargo per ton in Vietnam is calculated by import and export in 2014, prepared by UN Comtrade and adjusted to 2016 price by GDP deflator. Average loading weight by truck and commodity is based on the results of the roadside interview survey in 2016.

Source: JICA Survey Team

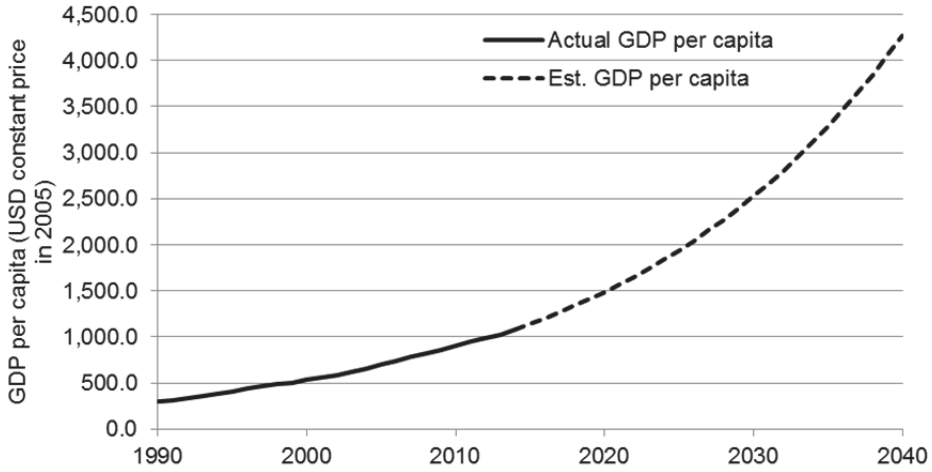
Based on the estimated current time value by type of vehicle, future time values are forecasted using the forecasted GDP per capita and the current value of time by vehicle type. Future GDP per capita in Vietnam is estimated using the following regression model.

$$\log(GDPc) = 107 \times \log(Year) - 350.5 \qquad (R^2=0.997)$$

Where,

GDPc : GDP per capita (USD constant price in 2005), and

Year : Year.



Source: JICA Survey Team

Figure 4.1.6 Forecasted Future GDP per Capita of Vietnam

As the result, the future time value by type of vehicle is shown in the following table. Time value is used for calculation of socio-economic benefit generated by travel time saving by implementation of the project.

Table 4.1.12 Time Value for Economic Evaluation

Year	Time Value (USD/hour/vehicle)						
	Motorcycle	Car	Mini bus	Large bus	2 Axle truck	3+ Axle truck	Trailer
2016	2.4	10.8	17.6	34.8	5.4	9.7	10.7
2020	2.9	13.4	21.8	43.1	6.7	12.1	13.3
2030	5.0	22.7	37.0	73.0	11.3	20.4	22.5
2040	8.4	38.3	62.5	123.4	19.1	34.6	38.0

Source: JICA Survey Team

(5) Vehicle Operating Cost

Vehicle Operating Cost (VOC) prepared by HCMC Outer Ring Road is estimated by aggregate of detail cost items and the same vehicle classification as the survey, therefore, VOCs prepared by HCMC Outer Ring Road that are updated to the 2016 price using the GDP deflator are adopted.

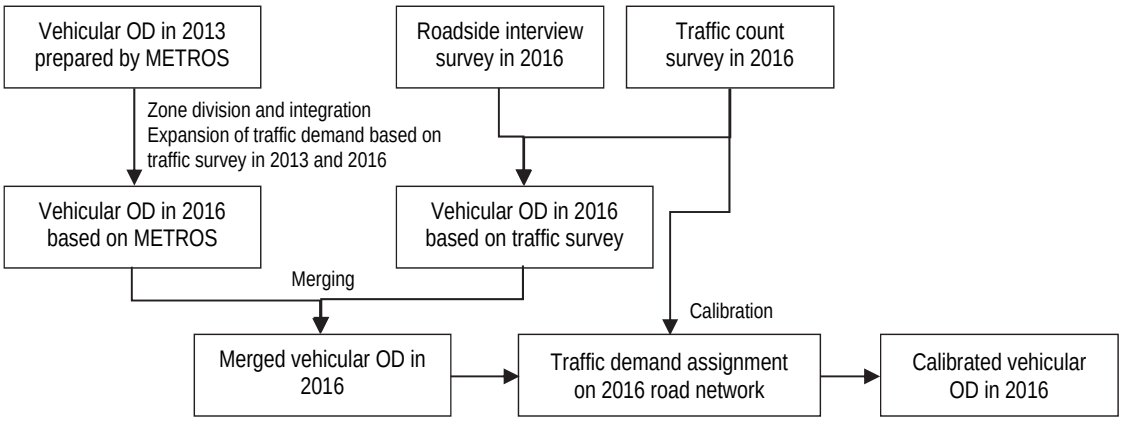
Table 4.1.13 VOC in 2016

	Base Year	Motorcycle	Passenger car	Mini bus	Large bus	Small truck	Large truck	Container truck
Vehicle Operating Cost (USD/1,000 km)	2016	62	221	467	613	445	586	821

Source: JICA Survey Team

4.2 Estimation of Current Traffic Demand

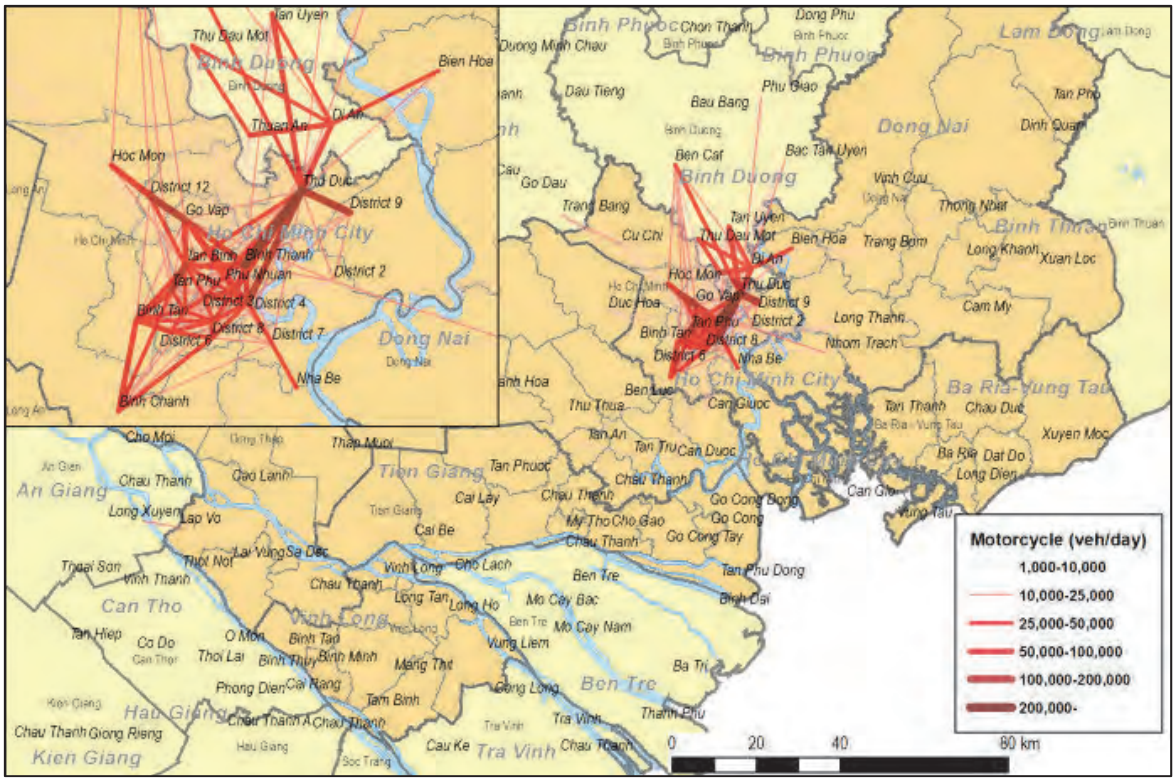
Current traffic demand in the survey area is estimated using the following workflow. The results of the traffic survey in 2016 are summarized in Appendix-2.

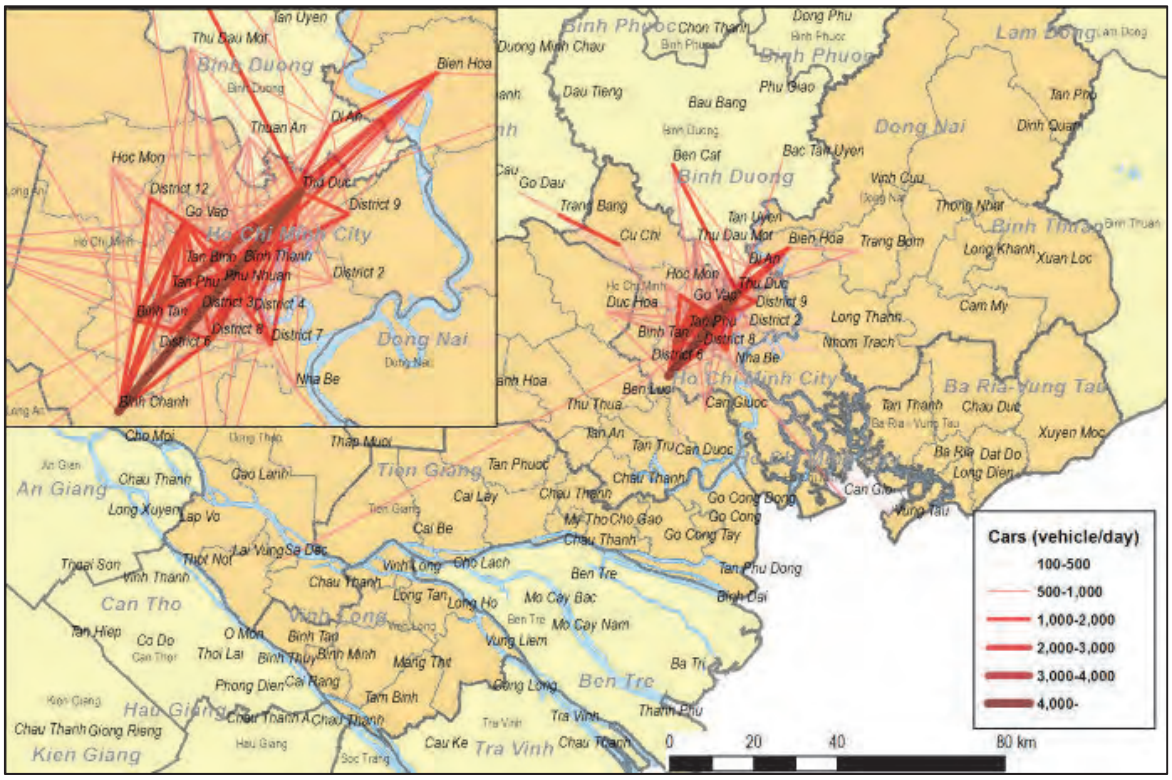


Source: JICA Survey Team

Figure 4.2.1 Work Flow for the Estimation of Current Traffic Demand

The following figures show the estimated current traffic demand by desire lines.

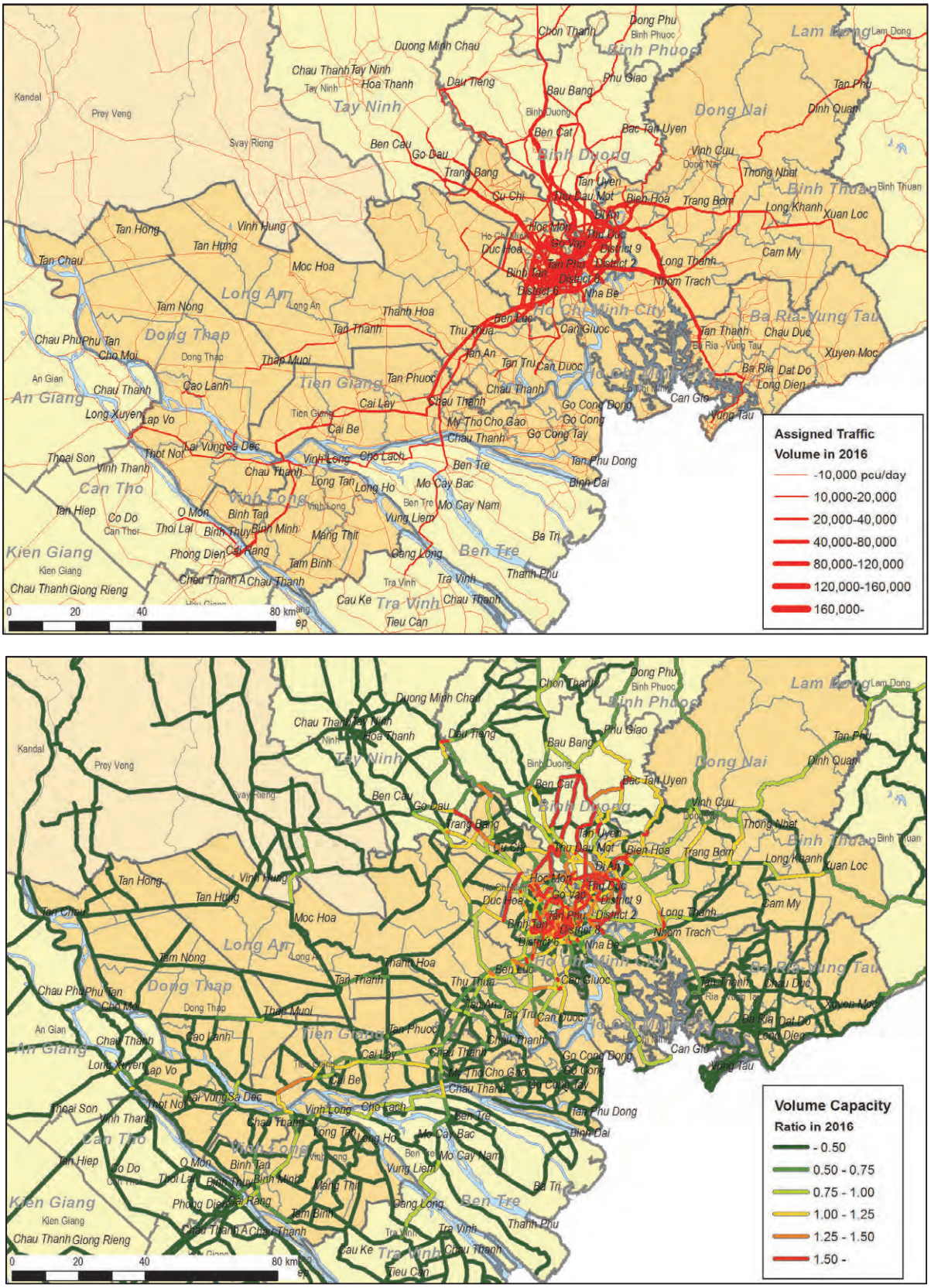




Source: JICA Survey Team

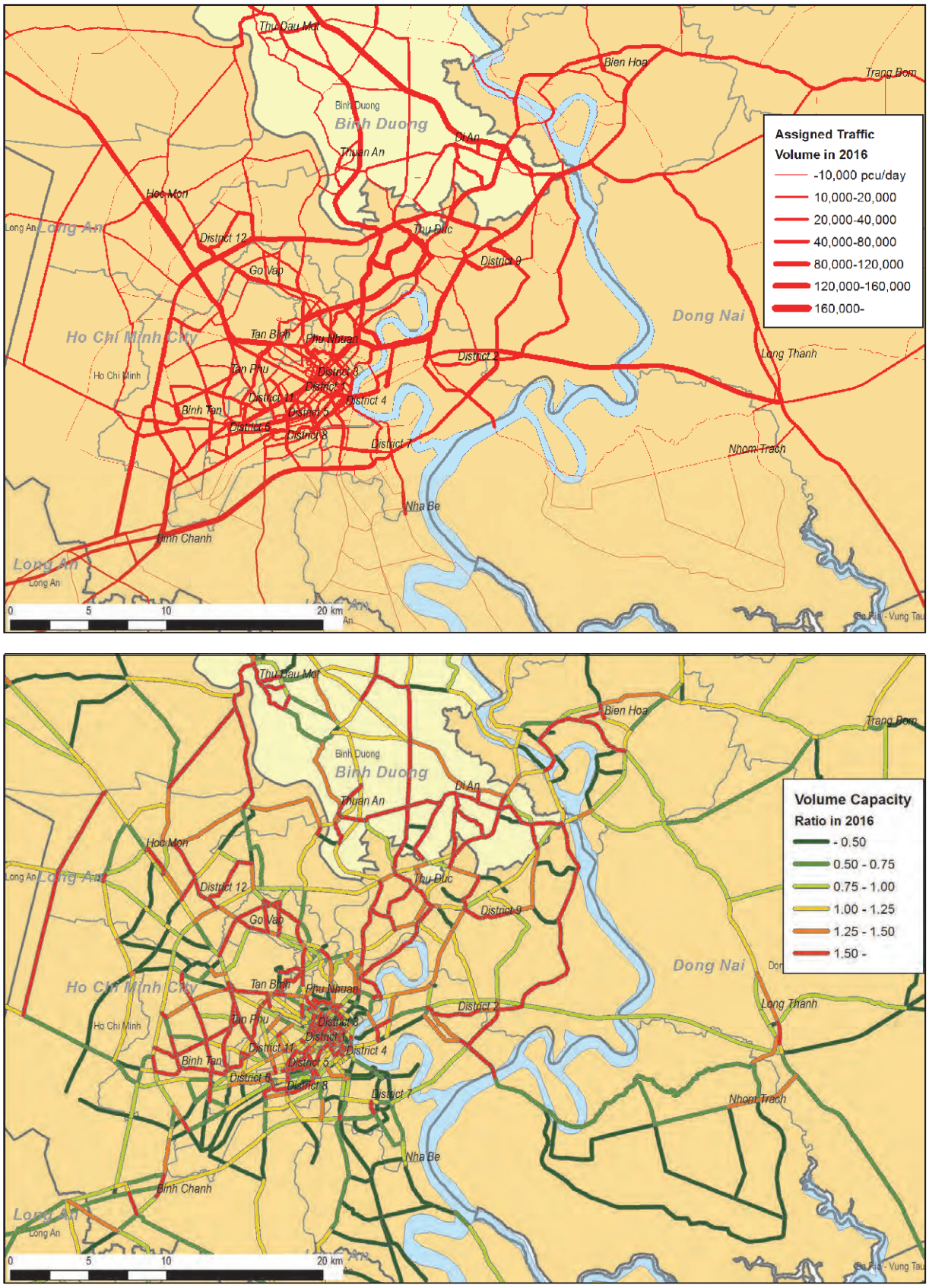
Figure 4.2.2 Desire Lines of Estimated Current Traffic Demand

The following figures show the results of the current traffic demand allocation of the existing road network.



Source: JICA Survey Team

Figure 4.2.3 Results of Current Traffic Demand Assignment



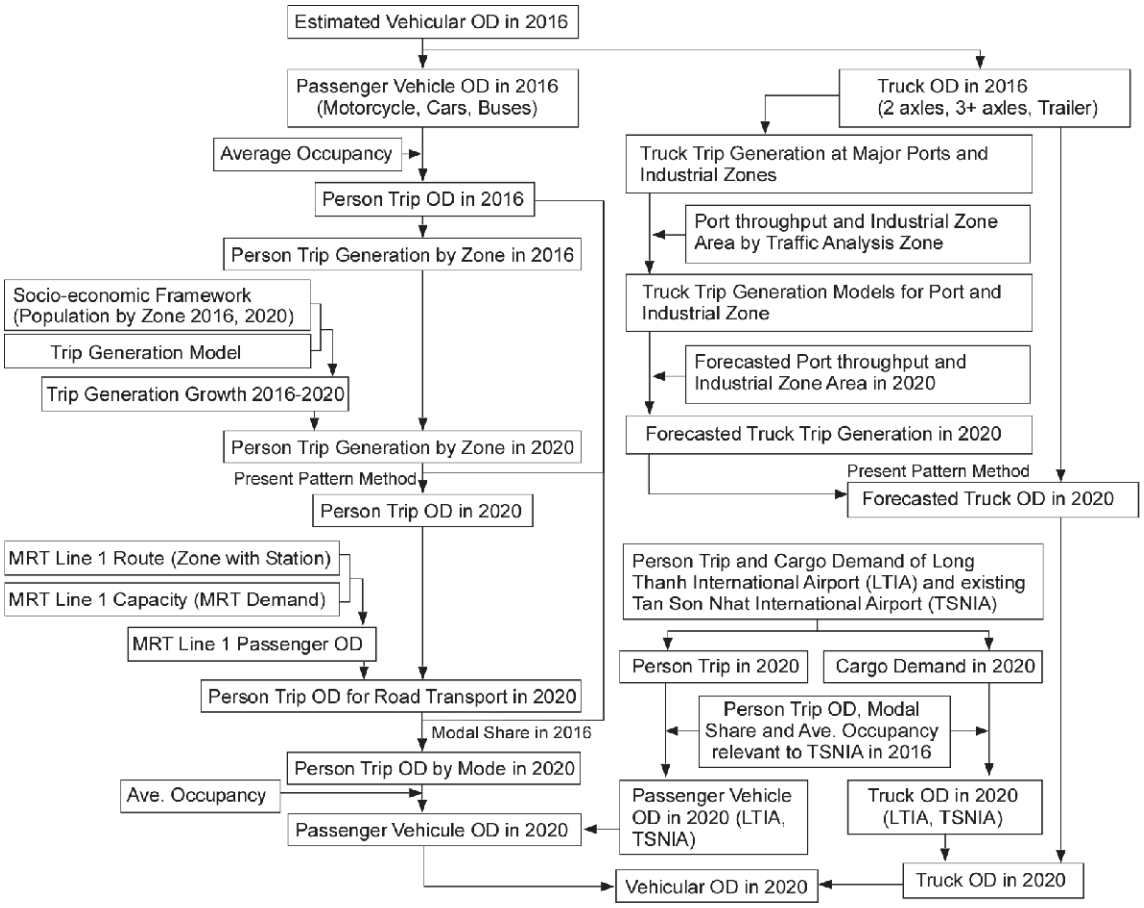
Source: JICA Survey Team

Figure 4.2.4 Results of Current Traffic Demand Assignment

4.3 Methodology of Traffic Demand Forecast

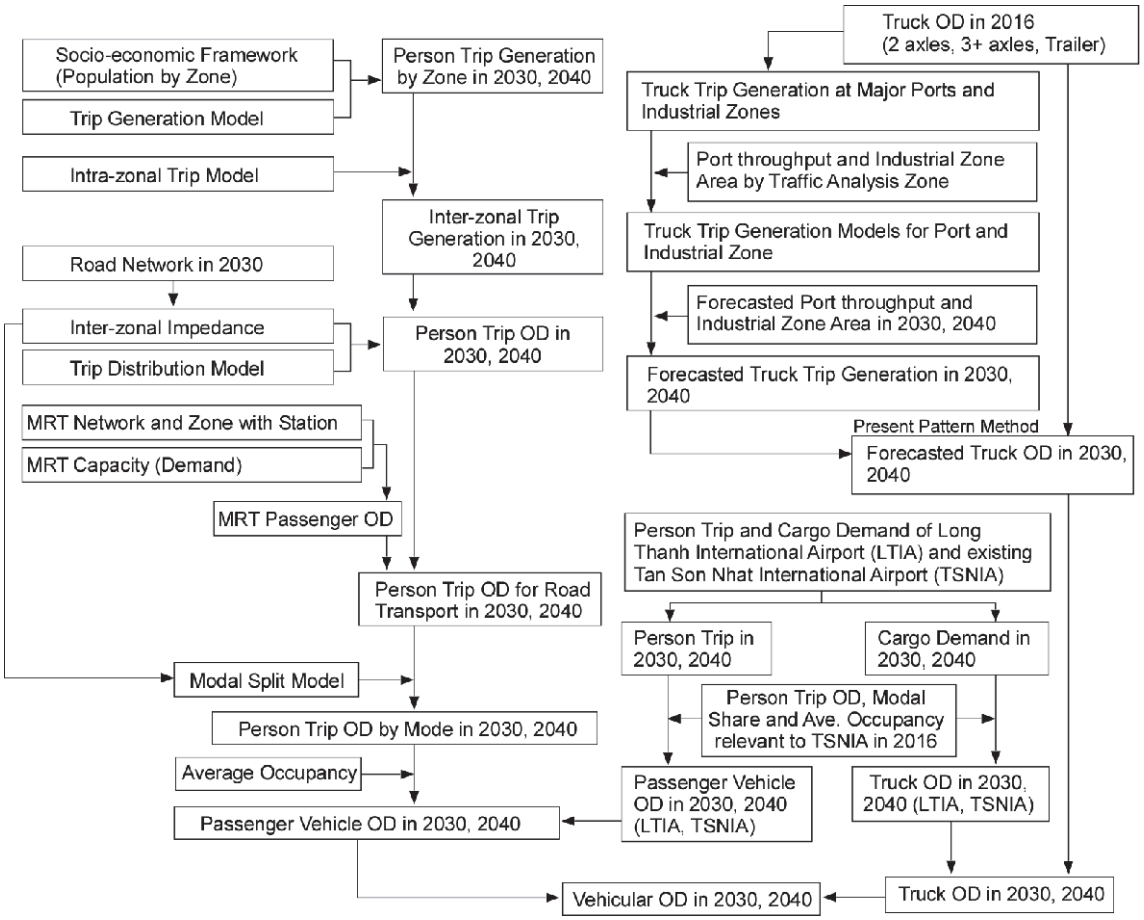
Future traffic demand is forecasted using the following workflows. Basically, passenger vehicle demand for such vehicles as motorcycles, cars and buses in 2020 is computed using the present pattern method based on estimated current vehicular OD in 2016. Future passenger vehicle demand in 2030 (and 2040 for the economic evaluation) is computed using demand forecast models estimated by the METROS PT survey results.

Future demand of trucks is estimated using the present pattern method taking account of truck generation at major seaports and industrial zones.



Source: JICA Survey Team

Figure 4.3.1 Work Flow of Demand Forecast in 2020



Source: JICA Survey Team

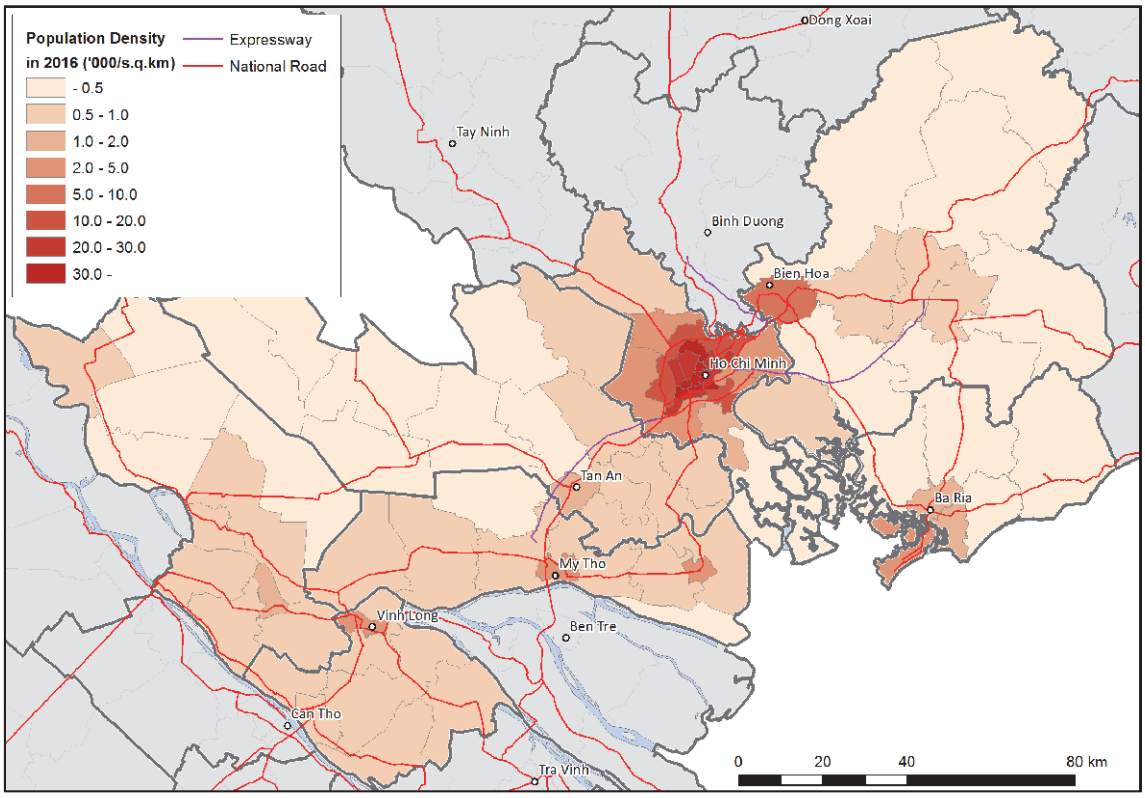
Figure 4.3.2 Work Flow of Demand Forecast in 2030 and 2040

The details of the future demand forecast is described in Appendix-3.

4.4 Future Population and Socio-economic Framework

4.4.1 Current Population Distribution and Density in the Survey Area

The population distribution and density by district for the survey area in 2016 is estimated based on the current population growth trend derived from the 2009 and 2014 data of each city/provincial statistical yearbook, as shown in Figure 4.3.1. The population concentrates within 30 km of the center of HCMC and other provincial centers such as Bien Hoa, Ba Ria, Vung Tau, Vinh Long, My Tho and Tan An.



Source: JICA Survey Team

Figure 4.4.1 Estimated Population Density in 2016

4.4.2 Future Population Framework and Distribution

For the estimation of future traffic demand, the future population (in urban and rural areas) by district is applied, especially for the analysis of person trip generation. The future population framework is based on data obtained from the General Statistics Office and relevant city/provincial statistical offices. In addition to those data, the 2009 census office projected the future urban and rural population from 2009 till 2049, which is based on the demographic analysis of the 2009 census.

Further, one of the latest development plans relevant to the current survey is the study "Data Collection Survey on Railways in Major Cities in Vietnam (METROS)", which was conducted under the technical assistance program of JICA from December 2013 till March 2016. METROS covered almost the same area of the current survey, including HCMC, Dong Nai, BRVT and Long An.

METROS carried out the necessary traffic survey supplemental to HOUTRANS (The Study on Urban Transport Master Plan and Feasibility Study in HCM Metropolitan Area), which carried out a comprehensive person trip survey by home interview in 2004, and also reviewed the existing plans such as HCMC Socio-economic Development Plans, HCMC General Construction Plan and provincial development plans. METROS is, therefore, referred to as the latest and most relevant study of similar nature.

METROS adopted the year 2013 as the base year and the year 2030 as the target planning year. The current survey however needs to set up the base year to be 2016 in order to maintain consistency with

the traffic survey results obtained by the current survey in 2016. Accordingly, the METROS population projected on the 2013 basis needs to be updated to the 2016 basis.

For the future population projection, the urban and regional development policies applied to METROS are adopted and the 2030 population is estimated by taking into account the following:

- The growth trend found between 2009 and 2014 is applied to estimating 2016 population.
- The 2016 population estimated above is compared with those by METROS for 2016, and the METROS 2030 projection is updated, accordingly.
- Basically, the future population distribution of the respective towns/districts of the city/provinces in 2030 is derived from the METROS projection.
- Population growth of HCMC remains slow but it will reach 9.5 million in 2030.
- In HCMC, the population in the city center will gradually decrease but increase in outer areas.
- Urban population in Dong Nai, Long An and Vinh Long will continue to grow at a rate over 3% per year.
- Rapid urbanization in those three provinces will take place not only on HCMC's periphery but also in their provincial urban centers.
- The population of intermediated year 2020 is interpolated between 2016 and 2030.

Consequently, the population of each city/province in the SA is estimated as shown in Tables 4.4.1 and 4.4.2; and the population growth rates in the towns/districts are estimated as shown in Figure 4.4.2.

Table 4.4.1 Population Framework of City/Provinces of the Survey Area

(Unit: '000 persons)

City/ Province	2016			2020			2030		
	Urban	Rural	Total	Urban	Rural	Total	Urban	Rural	Total
HCMC	6,895	1,421	8,316	7,429	1,294	8,723	8,507	984	9,491
Dong Nai	1,016	1,829	2,845	1,241	1,890	3,131	1,911	1,929	3,840
BRVT	571	529	1,100	635	498	1,132	773	402	1,176
Long An	281	1,214	1,495	330	1,248	1,578	472	1,278	1,751
Dong Thap	319	1,389	1,708	350	1,374	1,724	424	1,308	1,732
Tien Giang	275	1,436	1,711	304	1,422	1,726	372	1,359	1,730
Vinh Long	183	861	1,045	211	866	1,077	285	839	1,125
Survey Area	9,540	8,679	18,220	10,499	8,592	19,091	12,744	8,100	20,843

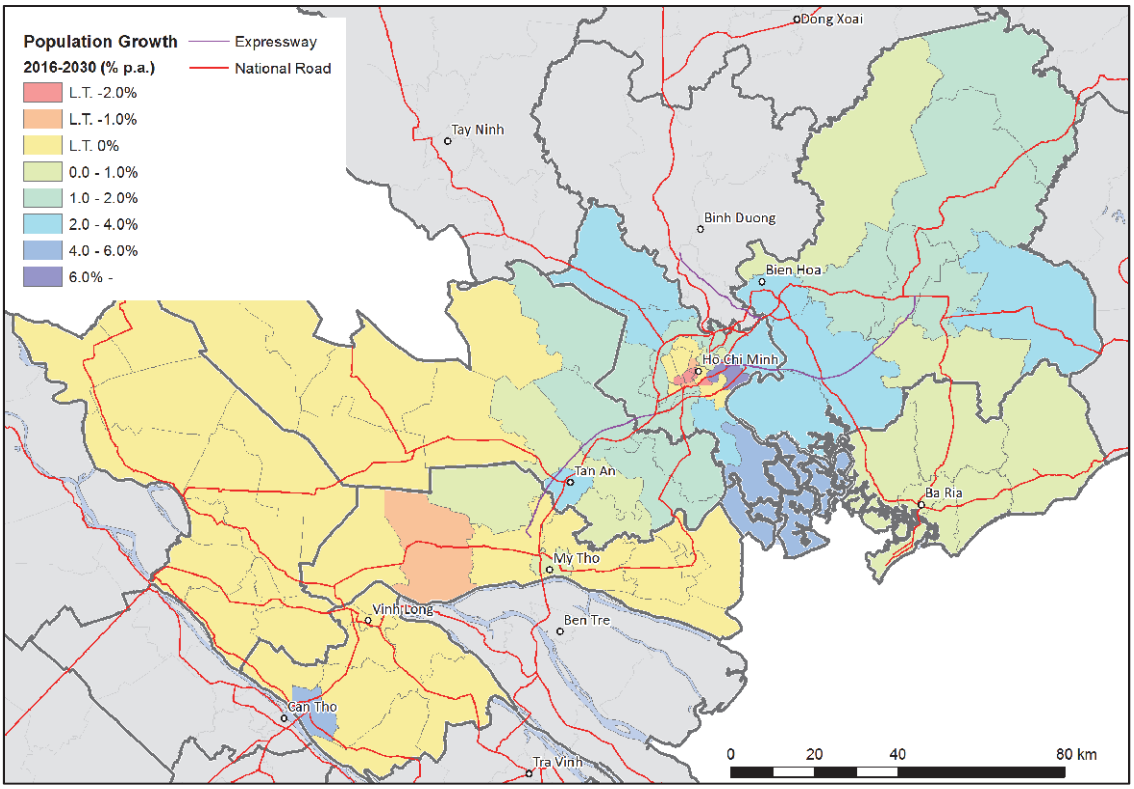
Source: JICA Survey Team

Table 4.4.2 Growth Rates of Future Population Framework in the Survey Area

(Unit: annual rate)

City/ Province	2016-2020			2020-2030		
	Urban	Rural	Total	Urban	Rural	Total
HCMC	1.88%	-2.32%	1.20%	1.36%	-2.70%	0.85%
Dong Nai	5.12%	0.82%	2.42%	4.41%	0.20%	2.06%
BRVT	2.68%	-1.51%	0.73%	2.00%	-2.11%	0.38%
Long An	4.10%	0.70%	1.36%	3.65%	0.24%	1.04%
Dong Thap	2.36%	-0.28%	0.23%	1.92%	-0.49%	0.05%
Tien Giang	2.47%	-0.24%	0.22%	2.05%	-0.46%	0.03%
Vinh Long	3.53%	0.14%	0.76%	3.08%	-0.31%	0.44%
Survey Area	2.42%	-0.25%	1.17%	1.96%	-0.59%	0.88%

Source: JICA Survey Team



Source: JICA Survey Team

Figure 4.4.2 Forecast Future Population Growth by District between 2016 and 2030

4.5 Future Traffic Demand Forecast

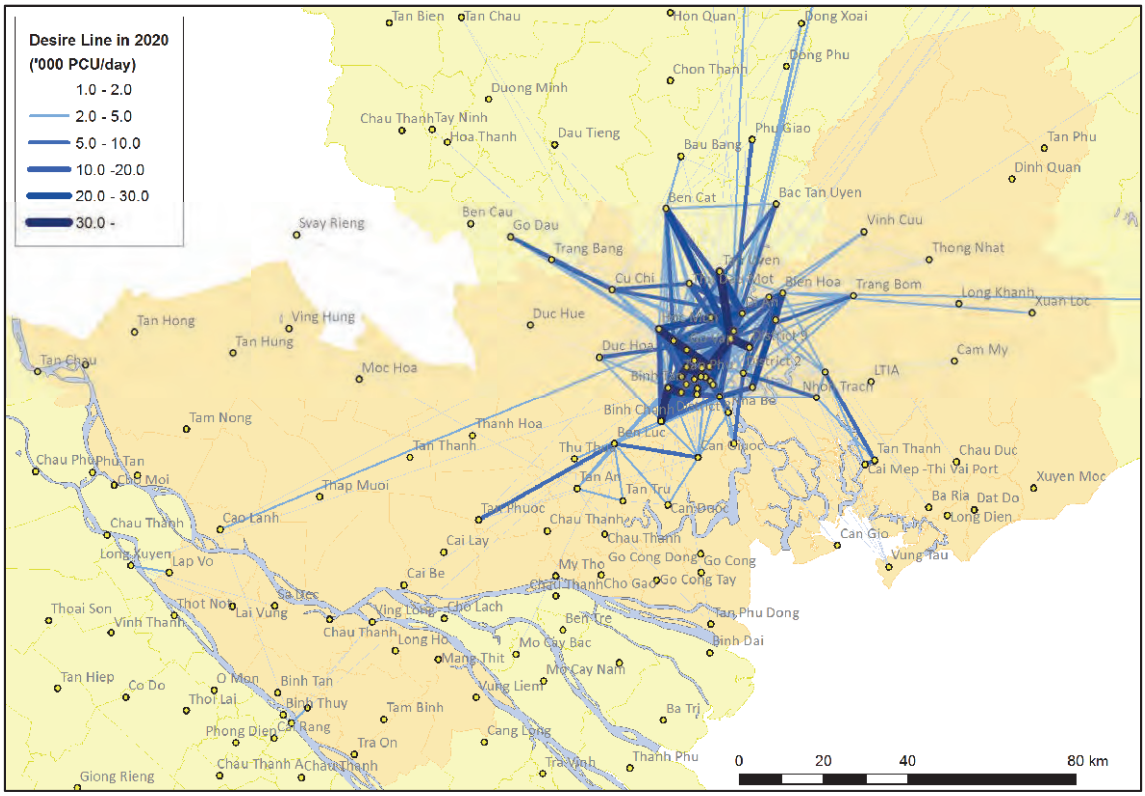
Forecasted vehicle demand is combined passenger vehicle OD and truck OD. The following table summarizes future vehicle demand relevant to the survey area.

Table 4.5.1 Forecasted Vehicle Trips

Mode	Vehicle Trips ('000 trip per day)				Annual Growth Rate (% p.a.)		
	2016	Est. 2020	Est. 2030	Est. 2040	2016-2020	2020-2030	2030-2040
Motorcycle	16,894	17,769	16,059	17,782	1.3%	-1.0%	1.0%
Car	413	437	1,210	1,346	1.5%	10.7%	1.1%
Mini Bus	29	31	85	95	1.2%	10.8%	1.1%
Large Bus	53	55	153	170	0.9%	10.9%	1.0%
2 Axle Truck	316	416	769	1,352	7.1%	6.3%	5.8%
3+ Axle truck	40	53	97	170	7.1%	6.2%	5.7%
Trailer	41	65	163	372	11.9%	9.7%	8.6%

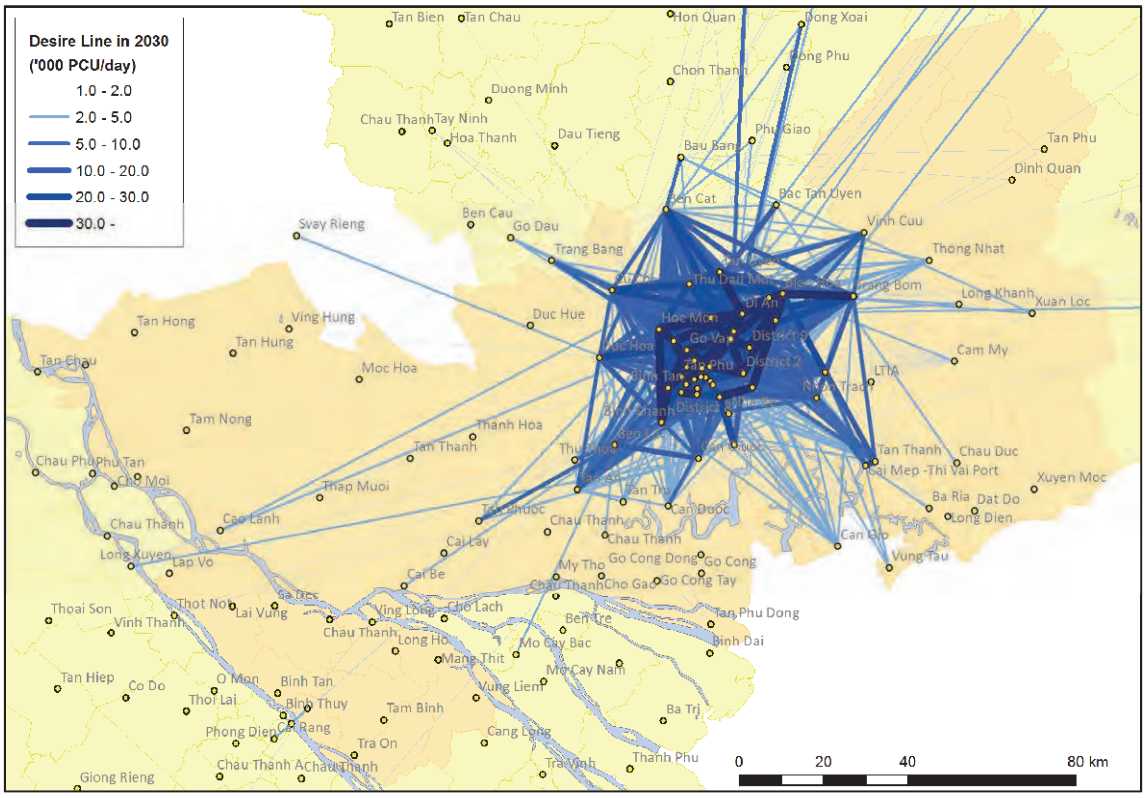
Note: Vehicular trip is based on vehicular OD matrices for the traffic assignment and only trips relevant to the survey area.
Source: JICA Survey Team

Future vehicular OD in 2020 is estimated by the present pattern method with estimated vehicular OD in 2016 and forecasted vehicular trip generation in 2020. Passenger vehicle OD in 2030 is estimated by trip generation model, trip distribution model and modal split model. Truck OD in 2030 is estimated by forecasted vehicular trip generation and the present pattern method. The following figures show the desire lines of forecasted vehicular OD in 2020 and 2030.



Source: JICA Survey Team

Figure 4.5.1 Desire Lines of Forecasted Vehicular Trips in 2020



Source: JICA Survey Team

Figure 4.5.2 Desire Lines of Forecasted Vehicular Trips in 2030

Based on collected information of future road and bridge projects relevant to the survey area such as the HCM Master Plan and the Master Plan of Mekong Delta Region, future road network for the demand forecast will be built, and forecasted future traffic demand is allocated on the road network. The following table and figures show the projects included in the future road network in 2020 and 2030 for the demand forecast.

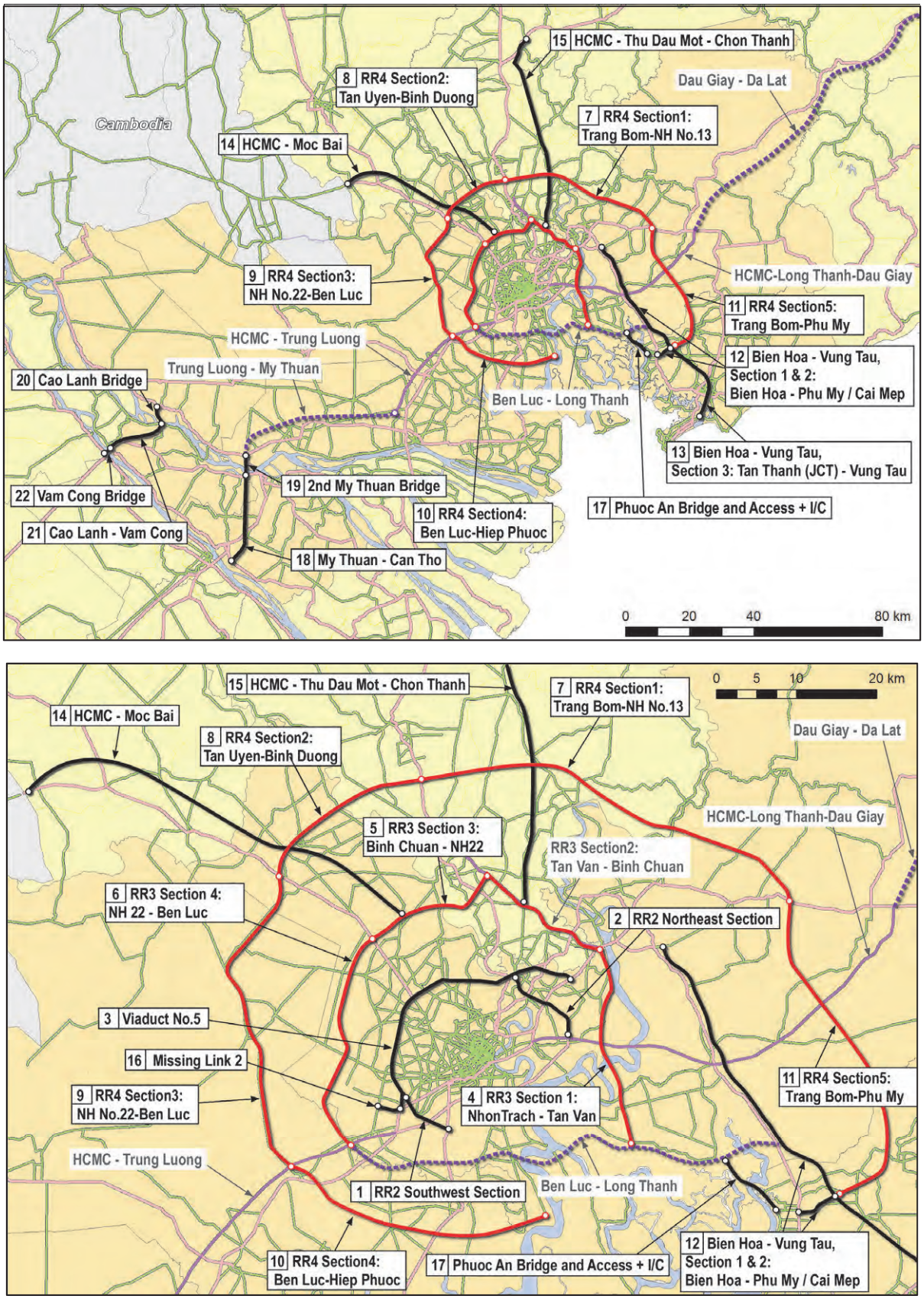
Especially, the following eight (8) projects are regarded as higher priority projects and as candidate projects for Japanese ODA in the survey.

- 3rd Ring Road , Section 3: Binh Chuan – NH22,
- 3rd Ring Road , Section 4: NH 22 – Ben Luc,
- 4th Ring Road, Section 4: Ben Luc-Hiep Phuoc,
- Bien Hoa - Vung Tau Expressway, Bien Hoa – Phu My,
- Bien Hoa - Vung Tau Expressway, Phu My – Vung Tau,
- HCM-Moc Bai Expressway,
- 2nd My Thuan Bridge, and
- Phuoc An Bridge and Access + I/C

Table 4.5.2 Major Road and Bridge Projects in the Survey Area

No.	Project Name	Section	Length (km)	Expected Opening Year		Traffic Volume in 2030 ('000 pcu/day)
				2020	2030	
1	2nd Ring Road	Southwest Section	5	N/A	Open	30
2		Northeast Section	9	N/A	Open	142
3	Viaduct No. 5		30.4	N/A	Open	125
4	3rd Ring Road	Section 1: Nhon Travh - Tan Van	34.3	N/A	Open	146
-		Section 2: Tan Van - Binh Chuan	16.7	Open	Open	183
5		Section 3: Binh Chuan - NH22	17.5	N/A	Open	166
6		Section 4: NH22 - Ben Luc	29.2	N/A	Open	180
7	4th Ring Road	Section 1: Trang Bom-NH No.13	51.9	N/A	Open	64
8		Section 2: Tan Uyen-Binh Duong	22.8	N/A	Open	73
9		Section 3: NH No.22-Ben Luc	41.6	N/A	Open	59
10		Section 4: Ben Luc-Hiep Phuoc	34.7	N/A	Open	38
11		Section 5: Trang Bom-Phu My	TBD	N/A	Open	33
-	HCMC-Long Thanh-Dau Giay		55	Open	Open	138
12	Bien Hoa – Vung Tau	Section 1: Bien Hoa – Phu My (JCT)	38	N/A	Open	135
12		Section 2: Phu My (JCT) – Cai Mep Thi Vai Port	8.8	N/A	Open	76
13		Section 3: Tan Thanh (JCT) – Vung Tau	30.8	N/A	Open	55
-	Ben Luc – Long Thanh	Section 1: Package A1 – A3	18.7	Open	Open	182
-		Section 2: Package A4, J1 – J3	13.7	Open	Open	219
-		Section 3: Package A5 – A7	25.3	Open	Open	149
14	HCMC – Moc Bai		55	N/A	Open	99
15	HCMC – Thu Dau Mot – Chon Thanh		69	N/A	Open	116
-	HCMC – Trung Luong		61.9	Open	Open	146
-	Tan Tao Expressway		10.5	Open	Open	82
-	Missing Link 1 (between HCM-Long Thanh –Dau Giay and East West Road)		4.5	Open	Open	22
16	Missing Link 2 (Access road between Tan Tao Expressway and East-West Road		3	N/A	Open	26
-	East –West Road		22	Open	Open	66
17	Phuoc An Bridge and Access including I/C		12	N/A	Open	21
-	Trung Luong – My Thuan		54.3	N/A	Open	79
-	My Thuan – Can Tho		32.3	N/A	Open	36
-	Can Tho – Ca Mau			N/A	N/A	N/A
19	2nd My Thuan Bridge		1.9 or 1.0	N/A	Open	61
-	2nd Can Tho Bridge			N/A	N/A	N/A
20	Second Southern Highway	Cao Lanh Bridge	7.8	N/A	Open	9
21		Cao Lanh – Vam Cong	15.7	N/A	Open	10
22		Vam Cong Bridge	5.8	N/A	Open	20

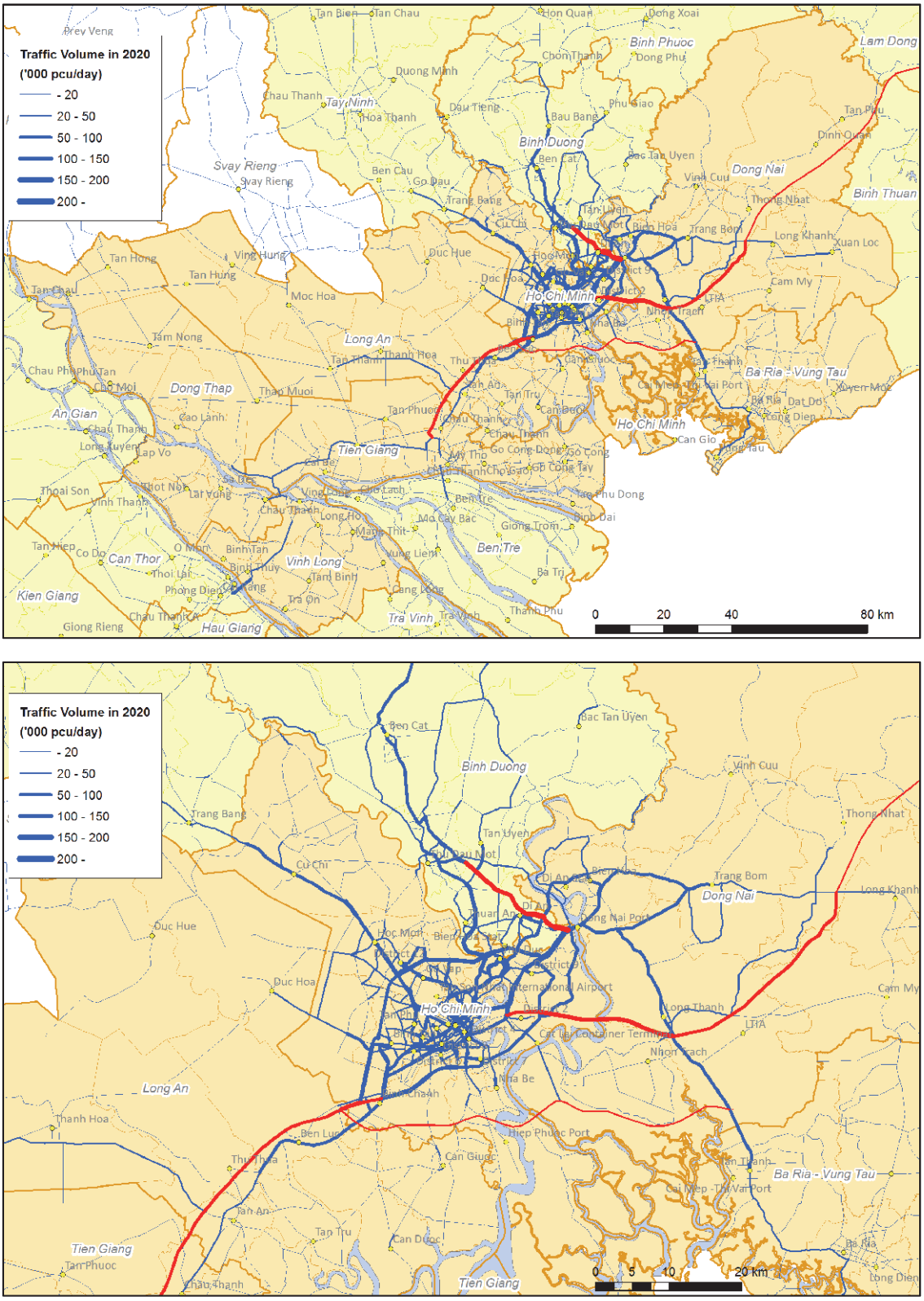
Source: JICA Survey Team



Source: JICA Survey Team

Figure 4.5.3 Major Road and Bridge Projects for Demand Forecast

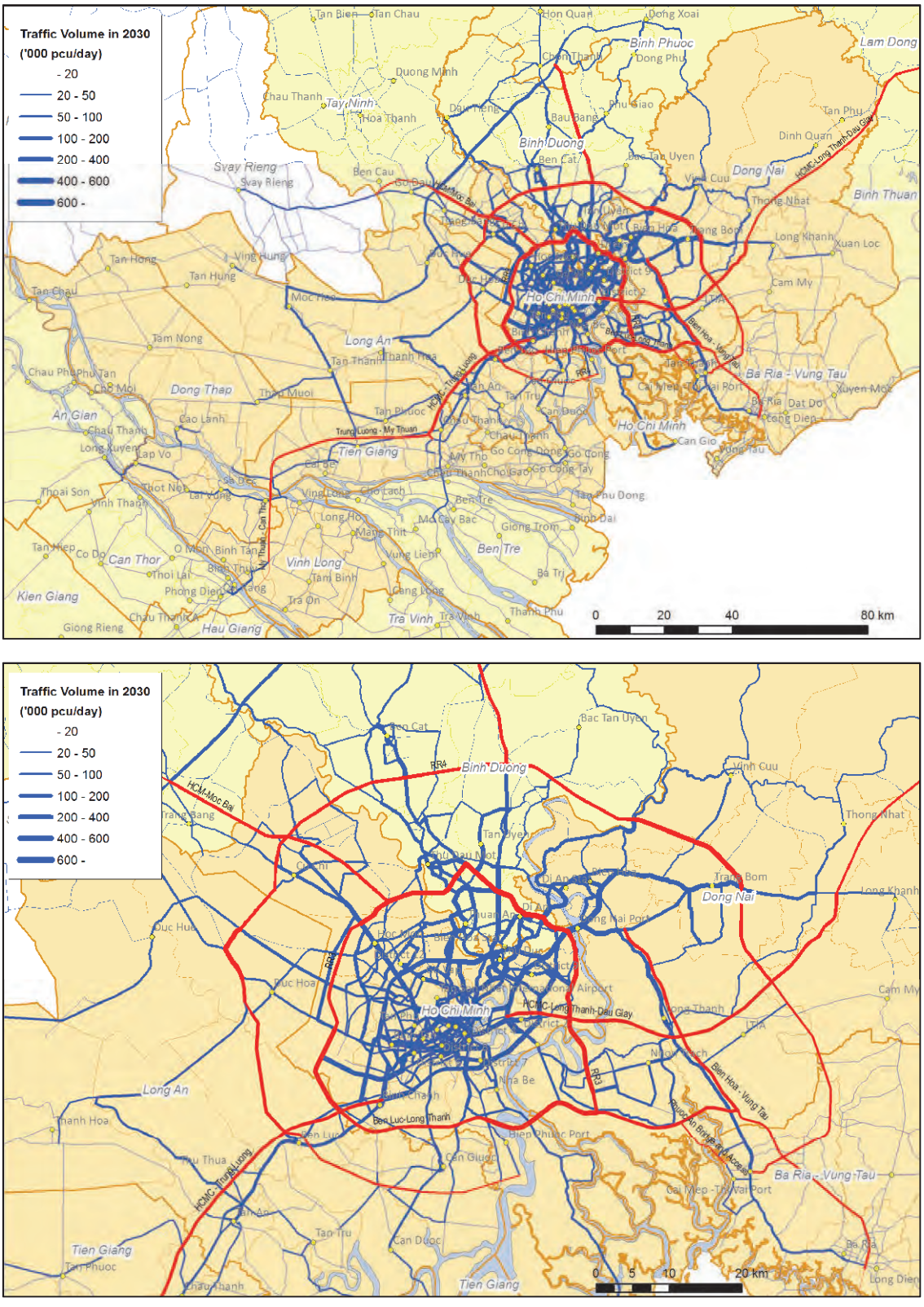
The following figures show the results of traffic demand assignment on the road network in 2020 and 2030.



Note: Major projects such as expressways, including sections in service, are indicated by red line.

Source: JICA Survey Team

Figure 4.5.4 Results of Traffic Assignment in 2020



Note: Major projects such as expressways, including sections in service, are indicated by red line. All projects expected to be in service until 2030 are included in the network.

Source: JICA Survey Team

Figure 4.5.5 Results of Traffic Assignment in 2030

For the evaluation of eight (8) projects as candidates for Japanese ODA, traffic demand assignment for without project and with project will be done individually. The results of the traffic demand forecast, excluding motorcycles, is summarized in the following table. The average assigned traffic volume is calculated using the following weighted average.

$$T = \frac{\sum L_i \cdot T_i}{\sum L_i}$$

Where,

T: Average traffic volume,

Li: Link length of link *i* of the project, and

Ti: Assigned traffic volume of link *i*.

Table 4.5.3 Forecasted Average Daily Traffic Volume in 2030

Project	Section	Car	Medium Bus	Large Bus	2 Axle Truck	3+ Axle Truck	Trailer	Total (PCU)
3rd Ring Road	Section 3: Binh Chuan – NH22	70,900	5,100	9,000	23,300	3,700	2,700	164,300
	Section 4: NH 22 – Ben Luc	75,500	5,700	10,000	24,800	3,500	3,400	176,800
4th Ring Road	Section 4: Ben Luc-Hiep Phuoc	4,500	600	800	4,500	1,100	1,800	24,100
Bien Hoa - Vung Tau Expressway	Bien Hoa – Phu My	14,500	2,200	3,800	13,700	6,800	7,700	92,900
	Phu My – Vung Tau	4,600	600	1,200	10,900	3,900	3,800	50,500
HCM-Moc Bai Expressway		10,200	1,000	1,900	12,900	3,400	2,300	57,100
2nd My Thuan Bridge		7,000	900	1,900	23,800	6,700	2,400	84,100
Phuoc An Bridge and Access + I/C		2,800	200	400	1,300	1,400	5,700	25,900

Note: Motorcycle is also assigned on the network with other vehicles, however, dedicated lanes for motorcycles might be prepared and free of charge, therefore, the traffic volume of motorcycles has been excluded from the table.

Source: JICA Survey Team

5 PRIORITIZATION OF ROAD AND BRIDGE PROJECTS AND NECESSITY OF PUBLIC INVESTMENT

5.1 Filtering of Listed Road and Bridge Projects in the Survey Area

Table 3.2.1 ~ Table 3.2.4 includes projects that are opened or the construction has started. It also includes projects that will be very difficult to implement by 2030. These projects are not suitable to be compared to the project's effect without exception. Therefore, the long list of project implementations in the survey area in Table 3.2.1 is filtered by the following 4 conditions.

- Exclude projects that are located mainly outside of the survey area.
- Exclude projects that are opened already.
- Exclude projects that are under construction.
- Exclude projects that are difficult to be opened before year 2030.

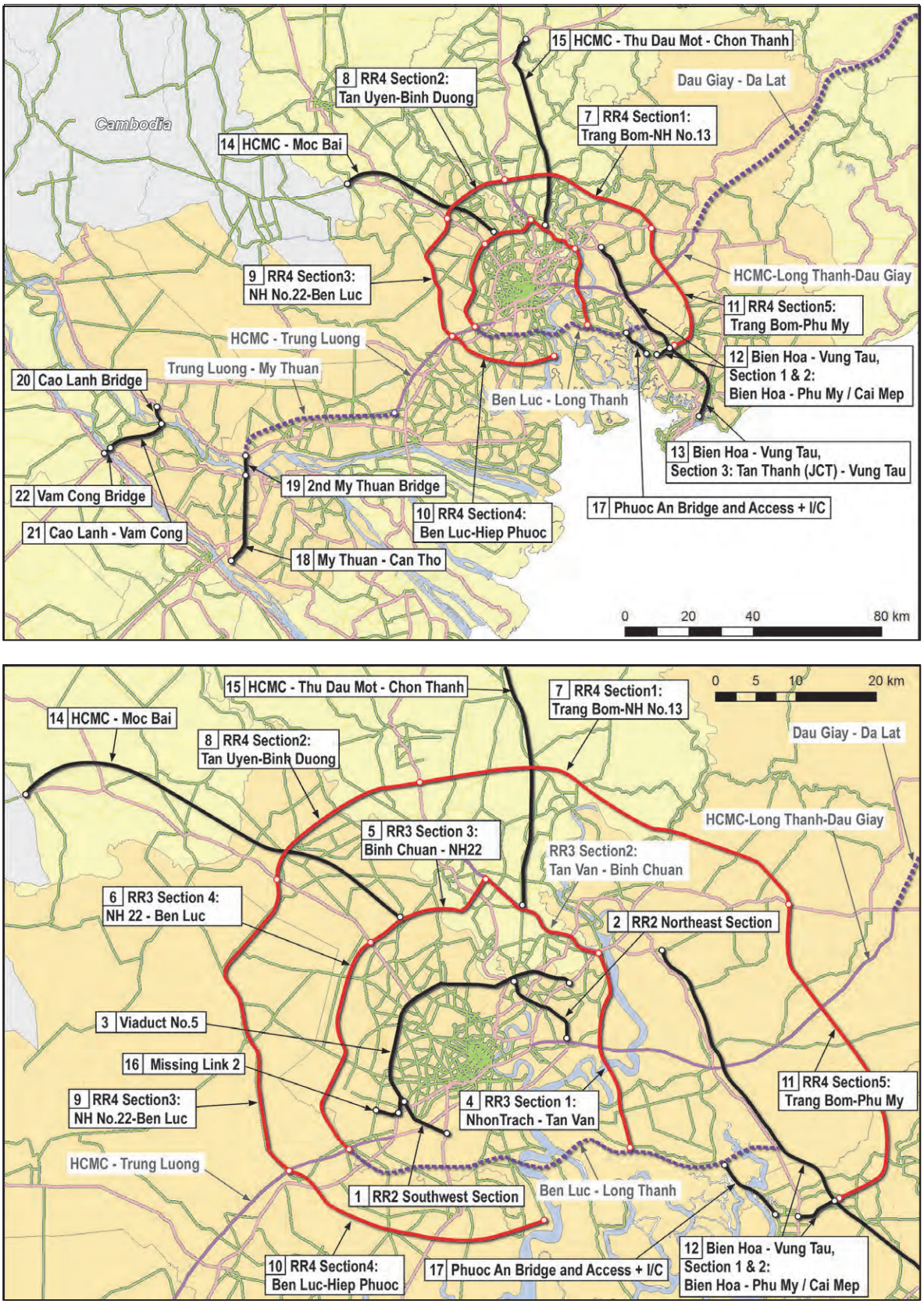
22 projects have been selected through this filtering process and are shown in Table 5.1.1 and their locations are shown in Figure 5.1.1.

Table 5.1.1 List of Road and Bridge Projects with High Possibility to be Implemented before 2030 in the Survey Area

Road Category	No.	Project Name	Length (km)	No. of Lanes/width (m)	Completed Phase of the Project	ETD*, 2030 (pcu/day)	Expected Fund Source
Ring Road	**2nd Ring Road:**						
	1	Southwest Section	5.0	4 lanes	F/S	30,000	PPP
	2	Northeast Section	9.0	6 lanes	F/S	142,000	BOT
	3	Viaduct No.5	30.4	4 lanes	Master Plan	125,000	undecided
	3rd Ring Road:						
	4	Section 1: NhonTrach - Tan Van	34.3	4 lanes/19.5m	F/S	146,000	PPP
	5	Section 3: Binh Chuan – NH22	17.5	8 lanes/74.5m	Pre-F/S	166,000	BOT
	6	Section 4: NH 22 – Ben Luc	29.2	8 lanes/74.5m	Pre-F/S	180,000	ODA
	4th Ring Road:						
	7	Section1:Trang Bom-NH No.13	51.9	4 lanes/27.0m	Pre-F/S	64,000	undecided
	8	Section2:Tan Uyen-Binh Duong	22.8	4 lanes/27.0m	Pre-F/S	73,000	undecided
	9	Section3:NH No.22-Ben Luc	41.6	4 lanes/27.0m	Pre-F/S	59,000	undecided
	10	Section4:Ben Luc-Hiep Phuoc	34.7	4 lanes/27.0m	Pre-F/S	38,000	undecided
	11	Section5:Trang Bom-Phu My	40.0	4 lanes/27.0m	Pre-F/S	33,000	undecided
HCM Region Regional EXPWY	**Bien Hoa – Vung Tau Expressway:**						
	12	Section 1&2: Bien Hoa – Phu My / Cai Mep	46.8	6-8 lanes/30.5~42m	Pre-F/S	(1)135,000 (2)76,000	BOT
	13	Section 3: Tan Thanh (JCT) – Vung Tau	31.0	4 lanes/24.75~27m	Pre-F/S	55,000	undecided
	14	**HCMC – Moc Bai Expressway**	55.0	4-6 lanes	Pre-study	99,000	BOT
	15	**HCMC – Thu Dau Mot – Chon Thanh Expressway**	69.0	6-8 lanes	Master Plan	116,000	BOT
Connecting Links in HCM Region	16	**Missing Link 2 (Extenton of E-W Road to the west)**	3.0	4lanes	Master Plan	26,000	BOT
	17	**Phuoc An Bridge and Access + I/C**	12.0	6 lane/66m	METI FS	21,000	BOT
Mekong Delta Region	18	**My Thuan – Can Tho Expressway**	32.3	4 lanes	Pre-F/S	36,000	PPP
	19	**2nd My Thuan Bridge**	3.0	6 lanes/33.0m	METI FS	61,000	undecided
	Second Southern Highway:						
	20	Cao Lanh Bridge	7.8	4 lanes/24.5m	Pre-F/S	9,000	ODA
	21	Cao Lanh – Vam Cong	15.7	4 lanes/33m	Pre-F/S	10,000	ODA
	22	Vam Cong Bridge	5.8	4 lanes/24.5m	Pre-F/S	20,000	ODA

*ETD: Estimated Traffic Demand

Source: JICA Survey Team



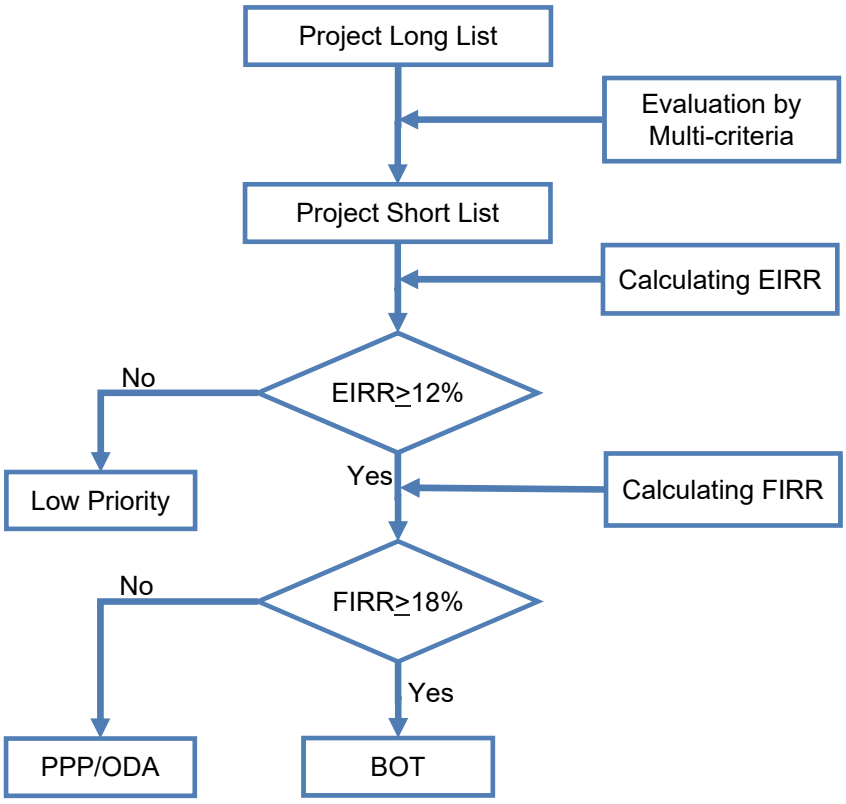
Source: JICA Survey Team

Figure 5.1.1 Location of Road and Bridge Projects with High Possibility to be Implemented before 2030 in the Survey Area

5.2 Prioritization of Road and Bridge Projects

The road and bridge projects of Table 5.1.1 are prioritized by multi-criteria, economic analysis and financial analysis to select specific projects that contribute highly to the region and VN.

The flow chart of the prioritization is shown in Figure 5.2.1. STEP 1 is done using multi-criteria. STEP 2 is an economic analysis calculating Economic Internal Rate of Return (EIRR), and STEP 3 is a financial analysis calculating Financial Internal Rate of Return (FIRR). If the projects' EIRR exceeds 12% (EIRR≥12%), the project is judged as a socio-economically valuable project in STEP 2. 12% is set after the ODA former projects' study reports. If the projects' FIRR exceeds 18% (FIRR≥18%), the project is judged as a financially valuable project in STEP 3. 18% is set by adding the average lending interest rate of the past 5 years in VN, 12.54%, and VN's Country Risk Premium (CRP), 4.99%, which totals 17.53% and is rounded up to 18%. If FIRR is over 18%, it is recommended to procure the projects' implementation cost through a BOT scheme. If FIRR is below 12.5%, it is not considered financially feasible and it is recommended to seek the possibility of ODA finance procurement. However, the calculated EIRR and FIRR do not represent the analysis result of a detailed study of the projects. It is only to compare the project priority to judge the financial source and possibility of receiving a donation from the Japanese government.



Source: JICA Survey Team

Figure 5.2.1 Flow Chart of Prioritization of Road and Bridge Projects

5.2.1 STEP 1: Evaluation of Projects' Characteristics (Evaluating by Multi-criteria)

Road and bridge projects are evaluated by their characteristics and quantified by their necessity and contribution to the region and so on. The criteria are set as follows:

1. Contribution to Social and Economic Development
2. Accessibility to Development Nodes / Missing Link
3. Contribution to Improvements of Urban Traffic and Logistics
4. Future Traffic Demand
5. Impacts on Land Use

(1) Details of the Criteria

1. Contribution to Social and Economic Development

Projects with high contribution to social and economic development are evaluated and quantified as 2, with low contribution as 0. Moreover, 3 areas where the projects contribute are focused on and evaluated separately.

1.1 Nationally or internationally
1.2 Regionally (to various provinces and municipalities[1])
1.3 To one province or municipality alone

2. Accessibility to Development Nodes / Missing Link

Projects that greatly improve the accessibility to the other development nodes are evaluated and quantified as 2, with limited improvement as 0. Moreover, 3 targets to improve accessibility are focused on and evaluated separately.

2.1 Developing industrial zone
2.2 Major gateways (seaports, river ports, and airports at the international level)
2.3 Filling in a missing link of highway network

3. Contribution to Improvements of Urban Traffic and Logistics

Projects with high contribution to improvements of urban traffic and logistics are evaluated and quantified as 2, with low contribution as 0. Moreover, 3 conditions the projects contribute to are focused on and evaluated separately.

[1] There are 5 municipalities in VN in 2016. Survey area contains HCMC only.

3.1 International traffic conditions crossing the border
3.2 Urban traffic conditions in Metropolitan Area
3.3 Logistics conditions in the survey area

4. Future Traffic Demand

The traffic demand forecast results of each project are categorized into 3 categories as follows:

2: T≥50,000 pcu/day
1: 25,000≤T<50,000 pcu/day
0: T< 25,000 pcu/day

5. Impacts on Land Use

The difficulty of land acquisition was set as the main factor in this criterion and categorized into 3 categories as follows:

2: Negligible
1: Not considerable
0: Considerably negative

(2) Result of the Evaluation

The result of the evaluation is shown in Table 5.2.1 and all projects are evaluated between 6 and 14. Projects are divided into 3 categories shown in Table 5.2.1. Six projects (8 sections) are categorized into the first priority and they will proceed to STEP 2, calculating EIRR.

Table 5.2.1 STEP 1: Results of Evaluation of Projects' Characteristics (Evaluating by Multi-criteria)

Priority	Points	Number of Projects (Sections)	Outline
1st	12～14	6 (8)	Projects with remarkable contributions in the social-economic aspects not only nationally and regionally but also internationally. Iimprove urban traffic and logistic conditions. Estimated to have considerable amount of traffic forecast demand. Priority is very high.
2nd	9～11	6 (11)	Projects have positive impact, between 1st priority and 3rd priority projects. The priority of these projects is not as high as 1st priority projects.
3rd	6～8	4 (4)	Projects with very limited improvement in social-economic, urban traffic and logistic aspects. It is estimated to have very limited amount of traffic forecast demand. Priority is low.

Source: JICA Survey Team

Table 5.2.2 STEP 1: Results of Evaluation of Projects' Characteristics (Evaluating by Multi-criteria) in details

Road Category	No	Name of the project	length	Social and Economic Development			Accessibility			Traffic and Logistics			Traffic Demand	Land Use	Total
			(km)	1.1	1.2	1.3	2.1	2.2	2.3	3.1	3.2	3.3	4	5	
Ring Road		2nd Ring Road:													
	1	Southwest Section	5.0	0	0	2	0	0	2	0	2	0	1	1	8
	2	Northeast Section	9.0	0	0	2	0	0	2	2	2	0	2	0	10
	3	Viaduct No. 5	30.4	0	0	2	0	0	0	0	2	0	2	0	6
		3rd Ring Road:													
	4	Section 1: Nhon Trach - Tan Van	34.3	0	0	2	2	0	0	0	2	2	2	0	10
	5	Section 3: Binh Chuan – NH22	17.5	0	2	2	2	0	0	0	2	2	2	2	14
	6	Section 4: NH 22 – Ben Luc	29.2	0	2	2	2	0	0	0	2	2	2	2	14
		4th Ring Road:													
	7	Section 1: Trang Bom-NH No.13	51.9	0	2	0	2	0	0	0	0	2	2	1	9
	8	Section 2: Tan Uyen-Binh Duong	22.8	0	2	0	2	0	0	0	0	2	2	1	9
	9	Section 3: NH No.22-Ben Luc	41.6	0	2	0	2	0	0	0	0	2	2	2	10
	10	Section 4: Ben Luc-Hiep Phuoc	34.7	0	2	0	2	2	0	2	0	2	1	2	13
	11	Section 5: Trang Bom-Phu My	40.0	0	2	0	0	2	0	0	0	2	1	2	9
HCM Metropolitan Area Regional Express-way		Bien Hoa – Vung Tau:													
	12	Section 1 & 2: Bien Hoa – Phu My / Cai Mep	46.8	0	2	0	2	2	0	2	0	2	2	2	14
	13	Section 3: Tan Thanh (JCT) – Vung Tau	31.0	0	0	2	2	2	0	0	2	2	2	0	12
	14	HCMC – Moc Bai	55.0	2	2	0	2	2	0	0	0	2	2	2	14
	15	HCMC – Thu Dau Mot – Chon Thanh	69.0	0	2	0	2	0	0	0	0	2	2	0	8
Connecting Links in HCM Metropolitan Area	16	Missing Link 2	3.0	0	0	2	0	0	2	0	2	0	2	1	9
	17	Phuoc An Bridge and Access + I/C	12.0	0	2	0	2	2	2	0	0	2	0	2	12
Mekong Delta Region	18	My Thuan – Can Tho	32.3	2	2	0	2	0	0	0	0	2	1	1	10
	19	2nd My Thuan Bridge	3.0	2	2	2	0	0	2	0	0	2	2	1	13
		Second Southern Highway:													
	20	Cao Lanh Bridge	7.8	0	2	2	0	0	2	0	0	2	0	2	10
	21	Cao Lanh – Vam Cong	15.7	0	0	2	0	0	0	0	0	2	0	2	6
	22	Vam Cong Bridge	5.8	0	2	2	0	0	2	0	0	2	0	2	10

Source: JICA Survey Team Legend: 1st priority, 2nd priority, ☐ 3rd priority

5.2.2 STEP 2: Economic Analysis

(1) Results of Traffic Demand Forecast

For the evaluation of six (6) projectsor (8) sections as candidates for Japanese ODA, traffic demand forecasting with and without the project was executed. Results of the traffic demand forecast, excluding motorcycles, are summarized in Table 5.2.3. The average assigned traffic volume is calculated by using the following weighted average.

$$T = \frac{\sum L_i \cdot T_i}{\sum L_i}$$

Where,

T: Average traffic volume,

Li: Link length of link *i* of the project, and

Ti: Assigned traffic volume of link *i*.

Table 5.2.3 Forecasted Average Daily Traffic Volume in 2030

(Unit: Vehicle)

Project	Section	Cars	Medium Bus	Large Bus	2 Axles Truck	3+Axles Truck	Trailer	Total	
								Vehicle	PCU
3rd Ring Road	Section 3 : Binh Chuan – NH22	70,900	5,100	9,000	23,300	3,700	2,700	114,700	164,300
	Section 4 : NH 22 – Ben Luc	75,500	5,700	10,000	24,800	3,500	3,400	122,900	176,800
4th Ring Road	Section 4 : Ben Luc-Hiep Phuoc	4,500	600	800	4,500	1,100	1,800	13,300	24,100
Bien Hoa – Vung Tau Expressway	Phase 1: Bien Hoa – Phu My	14,500	2,200	3,800	13,700	6,800	7,700	48,700	92,900
	Phase 2: Phu My – Vung Tau	4,600	600	1,200	10,900	3,900	3,800	25,000	50,500
HCM-Moc Bai Expressway		10,200	1,000	1,900	12,900	3,400	2,300	31,700	57,100
2nd My Thuan Bridge		7,000	900	1,900	23,800	6,700	2,400	42,700	84,100
Phuoc An Bridge and Access + I/C		2,800	200	400	1,300	1,400	5,700	11,800	25,900

Note: Motorcycles are also assigned on the network with other vehicles, however, dedicated lanes for motorcycles might be prepared and free of charge, therefore, traffic volume of motorcycles is excluded in the table.

Source: JICA Survey Team

(2) Social Economic Benefit

Based on the assigned traffic volume between the two scenarios—with project and without project—socio-economic benefits consist of travel distance reduction and travel time reduction, calculated using the following formula, and estimated as shown in following table.

$$B = \left(\sum L_i \cdot T_i^{WO} - \sum L_i \cdot T_i^{W}\right) \cdot VOC + \left(\sum Hr_i^{WO} \cdot T_i^{WO} - \sum Hr_i^{W} \cdot T_i^{W}\right) \cdot TV$$

Where,

B: Socio-economic benefit of the project,

Li: Link length of link *i* of entire network,

T_i^{WO}: Assigned traffic volume of link *i* of without project case,

T_i^{W}: Assigned traffic volume of link *i* of with project case,

H_i^{WO}: Travel time of link *i* of without project case,

H_i^{W}: Travel time of link *i* of with project case,

VOC: Vehicle operating cost per km-vehicle, and

TC: Time value per vehicle-hour.

Table 5.2.4 Forecasted Socio-Economic Benefits

Project	Section	Socio-Economic Benefit (million USD per year)		
		2020	2030	2040
3rd Ring Road	Section 3: Binh Chuan – NH22	193.9	354.4	647.7
	Section 4: NH 22 – Ben Luc	136.3	249.2	455.4
4th Ring Road	Section 4: Ben Luc-Hiep Phuoc	13.3	74.7	417.9
Bien Hoa - Vung Tau Expressway	Phase 1: Bien Hoa – Phu My	21.7	86.7	346.2
	Phase 2: Phu My – Vung Tau	13.1	52.2	208.5
HCM-Moc Bai Expressway		34.1	73.7	159.5
2nd My Thuan Bridge		16.2	95.0	556.4
Phuoc An Bridge and Access + I/C		2.7	39.2	569.8

Source: JICA Survey Team

(3) Projects' Economic Cost

1) Economic Construction Cost

Economic cost for the project evaluation is based on existing F/S studies of each project. The project cost is updated to its 2016 price by following GDP deflators. The base year of economic cost is set to 2016. The applied GDP deflator is in Vietnam Dong (VND), but the cost is estimated using USD. Therefore, the GDP deflator in USD is calculated and multiplied to the results of the F/S.

Table 5.2.5 GDP Deflators in Vietnam

	2011	2012	2013	2014	2015	2016
GDP deflator	0.89	0.98	1.02	1.05	1.01	1.00

Source: World Economic Outlook IMF

The following table shows the project costs including physical contingency (10% of civil cost). The economic cost of the project is calculated using a conversion factor to economic cost, 0.87 based on existing project.

Table 5.2.6 Economic Construction Cost

Project	Section	Project Cost (2016 Economic Price) Million USD			
		Total	Civil Cost	Physical Contingency	Land Acqu. Cost
3rd Ring Road	Section 3: Binh Chuan – NH22	442	373	37	32
	Section 4: NH 22 – Ben Luc	540	435	43	62
4th Ring Road	Section 4: Ben Luc-Hiep Phuoc	346	201	20	125
Bien Hoa - Vung Tau Expressway	Bien Hoa – Phu My	456	316	32	109
	Phu My – Vung Tau	397	336	34	28
HCM-Moc Bai Expressway		375	297	30	48
2nd My Thuan Bridge		696	584	58	53
Phuoc An Bridge and Access + I/C		379	304	30	45

Source: JICA Survey Team

2) Operation and Maintenance Cost

Operation and maintenance costs of the project are defined as 0.5% for routine maintenance for every year since opening, and 4% of the project cost is considered as the periodic maintenance cost for every 10 years after opening.

(4) Assumption of Economic Evaluation

In the benefit-cost analysis, two scenarios, "with project" and "without project" are used to evaluate the projects in the short-list shown in Table 5.2.6. Through comparison of these two scenarios, it is examined whether or not the benefit of savings in transport costs in the "with project" case could recover the economic costs of the proposed project from the viewpoint of the national economy.

The following 3 indicators are used in this economic analysis:

- Economic internal rate of return (EIRR)
- Economic benefit per cost
- Economic net present value (NPV)

(5) Implementation Schedule and Evaluation Period

For the comparison of effectiveness among projects in the short-list, the project schedule assumes that all projects start in 2017 and open in 2020. The project evaluation period is defined as 30 years, until 2047.

(6) Discount Rate

The discount rate is defined as 12%, the general discount rate used in existing studies in Vietnam.

(7) Results of Economic Evaluation

The results of the economic evaluation of candidate projects are summarized in the following table.

Table 5.2.7 Summary of Economic Evaluation

Project	Section	Project Economic Cost in 2016 (million USD)	Economic Evaluation		
			EIRR	B/C	NPV (Million USD)
3rd Ring Road	Section 3: Binh Chuan – NH22	442	37.0%	6.29	1,477.5
	Section 4: NH 22 – Ben Luc	540	25.5%	3.63	849.3
4th Ring Road	Section 4: Ben Luc-Hiep Phuoc	346	16.7%	2.62	306.2
Bien Hoa - Vung Tau Expressway	Phase 1: Bien Hoa – Phu My	456	14.7%	1.85	178.8
	Phase 2: Phu My – Vung Tau	397	12.1%	1.26	2.6
HCMC - Moc Bai Expressway		375	14.0%	1.57	77.9
2nd My Thuan Bridge		696	13.7%	1.67	193.3
Phuoc An Bridge and Access + I/C		379	16.5%	3.04	448.3

Source: JICA Survey Team

All of these 6 projects (8 sections) are evaluated as socio-economically feasible, since the EIRR of these projects exceeds 12% (EIRR≥12%). Therefore, the FIRR is calculated for all 6 projects (8 sections) in the next clause.

5.2.3 STEP 3: Financial Analysis

(1) Financial Revenue

Based on the existing toll system, distance related toll by type of vehicle is assumed as shown in the following table and the toll revenue for each project is estimated by traffic volume. In the survey, toll revenue is calculated using the same distance-related value, therefore, projects with short lengths such as 2nd My Thuan Bridge might be underestimated.

Table 5.2.8 Assumed Toll by Vehicle Type for the Estimation of Revenue

	Car	Medium Bus	Large Bus	2 Axle Truck	3+ Axle Truck	Trailer
VND/km	2,000	3,000	4,000	4,000	6,000	11,000

Source: JICA Survey Team

Table 5.2.9 Forecasted Toll Revenue

Project	Section	Toll Revenue (million USD per year)		
		2020	2030	2040
3rd Ring Road	Section 3: Binh Chuan – NH22	84.5	97.4	164.7
	Section 4: NH 22 – Ben Luc	100.6	173.4	220.0
4th Ring Road	Section 4: Ben Luc-Hiep Phuoc	10.2	33.5	36.7
Bien Hoa - Vung Tau Expressway	Bien Hoa – Phu My	110.1	113.9	192.8
	Phu My – Vung Tau	33.7	75.0	166.3
HCM-Moc Bai Expressway		37.7	113.3	188.0
2nd My Thuan Bridge		4.9	18.7	31.6
Phuoc An Bridge and Access + I/C		3.2	11.9	31.7

Source: JICA Survey Team

(2) Projects' Financial Cost

1) Financial Construction Cost

The base year is set as 2016 as with the economic analysis in Step 2. The financial construction cost is the actual cost in the implementation, therefore the results of the F/S are applied without price escalation and physical contingency. Financial construction costs are shown in Table 5.2.10.

Table 5.2.10 Financial Construction Cost

Project	Section	Project Financial Cost in 2016	Project Cost in Existing F/S	
			Project Cost (million USD)	Year
3rd Ring Road	Section 3: Binh Chuan – NH22	503.7	493	2012
	Section 4: NH 22 – Ben Luc	611.9	599	2012
4th Ring Road	Section 4: Ben Luc-Hiep Phuoc	378.6	371	2013
Bien Hoa - Vung Tau Expressway	Phase 1: Bien Hoa – Phu My	508.3	498	2013
	Phase 2: Phu My – Vung Tau	452.3	443	2013
HCM-Moc Bai Expressway		423.3	428	2015
2nd My Thuan Bridge		792.0	628	2011
Phuoc An Bridge and Access + I/C		429.4	341	2011

Source: JICA Survey Team

2) Operation and Maintenance Cost

The operation and maintenance cost of the project is defined such that 0.5% of the financial construction cost for routine maintenance for every year since opening and 4% of the financial construction cost is considered as a periodic maintenance cost for every 10 years since opening.

(3) Assumptions of the Financial Evaluation

1) Financial Indicators

Financial Internal Rate of Return (FIRR) is used in this financial analysis.

2) Implementation Schedule and Evaluation Period

For comparison of effectiveness between projects on the short-list, the project schedule assumes that all projects start in 2017 and open in 2020. The project evaluation period is defined as 30 years, until 2047.

(4) Results of Financial Evaluation

The results of the financial evaluation of candidate projects are summarized in the following table.

Table 5.2.11 Summary of Financial Evaluation

Project	Section	Project Financial Cost in 2016 (million USD)	FIRR
3rd Ring Road	Section 3: Binh Chuan – NH22	503.7	15.9% (16%)
	Section 4: NH 22 – Ben Luc	611.9	17.9% (18%)
4th Ring Road	Section 4: Ben Luc-Hiep Phuoc	378.6	Negative (Neg.)
Bien Hoa - Vung Tau Expressway	Phase 1: Bien Hoa – Phu My	508.3	18.8% (19%)
	Phase 2: Phu My – Vung Tau	452.3	12.4% (12%)
HCM-Moc Bai Expressway		423.3	15.2% (15%)
2nd My Thuan Bridge		792.0	Negative (Neg.)
Phuoc An Bridge and Access + I/C		429.4	1.4% (1%)

Source: JICA Survey Team

The results of the financial analysis of 6 candidate projects (8 sections) are categorized into 3 categories as in Table 5.2.4.

Table 5.2.12 Financial Categories Based on the Results of Financial Analysis

Financial Category	FIRR	Projects (Sections)
High	18% and more	3rd Ring Road, Section 4 Bien Hoa - Vung Tau Expressway, Phase 1
Medium	12%* - 18%	3rd Ring Road, Section 3 Bien Hoa - Vung Tau Expressway, Phase 2 HCM-Moc Bai Expressway
Low	below 12%*	4th Ring Road, Section 4 2nd My Thuan Bridge Phuoc An Bridge and Access + I/C

*Average of Loan Lending Interest Rate in past 5 years in VN

Source: JICA Survey Team

5.2.4 Selection of Project Scheme and Financial Source (VN Government's own budget, ODA yen-loan, ODA from other donors, PPP, BOT, etc.)

Selection of the 6 candidate projects (8 sections) is studied based on the results of STEP 3, Financial Analysis. The VN Government is now executing the policy to reduce international debt.[2] Therefore, a

[2] The remaining debt ratio of VN government to GDP is increased from 50.0% to 59.6% from 2010 to 2014.

scheme to utilize as much private finance as possible is desired for the implementation of road and bridge projects.

There are some projects among the 6 candidate projects (8 sections) with a FIRR lower than 18% (criterion) but evaluated to produce considerable economic benefit. These projects/sections produce NPV greater than or nearly equal to project cost. Therefore, it is proposed to examine the financial analysis by assuming a more realistic toll rate or applying a PPP scheme and investing public budget partially to improve the project financial feasibility in a further stage of the project implementation. It will generate private finance in implementing road and bridge projects.

The FIRR of the 3rd Ring Road, Section 4 and Bien Hoa – Vung Tau expressway, phase 1 exceed 18%. Therefore, these 2 projects are judged as appropriate for implementing a BOT scheme utilizing private finance.

The FIRR of Road No. 3, Section 3, Bien Hoa – Vung Tau expressway, phase 2, and HCM – Moc expressway exceed 12.53% (Average of Loan Lending Interest Rate in past 5 years in VN). Therefore, these 3 projects can have sufficient financial feasibility to utilize private finance if the scheme is designed properly. It is judged that it is appropriate that these projects implement a PPP scheme utilizing private finance as well as public investment.

On the other hand, the FIRR of the 4th Ring Road, Section 4, and the 2nd My Tuan Bridge projects did not exceed 12.53% and showed negative value. It is judged that it would be very difficult to implement a BOT scheme by toll revenue. However, the EIRR of these projects are higher than 12% and they are judged as social-economically feasible. Therefore, these 2 projects should be implemented using ODA as a financial source.

Lastly, the Phouc An Bridge project does not have a high FIRR but its EIRR, NPV, and B/C are very high. Since its NPV exceeds the project cost and its B/C is as high as 3.04, it is judged as a very significant project socio-economically. Moreover, as it is a bridge project with a short road length, the toll rate is relatively low considering the positive impact to the region and society along the route. In other words, if the toll rate is set to the appropriate rate determined through further study, such as a FS, financial feasibility could improve dramatically. This project, through use of a PPP scheme beneficial to both private investors and the government, can be designed in the following stage with a certain amount of public investment, therefore it is conditionally said that it should aim to implement using a PPP scheme.

The relations among the results of the economic analysis, financial analysis and the study results of the selection of project scheme and financial source is shown in Table 5.2.13.

Table 5.2.13 Relations among Results of Economic Analysis, Financial Analysis and Selection of Project Scheme and Financial Source

Project	Section	EIRR	B/C	NPV (Mil. USD)	FIRR	Selection of Project Scheme and Financial Source
3rd Ring Road	Section 3 : Binh Chuan – NH22	37.0%	6.29	1,477.5	15.9%	ODA/PPP
	Section 4 : NH 22 – Ben Luc	25.5%	3.63	849.3	17.9%	BOT
4th Ring Road	Section 4 : Ben Luc-Hiep Phuoc	16.7%	2.62	306.2	Negative	ODA
Bien Hoa - Vung Tau Expressway	Phase 1: Bien Hoa – Phu My	14.7%	1.85	178.8	18.8%	BOT
	Phase 2: Phu My – Vung Tau	12.1%	1.26	2.6	12.4%	ODA/PPP
HCM-Moc Bai Expressway		14.0%	1.57	77.9	15.2%	ODA/PPP
2nd My Thuan Bridge		13.7%	1.67	193.3	Negative	ODA
Phuoc An Bridge (with access road and IC)		16.5%	3.04	448.3	1.4%	ODA/PPP

Source: JICA Survey Team

5.3 Consistency with C/P Implementation Plan

5.3.1 Consistency with C/P's Implementation Plan

The Survey Team presented the survey results, namely the prioritization study result in 5.2, to the main C/Ps, Department of Planning and Investment (DPI), Ministry of Transport (MOT) in Hanoi, and held the presentation seminar inviting 1 metropolitan (HCMC) and 6 provinces in the survey area in HCMC in July 2016.

DPI and MOT basically agreed to the survey result and the 1 metropolitan (HCMC) and 6 provinces did not show any objection to the presentation. Therefore, it is considered that the survey result is accepted by all C/Ps of this survey.

Based on the presentation, it is judged that the consistency between the survey result and the implementation plan of the C/Ps is ensured.

5.3.2 Consistency with I/A's Implementation Plan

The survey team has conducted interviews with the I/A of the 6 candidate projects (8 sections) in Table 5.2.2 and asked the current contents and status of the implementation plan, specifically confirming the financial procurement intention.

Table 5.3.1 Consistency between Survey Result and I/A's Implementation Plan

Project	Section	I/A	I/A's Intention	Survey Result
3rd Ring Road	Section 3: Binh Chuan – NH22	Cuu Long CIPM	BOT	ODA/PPP
	Section 4: NH 22 – Ben Luc	Cuu Long CIPM	ODA	BOT
4th Ring Road	Section 4: Ben Luc-Hiep Phuoc	Cuu Long CIPM	undecided	ODA
Bien Hoa - Vung Tau Expressway	Phase 1: Bien Hoa – Phu My	PMU85	BOT	BOT
	Phase 2: Phu My – Vung Tau	PMU85	BOT	ODA/PPP
HCM-Moc Bai Expressway		TSPMU	BOT	ODA/PPP
2nd My Thuan Bridge		PMU7	ODA	ODA
Phuoc An Bridge (with access road and IC)		Ba Ria – Vung Tau Province DOT	BOT	ODA/PPP

Source: JICA Survey Team

The 3rd Ring Road, Section 3, Bien Hoa-Vung Tau Expressway, Phase 2, HCM-Moc Bai Expressway, and the Phuoc An Bridge (with access road and IC) all had the result that they should be implemented by PPP utilizing public investment, but the I/A of these projects intend to implement using a BOT scheme. The reason why those I/A insist on implementing by BOT scheme is that these projects are described in the Master Plan (Adjusted Planning for Road Traffic Development in Vietnam by 2020, and the Orientation towards 2030 (PM Decision), 2013) and they have not found the specific financial source yet. Moreover, there is not enough time to procure the budget from the VN central or local government, or ODA donor. Therefore, they are seeking the chance to find a BOT investor in the private sector to realize the Master Plan. However, survey results show insufficient financial feasibility if implemented by BOT scheme. The survey team is doubtful that all of these 4 projects will be implemented by BOT scheme as their I/A is planning.

Many projects implemented by BOT scheme in VN apply public investment of land acquisition or offering roadside development rights to the BOT investor, which is practically equivalent to a PPP scheme. If the public investment ratio could be increased to secure the private sectors' profit, it is still possible to implement by so-called BOT scheme in VN. Specifically, if the ODA finance is utilized as a public investment, and makes good use of its advantage (e.g, very low interest rate compared to BOT scheme), the feasibility could improve dramatically. This would be one of the main issues to be resolved in a future stage.

6 STUDY ON EFFECTIVE ASSISTANCE PROGRAM

6.1 Applicability of Official Development Assistance (ODA)

Here, applicability of ODA as a financial source for the 6 candidate projects (8 sections) is studied. The following 5 conditions are the applicable conditions for ODA for the transportation infrastructure implementation project.

1) High Economic Feasibility (EIRR≥15%)
2) Very few possibilities for procuring non-ODA financial source, such as private finance (FIRR: low, low possibility to improve the financial feasibility, the project with study results of ODA in 5.2.4)
3) Contributes to improvement of traffic and logistics conditions (Traffic demand higher than the 4-lane road))
4) Contributes to solving missing link problems
5) Contributes to improving the access to international gateways and increasing international traffic volume

The number of the abovementioned conditions indicates the applicability of ODA.

4 or 5: Very high

3: High

2: Medium

1 or 0: Low

Table 6.1.1 shows the result of the study on applicability of ODA

Table 6.1.1 Applicability of ODA to 6 Candidate Projects (8 sections)

	Project	Section	Cost (Mil. USD)	EIRR	FIRR	1)	2)	3)	4)	5)	Applied condition	Applicability of ODA
1	3rd Ring Road	Section 3 : Binh Chuan – NH22	442	37.0%	15.9%	○	-	○	-	-	2	Medium
2		Section 4 : NH 22 – Ben Luc	540	25.5%	17.9%	○	-	○	-	-	2	Medium
3	4th Ring Road	Section 4 : Ben Luc – Hiep Phuoc	346	16.7%	Negative	○	○	-	-	○	3	High
4	Bien Hoa - Vung Tau Expressway	Phase 1: Bien Hoa – Phu My	456	14.7%	18.8%	○	-	○	-	-	2	Medium
5		Phase 2: Phu My – Vung Tau	397	12.1%	12.4%	-	-	○	-	-	1	Low
6	HCM-Moc Bai Expressway		375	14.0%	15.2%	○	-	○	-	○	3	High
7	2nd My Thuan Bridge		696	13.7%	Negative	-	○	○	○	-	3	High
8	Phuoc An Bridge (with access road and IC)		379	16.5%	1.4%	○	-	○	○	-	3	High

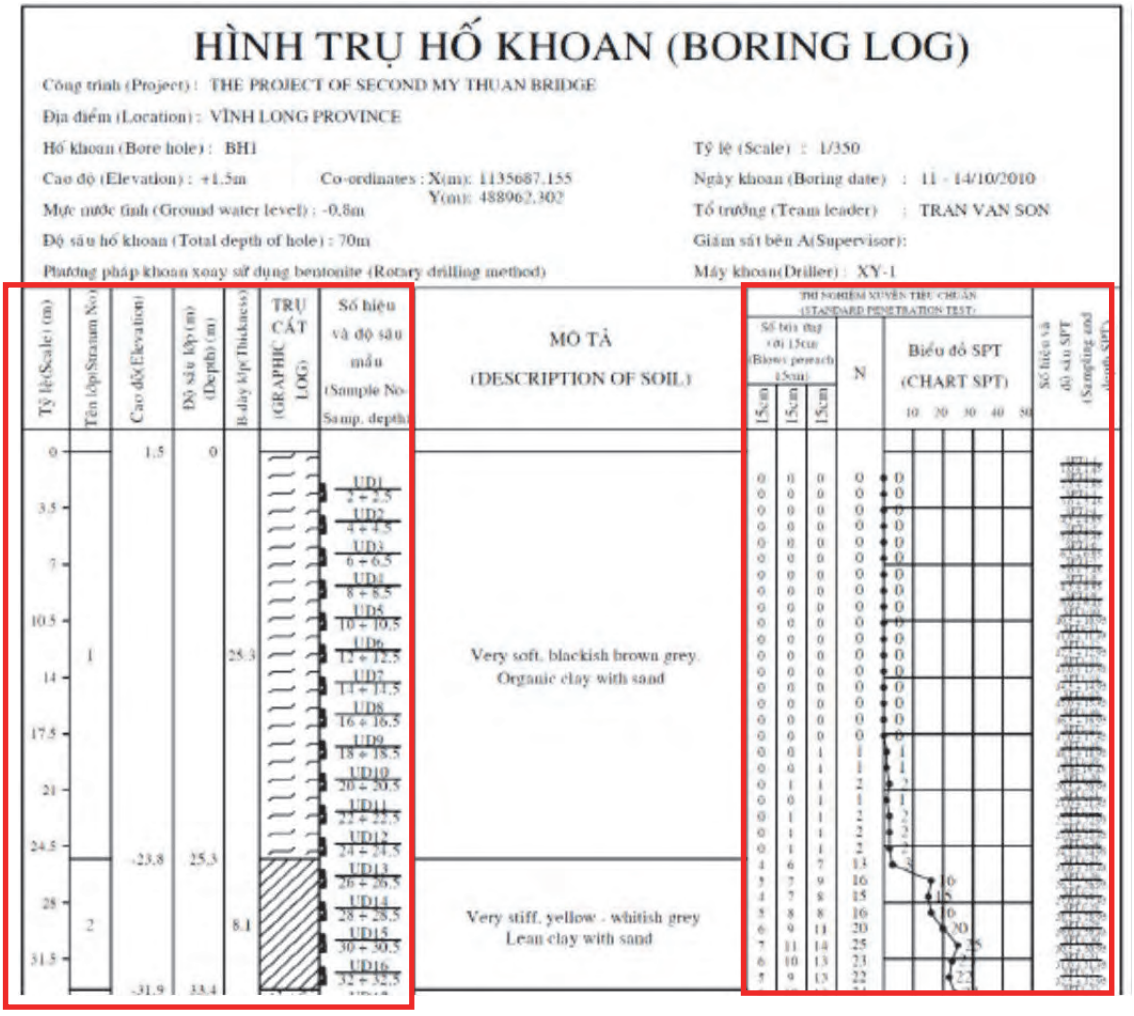
Source: JICA Survey Team

6.2 Applicability of Japanese Technology

6.2.1 Characteristics of Mekong Delta Area

The survey area includes the Mekong Delta area, which is formed by the Mekong River, one of the biggest rivers in the world, and is very flat terrain with low altitude. There are numerous small and big distributaries of the Mekong River, canals, and channels in the delta.

Geological strata consist of very thick alluvium. Particularly the layers near the surface are very soft with silt and clay. It is said that the thickness of the soft layer is approximately 10 to 70 m and requires special treatment for road and bridge construction. The thickness tends to increase along the river stream under the natural levee, and the geological survey result in the F/S of the 2nd My Tuan Bridge (Mar. 2011, METI, Japan) shows that there is very soft ground with nil N-value 17.5 m thick.



Source: JICA Survey Team

Figure 6.2.1 Boring Log of Planned Construction Site of 2nd My Tuan Bridge

The countermeasure to prevent resettlement and slide of embankment, as well as soil improvement, is necessary to implement roads and bridges on these kinds of very soft ground.

Even the distributaries in the delta are rivers after the main stream diverges from the main stream. Some streams have very rapid flow, such as 1.5 m/s, with a considerable amount of discharge. Moreover, the deepest depth of the flow is around 30 m. These natural conditions are very favorable to the scour of both riverbed and riverbank. Specific countermeasures to prevent scour around the substructure and embankment are necessary to implement bridge crossings in these types of river flow. (Extracted from F/S of the 2nd My Tuan Bridge, Mar. 2011, METI, Japan)

Moreover, it is said that with the increase of water use upstream, including China, Laos, Cambodia, etc., the total flow of the Mekong River and the river depth are decreasing in recent years. Also, the rise of the sea level is polluting the farm land of the delta near the seashore with salt from the sea water. Salt pollution damages steel and concrete structures by speeding up the corrosion and deterioration. It could be a big problem in the operation stage, therefore it is necessary to prepare and design countermeasures from the planning and designing stages (extracted from Final Report of

Project for Climate Change Adaptation for Sustainable Agriculture and Rural Development in the Coastal Mekong Delta, 2013, JICA).

Judging from the findings mentioned above, the Mekong Delta region has a very severe natural environment for the implementation of road and bridge projects. Specific countermeasures are necessary to prevent serious damage and rapid deterioration from occurring throughout the project period from planning to operation and maintenance stage. There are many Japanese technologies that can be utilized for these necessary countermeasures. Applicable Japanese technologies for the 6 candidate projects (8 sections) are listed in Table 6.1.1 and are described from the following clause. The effect of application of these technologies, in detail, and the decision to apply these technologies will be studied in detail in further stages of those projects, such as F/S, detailed design, etc.

6.2.2 Applicability of Japanese Technology

(1) Road Project

There are 2 Japanese technologies to apply to road projects among the 6 candidate projects (8 sections) in Table 6.1.1.

Soft ground generally consists of very clayey soil with high moisture content and scarce bearing capacity, and most of the survey area is no exception to it. Consolidation that lasts for more than several years will occur when embankment is constructed on those clayey soft grounds.

Road projects on soft clayey ground often suffer consolidation issues. How to deal with it is one of the main tasks in these projects. Major countermeasures are (1) to improve the ground physically or chemically, (2) to apply additional supporting construction methods to promote quick consolidation and stability, and (3) to lighten the load on the soft ground. There are 2 Japanese technologies that are suitable to recommend in the survey report: ‘plastic board drain method’ of category (2); and ‘light weight embankment method’ of category (3).

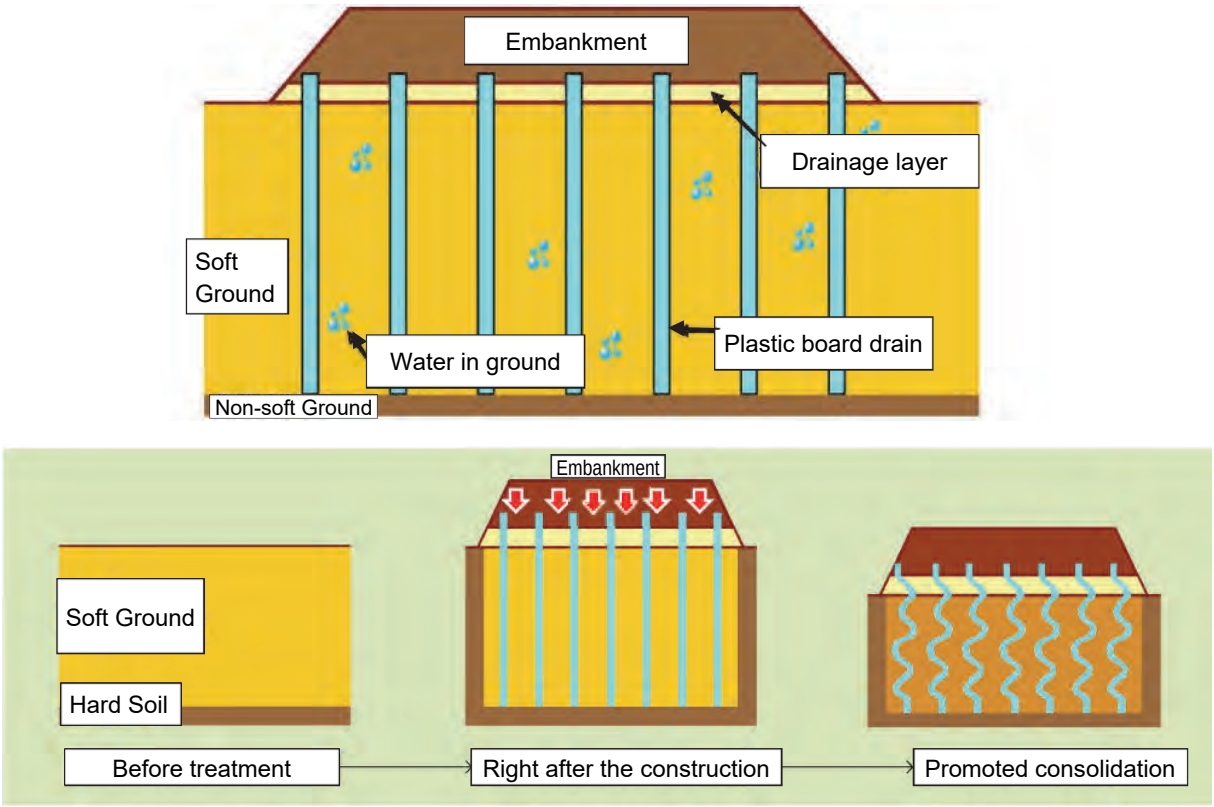
1) Plastic board drain method
2) Light weight embankment method

1) Plastic Board Drain Method

This construction method is one of the additional supporting construction methods to promote quick consolidation and stability. It penetrates prefabricated plates of plastic made of highly permeable resin to soft ground. This method was applied to ‘Cai Mep Thi Vai International Port Construction Project’ financed by JICA. It requires highly skilled labor to secure the quality when the soft soil exists very deep.

The main advantages of this method are as follows:

- Easy to control permeability (using resin-made plastic board with stable permeability)
- Scarce negative impact to the natural environment of the surrounding area



Source: JICA Survey Team

Figure 6.2.2 Outline of Plastic Board Drain Method

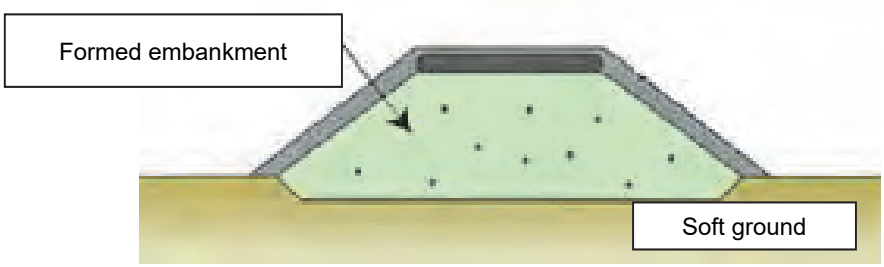
Source: JICA Survey Team

Figure 6.2.3 An Example of Plastic Board Drain Method

2) Light Weight Embankment Method

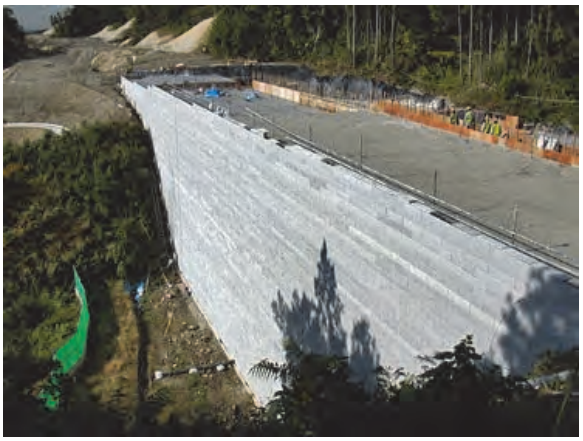
This construction method is one of the methods to lighten the load on the soft ground by utilizing formed soil with bubbles for embankment material. There are many technologies that have different materials for row material (e.g. utilizing soil at the site, etc.), or different methods to form the bubble. There are 8 technologies listed in NETIS (MLIT, Japan)[3] and there are also prefabricated materials of embankment.

This method has a big advantage, which is a direct and short-term effect to the embankment by lightening the load to the embankment. However, if the embankment material has lightened too much, it will float in a flood disaster.



Source: JICA Survey Team

Figure 6.2.4 Outline of Light Weight Embankment Method



Source: JICA Survey Team

Figure 6.2.5 Examples of Light Weight Embankment Method

[3] http://www.netis.mlit.go.jp/NetisRev/Explanation/MainExplanation.asp (only available in Japanese)

(2) Bridge Project

There are 7 applicable Japanese technologies as follows:

1) Extradosed bridge
2) Atmospheric corrosion resistant steel (anti-corrosion steel)
3) Steel pipe sheet piles foundation
4) Steel piers
5) Composite slab
6) Epoxy coated and filled strand cable
7) Epoxy coated reinforcing bar

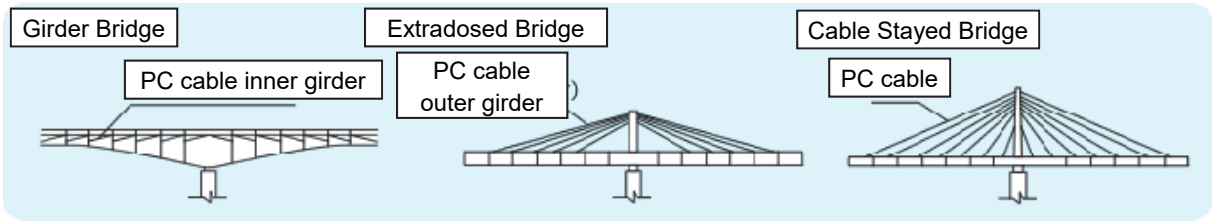
1) Extradosed Bridge

An extradosed bridge is a type of pre-stressed concrete (PC) bridge that has tensioning cable outside of the girder to enlarge the eccentric length of the cable and the bearing capacity to the load.

The main advantages of this method are as follows:

- Enables to make the span length longer with light dead load
- Enables to construct with lower cost compared to other types of PC bridges
- Creates land marking structure from its appearance

The longest applied span length is 185 m for a multiple-span continuous bridge, and 275 m for a steel-concrete composite girder bridge.



Source: JICA Survey Team

Figure 6.2.6 Outline of Extradosed Bridge

New Kelani Bridge (Sri Lanka)

Source: JICA website

Japan-Palau Friendship Bridge (Palau)

Source: JICA Survey Team

Figure 6.2.7 Examples of Extradosed Bridge

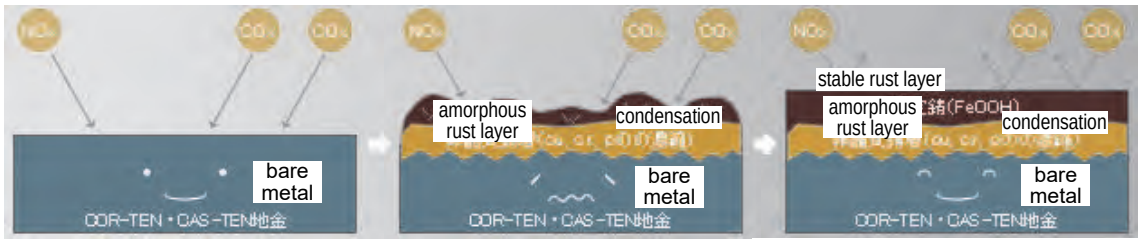
2) Atmospheric Corrosion Resistant Steel (Anti-corrosion Steel)

Atmospheric corrosion resistant steel (anti-corrosion steel) has alloying elements, such as Cu, Cr, Ni, etc., and gradually forms very stable rust on the surface which is very elaborate and adhesive. In recent years, reducing the Life Cycle Cost (LCC) of bridges is a considerable issue all over the world and it has been attempted to prolong their lifespan to 100 years. Anti-corrosion steel is one of the most attractive steel materials for bridges in the sense of reducing the LCC, and has very remarkable characteristics as a welding steel material for structures, and will exercise very high anti-corrosive performance with appropriate planning, designing, construction, and operation.

- Steel structure is very stable because its mechanical characteristics do not deteriorate semi-permanently.
- The workability in fabrication and construction is very high with very high welding performance.
- Anti-corrosion performance is very reliable in appropriate environment.

Source: The Japan Iron and Steel Federation's website

Japanese steel manufactures can prepare steel materials that form stable rust with their high-tech facility and, applying this steel to a bridge member, can realize an uncoated steel bridge. Therefore, it reduces the LCC because it does not require repainting work for the entire lifespan. However, the atmospheric corrosion resistant steel cannot be used in the area where salt pollution occurred. In that regard, it is necessary to conduct the airborne salt survey and to study for nickel system of the atmospheric corrosion resistant steel.



initial stage: corrosion begins

Corrosion progress and forming oxide layer simultaneously.

Stable rust is formed and steel member is covered completely. There will not be any progress of corrosion even it is exposed to corrosion factor

Source: JICA Survey Team

Figure 6.2.8 Outline of Anti-corrosion Steel

Source: JICA Survey Team

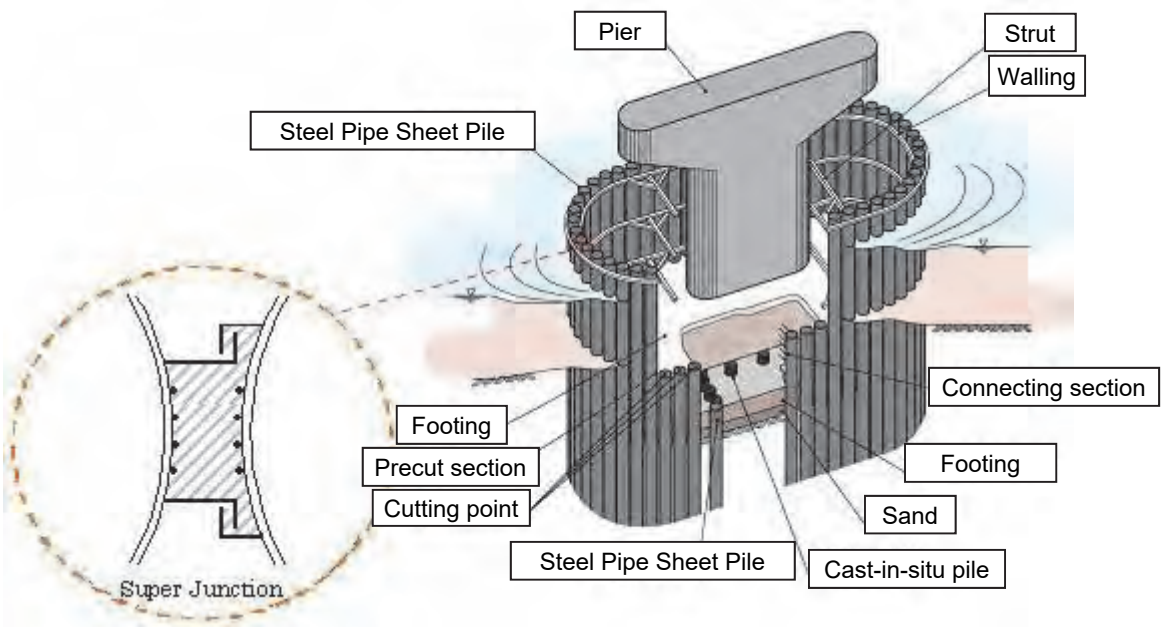
Figure 6.2.9 Examples of Anti-corrosion Steel

3) Steel Pipe Sheet Piles Foundation

A steel pipe sheet piles foundation is a foundation construction method that has advantages in construction in deep water in river/sea. It drills the steel pipe sheet pile and those piles are connected together in a circle or oval. The inside is dried up to secure the work space for construction. The top end of the piles is connected rigidly by footing and will perform as a one body structure. It is a rather intermediate structure between pile foundation and caisson foundation, but it obtains stronger bending rigidity and vertical bearing capacity than pile foundation and can be constructed with lower cost, and has fewer negative impacts to the natural environment than caisson foundation.

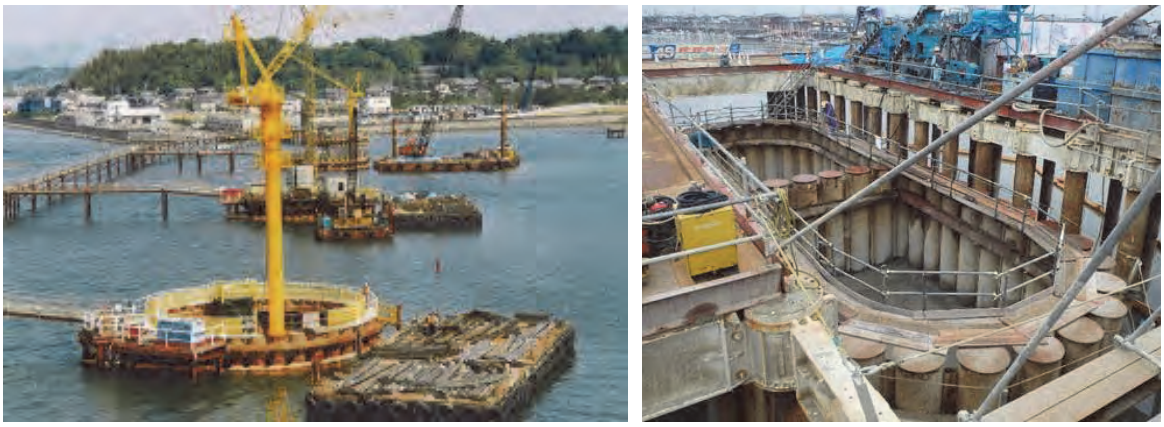
This foundation was applied to the Nhat Tan Bridge which was financed by Japanese ODA. Moreover, a Japanese steel manufacture has a steel pile sheet pile factory in Ba Ria – Vung Tau province.

The 2nd My Tuan Bridge and Phouc An Bridge project is planned to cross deep river with piers in the river. Applying this foundation will contribute not only to an increase of workability, but also reducing construction costs and shortening the construction period.



Source: JICA Survey Team

Figure 6.2.10 Outline of Steel Pipe Sheet Piles Foundation



Source: JICA Survey Team

Figure 6.2.11 Examples of Steel Pipe Sheet Piles Foundation

4) Steel Piers

Steel piers are placed at the points where there is limited land to construct a pier due to complicated crossing structures in a crowded urban area. It enables a very short construction period by fabricating members in factory and applying large-block single operation erection method. Therefore, the negative impact to the current traffic can be very limited.

Advantages of steel piers are listed as follows:

- Enables rapid construction
- Enables to place pier in various places (no need to place immediately below the superstructure)
- Enables to design various appearances
- Enables to minimize the negative impact to current traffic (minimizing traffic congestion).


Source: JICA Survey Team

Figure 6.2.12 Examples of Steel Pier

5) Composite Slab

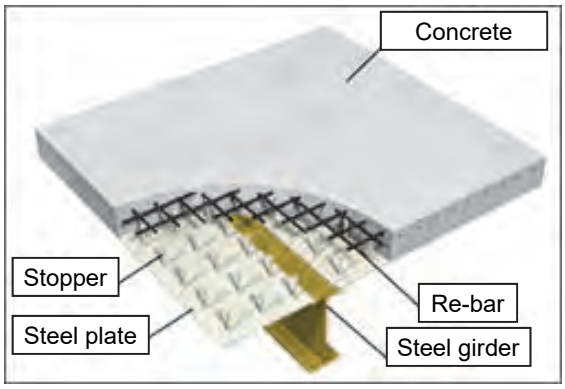
Composite slab has a steel-concrete composite structure that has much thinner, lighter and higher durability than ordinary RC slab. It attains these qualities by placing steel plates at the bottom surface and bears to tension due to bending moment. The steel plate at the bottom surface is used as a form when casting concrete and enables to do the work on site without installing scaffoldings and safety nets, and shortens the construction period. Moreover, it is very safe for the traffic crossing the construction site as well as securing workability.

The steel plate at the bottom surface protects traffic and pedestrians under the bridge from being hit by falling concrete blocks for the entire life span.

Several kinds of similar methods are registered in Ministry of Land, Infrastructure, Transport and Tourism (MLIT, Japan)[4]. The advantage of the composite slab is listed below.

- Short construction period
- Safe construction work
- Prevents concrete blocks from falling (very safe for traffic and pedestrians crossing under the bridge).

[4] http://www.netis.mlit.go.jp/NetisRev/Explanation/MainExplanation.asp (only available in Japanese)



Source: JICA Survey Team

Figure 6.2.13 Structure of Composite Slab

Source: JICA Survey Team

Figure 6.2.14 Example of Construction Works of Composite Slab

6) Epoxy Coated and Filled Strand Cable (ECF Strand)

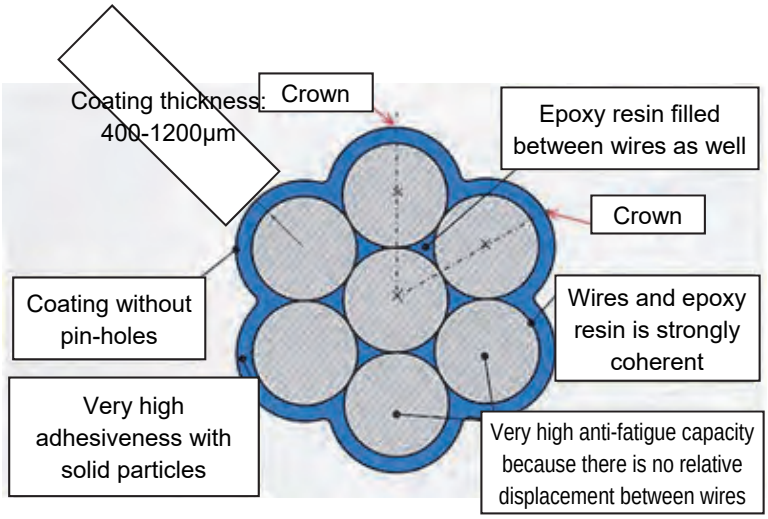
Epoxy coated and filled strand cable (ECF Strand) is a cable for PC bridges for which wires are coated or pre-grouted by epoxy resin. It can be applied to inner cables, outer cables, diagonal cables, and cables for pre-tension materials. The cable is protected from being exposed to air and liquid such as rain and waves and there is very scarce opportunity to be corroded, theoretically.

Moreover, it contributes to shortening the site works period because it has been coated or pre-grouted before shipment in the factory. Furthermore, it will reduce the maintenance cost and the LCC of those cables exposed to rain, waves, and chemical droplets, such as outer cables or diagonal cables of the bridges near the seashore or heavy industry plants.

Several products that use the epoxy coated method are registered in Ministry of Land, Infrastructure, Transport and Tourism (MLIT, Japan)[5]. The advantages of the ECF Strand are listed below.

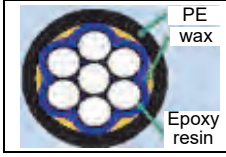
[5] http://www.netis.mlit.go.jp/NetisRev/Explanation/MainExplanation.asp (only available in Japanese)

- Very high anti-salt damage and anti-UV light capacity, and last for long term
- Improves workability
- Shortens the construction period
- Contributes to reducing maintenance cost and LCC of PC structure



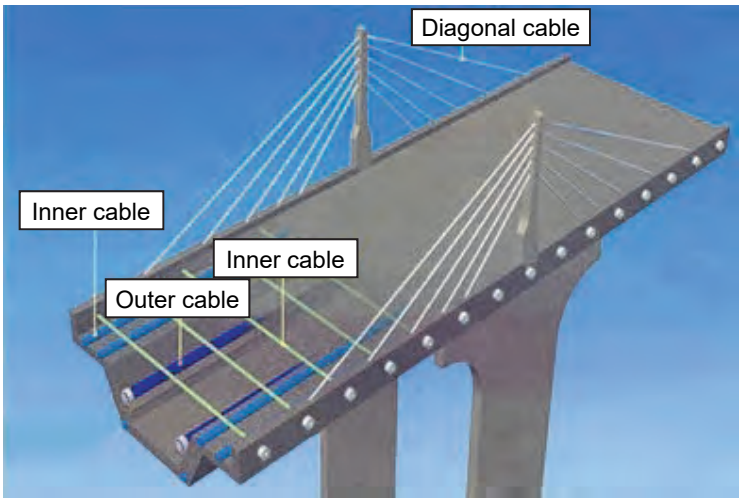
Source: JICA Survey Team

Figure 6.2.15 Section and Characteristics of ECF Strand

Cross Sectional View	Coating Type	Main Usage	Characteristics
	Standard	• Outer cable • Diagonal cable	• Very high anti-corrosion capacity • Very reliable with thick (0.4 mm) and strong coating
	Strong Adhesive	• Inner cable • Cables for Pretension PC materials • Diagonal cable	• Solid particles are buried on the surface to enhance the adhesiveness with concrete • Very high anti-corrosion capacity in salt damage environment • Applicable to Inner Cable and Pretension PC materials
	PE* Coating	• Outer cable • Diagonal cable	• Extremely high anti-corrosion capacity • Applicable in salt damage and UV light exposed environment
	PE+wax Coating	• Outer cable • Diagonal cable	• Extremely high anti-corrosion capacity • 3-layer coating of epoxy resin, wax, PE coating

Source: JICA Survey Team

Figure 6.2.16 Types, Usage, and Characteristics of ECF Strand



Source: JICA Survey Team

Figure 6.2.17 Location of ECF Strand on Bridges

7) Epoxy Coated Reinforcing Bar

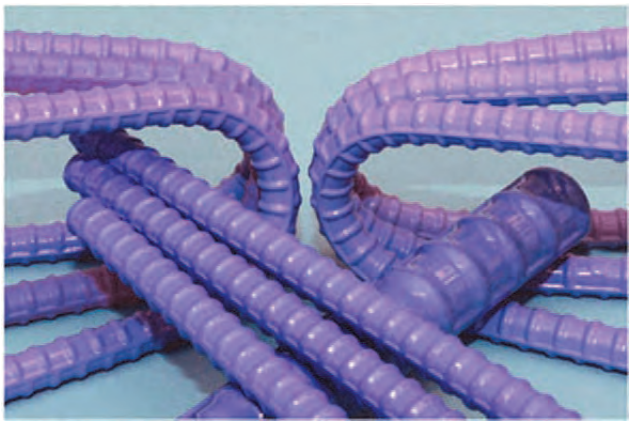
Epoxy coated reinforcing bar is usually applied to RC structures near the seashore as an anti-salt damage countermeasure. The epoxy coating protects re-bar from corroding. In other words, there will hardly be cracks due to re-bar corrosion. Therefore, it will facilitate to maintain the concrete structure sound and to reduce the LCC.

The 4th Ring Road, Section 4, and Bien Hoa – Vung Tau expressway, phase 2, and Phuoc An Bridge (with access road and IC) are planned including sections very near the seashore. A detailed study should be executed to select the appropriate structure for this rebar for the anti-salt damage countermeasure.

Several products that use the epoxy coated method are registered in Ministry of Land, Infrastructure, Transport and Tourism (MLIT, Japan)[6]. The advantages of the epoxy coated re-bar are listed below.

- Very high anti-salt damage capacity and lasts for long term
- Very scarce cracks due to re-bar corrosion
- Contributes to reducing maintenance cost and the LCC of RC structure

[6] http://www.netis.mlit.go.jp/NetisRev/Explanation/MainExplanation.asp (only available in Japanese)



Source: JICA Survey Team

Figure 6.2.18 Epoxy Coated Reinforcing Bar

Pier

RC slab

Source: JICA Survey Team

Figure 6.2.19 Example of Epoxy Coated Reinforcing Bar

6.3 Confirmation of Variable Feasibility

There are several problems/issues to be solved to realize implementation of the 6 candidate projects (8 sections) technically, financially and operationally. In this clause, technical, financial, and operational feasibility is confirmed by describing the problems to be solved with useful proposals.

6.3.1 Technical Feasibility

The following 4 problems/issues are the main technical problems/issues:

1) Very soft soil spread to the survey area
2) Scour around embankment and bridge substructure by river flow
3) Minimizing impact to current traffic flow during construction
4) Salt damage near the seashore

Among the abovementioned 4 problems/issues, 1) is mainly in embankment sections of road projects, 2) is a common problem/issue for road projects and bridge projects, and 3) and 4) are problems/issues in bridge projects.

Table 6.3.1 Relation between the Abovementioned Problems/Issues and Japanese Technology Mentioned in 6.2

	Abovementioned Problems/Issues	Japanese Technology Mentioned in 6.2
1)	Very Soft Soil spread to the Survey Area	[Road Project] 1) Plastic Board Drain Method 2) Light Weight Embankment Method
2)	Scour around Embankment and Bridge Substructure by River Flow	[Bridge Project] 3) Steel Pipe Sheet Piles Foundation
3)	Minimizing Impact to Current Traffic Flow during Construction	[Bridge Project] 4) Steel Piers 5) Composite Slab
4)	Salt Damage near the Seashore	[Bridge Project] 6) Epoxy Coated and Filled Strand Cable 7) Epoxy Coated Reinforcing Bar

Source: JICA Survey Team

Table 6.3.1 shows that the problems/issues to be solved to realize the 6 candidate projects are able to be solved by applying the Japanese technologies mentioned in 6.2. Moreover, the VN contractor can also solve these problems/issues in places where the problems/issues are not so severe. Therefore, it is judged that technical feasibility is secured by applying appropriate counter technologies.

6.3.2 Financial Feasibility

Among the 6 candidate projects (8 sections), there are only two projects that have a reliable financial source, which are Bien Hoa - Vung Tau Expressway, Phase 1, and the 3rd Ring Road, Section 4. These 2 projects have a high FIRR and could probably be implemented by BOT scheme. Other projects/sections are still searching for a reliable financial source. Procuring the project implementation cost is a very considerable issue to be solved in realizing the implementation.

The 3rd Ring Road, Section 3, is the only project, among the remaining projects/sections, for which financial source is being studied (by ADB). Among the remaining 5 projects/5 sections, 3 projects/3 sections (Bien Hoa - Vung Tau Expressway, Phase 2, HCM-Moc Bai Expressway, Phuoc An Bridge (with access road and IC)) are planned to be implemented by BOT scheme by VN I/As. However, feasibility and the possibility of the completion of these 3 projects by BOT scheme is very uncertain since they do not have a sufficient FIRR. The VN I/As for these projects will face the difficulty to find a BOT investor and sign the contract.

The remaining 2 projects/2 sections (4th Ring Road, Section 4, and 2nd My Thuan Bridge) do not have a specific reliable financial source yet and the problem of procuring finance still remains serious.

As is mentioned above, many projects still suffer in improving financial feasibility. Table 6.3.2 shows the problems and current status of the 6 candidate projects (8 Sections).

Table 6.3.2 Problems and Current Status of 6 Candidate Projects (8 Sections)

Project	Section	I.V.G[*1]	Financial Feasibility	Current Status	Applicability of ODA[*3]	R.F.S[*2]	I/A
3rd Ring Road	Section 3: Binh Chuan – NH22	BOT	Medium	I/A is intending to implement by BOT scheme but there is very small possibility to realize only by toll income assumed in this survey.	Medium	ODA/ PPP	Cuu-Long CIPM
	Section 4: NH 22 – Ben Luc	ODA	High	I/A is intending to implement by ODA but the survey results show relatively high financial feasibility and possibility to implement by BOT scheme. Since ADB and JICA are studying to co-finance the project a PPP scheme will increase the financial feasibility even more.	Medium	BOT	Cuu-Long CIPM
4th Ring Road	Section 4: Ben Luc – Hiep Phuoc	Undeci ded	Low	No particular donor shows an interest in providing the fund yet but logistics from Mekong Delta Region will benefit by an effiective access to the planned Hiep Phuoc Port. Increase of the future traffic deman will be a key for fund raising.	High	ODA	Cuu-Long CIPM
Bien Hoa - Vung Tau Expressway	Phase 1: Bien Hoa – Phu My	BOT	High	I/A is intending to implement by BOT scheme and it has sufficient financial feasibility. There is high possibility to be implemented by BOT scheme.	Medium	BOT	PMU 85
	Phase 2: Phu My – Vung Tau	BOT	Medium	I/A is intending to implement by BOT scheme but there is very small possibility to realize only by toll income assumed in this survey.	Low	ODA/ PPP	PMU 85
HCM-Moc Bai Expressway		BOT	Medium	I/A is internding to implement by BOT scheme but there is very small possibility to realize only by toll income assumed in this survey. Meanwhile, it is expected to facilitate the development of crossborder traffic and trunk roads.	High	ODA/ PPP	TSP MU
2nd My Thuan Bridge		ODA	Low	I/A is intending to implement by ODA and Japanese government has undertaken F/S for the preparation of implementation.	High	ODA	PMU 7
Phuoc An Bridge (with access road and IC)		BOT	Medium	I/A is intending to implement by BOT scheme. Though the FIRR is very low agaist the toll rate assumed in this survey, it is possible to raise the toll rate. Besides, the bridge will validate easier access to the Cai Mep-Thi Vai port and alleviation of heavy traffic from NH 51.	High	ODA/ PPP	Ba Ria – Vung Tau DOT

*1: Intent of Virtnamese Government

*2: Recommended Financial Scheme by JICA Survey Team

*3: Refer to "Table 6.1.1"

Source: JICA Survey Team

A more detailed and reliable feasibility study is required to solve financial issues. Moreover, to decide on an appropriate project scheme and volume and save on the initial investment cost is the most important countermeasure to this issue. For example, to design fewer bridges in sections where embankment is possible, to avoid constructing with many lanes only to deal with traffic volume increase in the far future. In the construction phase, setting the construction section and period must be studied carefully; it is necessary to avoid unnecessary financial procurement

In Phuoc An Bridge (with access road and IC), there are 2-layer flyover type IC planned as shown in Figure 6.3.1. Review of this plan is necessary and revising the plan by reducing crossing structures, such as flyovers, and applying grade intersections until the traffic volume is sufficient for the structure is worth constructing. The 3rd Ring Road is planned to implement with 4 lanes from the 1st phase but the number of lanes can be reviewed, especially in the long bridge section, until traffic volume is sufficient for the structure in order to reduce the initial investment cost.

Source: JICA Survey Team

Figure 6.3.1 Image of IC with Approach Road of Phuc An Bridge and Approach Road in Dong Nai Province

On the other hand, some projects are planned to be implemented by BOT scheme with very little public investment. However, these projects are all very big projects that require a huge amount of financial investment and risk and volatility of recouping the investment, and making a profit is considerably big and difficult to manage. Therefore, applying a PPP scheme and increasing the public investment to relieve the financial difficulties of BOT private investors is a very meaningful and effective countermeasure in order to increase projects' financial feasibility. Especially, a detailed study on the 3rd Ring Road, Section 3, and Phuoc An Bridge (with access road and IC) is desirable since

both projects have high socio-economic feasibility (EIRR, B/C and NPV) and a high volume of traffic forecast demand.

The survey team also proposes utilizing ODA as a financial source of public investment in a PPP scheme. It is very effective and a two-tiered scheme helps the BOT investor to recoup the investment and make profit. It also removes their barrier to joining the project and makes it easy to form a consortium/joint venture. This scheme is planned and nearly ready to implement by KOICA and a Korean private investor on the 3rd Ring Road, Section 1 and 2 (ODA finance for construction of bridges, which is relatively high cost, and private investor finance for embankment section with low cost.) It is also planned for the investor to operate the entire section.

The survey team also proposes to study the co-financing with ADB for the 3rd Ring Road, section 4 in the F/S, which is about to start by ADB, not excluding the possibility of designing a PPP scheme and utilizing ODA for public investment.

6.3.3 Operational Feasibility

To improve operational feasibility is to reduce the operation & maintenance (O&M) cost as much as possible. It is necessary to make best use of private initiative, experience, and know-how, and do whatever possible to realize the minimization of the O&M cost. In this sense, setting BOT in the center of the policy to implement road and bridge projects does make sense. However, the BOT investors are limited to Vietnamese companies due to various regulations regarding PPP/BOT.

Road transport infrastructure and related services are defined as one of the investment projects for PPP investment in a new decree of PPP in VN (Decree No. 15/2015/ND-CP), according to the published document of Japan External Trade Organization (JETRO)'s Hanoi office[7]. However, there is no BOT/PPP road and bridge project that the foreign investors have joined. The following paragraph describes the problems with the regulations that make foreign investors hesitate in joining those projects.

There are BOT as well as Build Transfer Operate (BTO) schemes defined in the degree, but as far as the survey team is concerned, the only scheme that has successfully made the contract between the government and the private sector is the BOT scheme. If the implemented infrastructure is considered as a fixed property, there would be the obligation for the investor (BOT project operator) to pay property tax according to Japanese tax regulations. However, Vietnam tax regulations do not impose a tax on fixed property in a way similar to Japan. Private sector parties, including individuals, are not allowed to own the land and the right of land-use is provided to those who use the particular land with obligation to pay the fee. However, BOT and BTO projects are exempted from paying the fee during the project operation period and the land acquisition cost is allowed to deal as depreciable cost. Therefore, the cash-flow of the two schemes (BOT/BTO) will not differ during the project period due

[7] https://www.jetro.go.jp/world/reports/2015/02/3a99357d720dfc15.html, (JETRO Haoni office, Mar, 2015, only available in Japanese)

to the difference of the schemes. In fact, unless there is a major loss due to a force majeure incident, the balance between the two schemes (BOT/BTO) makes little difference. However, there is no article that defines risk allocation between government and investor. This does not allow the investor to calculate and manage the project risk. Moreover, it makes the foreign investors hesitate to join the project as an investor. Therefore, risk allocation must be defined and the risk must be burdened by the player who can take the risk the most. In addition to the risk allocation article, there are very few articles related to a foreign currency conversion system guaranteed by the government, which is a major method to hedge foreign exchange rate risk. It is only mentioned that it needs to be studied for application. It can be judged that the decree does not clarify the risk allocation of force majeure and does not allow managing the foreign exchange rate risk in common ways. It can be judged that this is the reason that keeps foreign investors far from joining the project as an investor.

On the other hand, most of the BOT projects in the road sector already in operation do not have a business model that recoups the investment and makes profit by toll income from road users or by service fee from the government. The investors are provided development rights along the roadside and they earn profit by developing other businesses utilizing those rights.

The survey team proposes a two-tiered system[8], a PPP scheme, which is executed in Port and Airport field. This scheme can be utilized not only to reduce initial investment and make it easy for the private sector to recoup the investment, to make profit from the project, and to join the BOT road project, but also provide incentive to the investor to improve the service level for road users with additional equipment, such as Electronic Toll Collection (ETC), information technology of Intelligent Transport Systems (ITS), for instance. The 3rd Ring Road, Section 1 and 2, is planned to be implemented by Korean initiative, as mentioned in Chapter 3. This project is planned so that construction is divided into 2 sections, one is embankment with low initial cost, constructed by the private sector, and the other is the bridge/viaduct section with high initial cost, constructed by ODA. It could be one of the first examples of a BOT road project with a two-tiered system.

[8] Lach Huyen Port is planned to be implemented by Japanese ODA and be operated by private sector after the completion of construction. Noi Bai international airport terminal 2 was also implemented by Japanese ODA which was opened in Apr. 2015. There are private sector parties joining the operation and maintenance of the terminal.

7 SELECTION AND ARRANGEMENT OF CANDIDATE PROJECTS SUPPORTED BY JAPANESE ODA

7.1 Selection Method

While the Government of Vietnam (GOV) has been facied with financial difficulties, it is developing legal systems to promote infrastructure development by PPP/BOT. However, practical use of ODA is necessary for unprofitable projects. Besides, application of Special Terms for Economic Partnership (STEP) is considerable for the case required new/high construction technology.

The selection of candidate project supported by Japanese ODA is conducted in consideration of the following viewpoints. Moreover, the selection criteria are shown in Table 7.1.1.

- Heavy traffic demands
- High economic effectiveness
- It is difficult to utilize PPP/BOT scheme due to low financial effectiveness.
- Technical advantage to Japanese companies
- The project is not listed by other donors as independent assistance
- Prompt improvement to the business is required

Table 7.1.1 Selection Criteria of Candidate Projects Supported by Japanese ODA

Subject	Condition	Mark	Description
Traffic Demand	Large: T≥90,000 pcu/day	2	Evaluate with index of traffic demand (pcu/day) which requires more than 4 lanes
	Small: T<90,000 pcu/day	0	
Economic Effectiveness (EIRR)	High: ≥18%	2	Evaluate in 3 levels based on result of EIRR
	Medium: 15~18%	1	
	Low: 12~15%	0	
Financial Effectiveness (FIRR)	Low: <13%	2	Evaluate in 3 levels based on result of FIRR
	Medium: 13~18%	1	
	High: ≥18%	0	
Superiority of Japanese Technology	High: Applicable to STEP	2	Evaluate in consideration of possibility of application to STEP or possibility of utilization of Japanese technology
	Medium: Can be utilized	1	
	Low: Not required	0	
Supporting schedule by other donors	Existence	2	Evaluation considers if support has been scheduled at the moment or if there is interest from other donors
	Non-existence	0	
Project urgency	High: Ungently required	2	Project urgency evaluated in consideration of the situation of adjacent projects
	Low: Premature	0	

Source: JICA Survey Team

7.2 Selection and Arrangement of Candidate Projects Supported by Japanese ODA

7.2.1 Selection of Candidate Projects

In regard to the project, which is highly evaluated to be applicable to Japanese ODA as per Table 6.3.2, the validity of its selection as a candidate project shall be verified.

Table 7.2.1 Selection of Candidate Projects by Japanese ODA

Project	Traffic Demand (pcu/day)	Economic Effectiveness (EIRR)	Possibility of PPP-BOT/ Financial Effectiveness (FIRR)	Superiority of Japanese Technology	Supporting Schedule by Other Donors	Project Urgency	Evaluation
	L:T>90,000 S:T<90,000	H: >18% M: 15~18% L: 12~15%	L: <13% M: 13~18% H: >18%				
4th Ring Road Section4: Ben Luc–Hiep Phuoc	0 (38,000)	1 (16.7%)	2 (Negative)	1 (Medium)	2 (NO)	0	6
HCMC-Moc Bai Expressway	2 (99,000)	0 (14.0%)	1 (15.2%)	1 (Medium)	1 (YES*1)	2	7
2nd My Thuan Bridge	0 (61,000)	0 (13.7%)	2 (Negative)	2 (High)	2 (NO)	2	8
Phuoc An Bridge	0 (21,000)	1 (16.5%)	2 (1.4%)	2 (High)	0 (NO*2)	0	5

*1: KOICA has scheduled the Pre-F/S, GOV has been considering other donors to accelerate the implementation of the project, including F/S.

*2: Ba Ria – Vung Tau Province pursues a course to proceed with implementation by BOT.

Source: JICA Survey Team

The result of selection by Japanese ODA stated in Table 7.2.1 suggests the two projects, excluding the Phuoc An bridge and 4th Ring Road (Section4), have been highly evaluated.

Regarding the Phuoc An bridge, (1) Ba Ria – Vung Tau Province has pursued policy to continue as BOT. MOT also has agreed that the province will implement this project. (2) Although the FIRR shows a low rate, the EIRR (16.5%) is 4% more than the standard rate (12%). It can be expected that revising up the toll rate initially set improves the profitability because NPV is 1.2 times more than the initial investment. (3) There are port facilities including Cai Mep port, Thi Vai port and Phuoc An port as well as freight distribution centers, factories and power plants in the south of the Phuoc An bridge. The Inter-port Road connecting the ports is under construction, which is access road to the Phuoc An bridge. (4) In Dong Nai Province located to the north of the Phuoc An bridge, this project will contribute to the development around the access road section from the Phuoc An bridge to the Ben Luc – Long Thanh Expressway and the development of the industrial park in Long Thanh. Therefore, the beneficiaries of this project are expected to join as BOT. (5) On the other hand, even though Ba Ria – Vung Tau Province is taking the initiative to proceed with this bridge construction, it will take a long time to adjust between Ba Ria – Vung Tau Province and Dong Nai Province and with BOT investors, because the bridge across in Dong Nai Province as well.

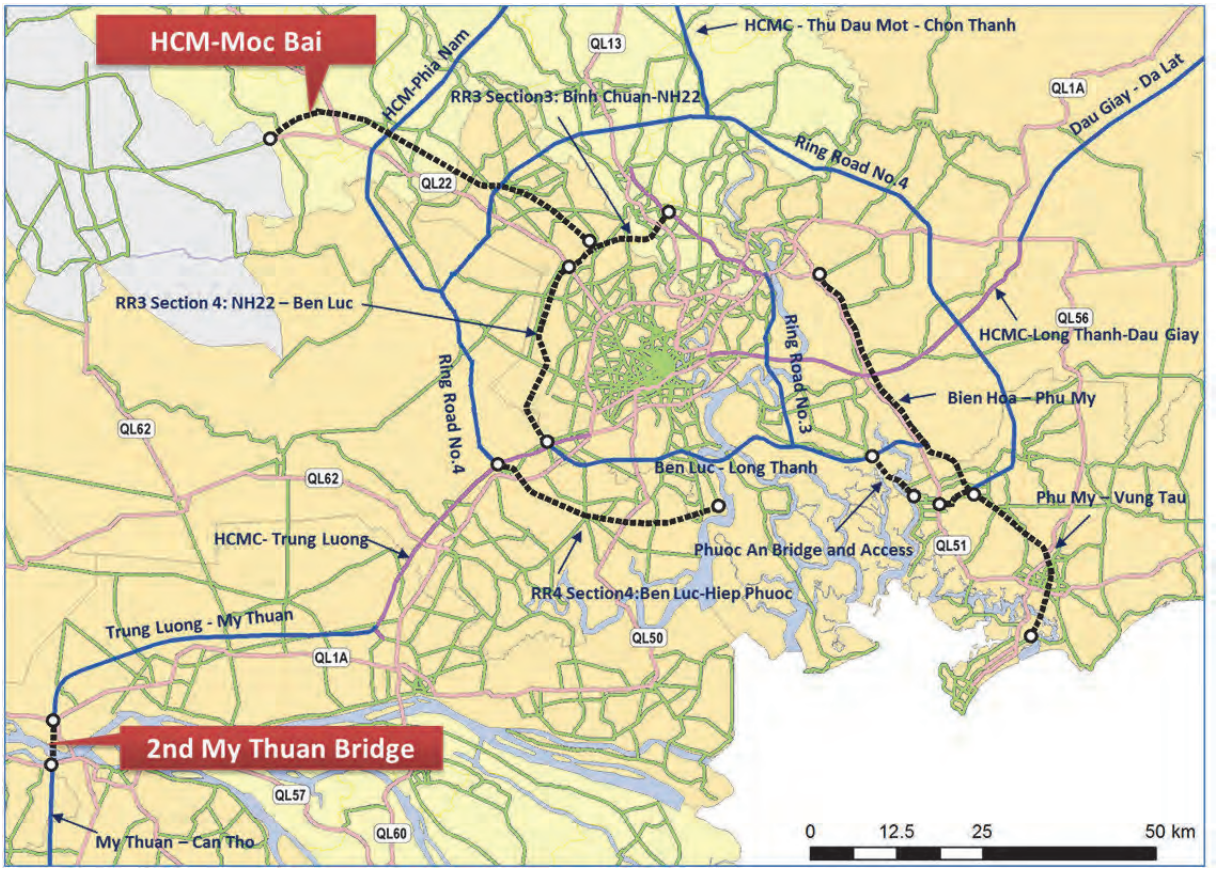
Regarding the 4th Ring Road (Section 4), “Department of Transport, Ho Chi Minh City” and “Cuu Long CIPM” deem it a high importance project, however, it deems it premature to maintain the road

because the 3rd Ring Road has not been completed and the ongoing project of upgrading and utilizing of Cai Mep - Thi Vai port should be prioritized as a policy issue. Therefore, the priority of the aforesaid project seen as important for the access to the port seems low.

Hence, the following two projects are recommended as the selected candidate projects for Japanese ODA.

- HCMC – Moc Bai Expressway
- 2nd My Thuan Bridge

The location of the two aforementioned projects is shown in Figure 7.2.1.



Source: JICA Survey Team

Figure 7.2.1 Location Map of Candidate Projects by Japanese ODA

7.2.2 Arrangement of Candidate Projects

In respect to the two candidate projects suggested in 7.2.1, their current statuses and source of project financing have been summarized in Table 7.2.2.

Table 7.2.2 Arrangement of Candidate Projects

Project Name	Status	Fund	Availability of Co-financing
HCMC- Moc Bai Expressway	- Pre-study has been completed - KOICA engaged ROD with MOT (June, 2016) - Pre-F/S and Railway F/S have been planned for implementation	Not yet determined	-
2nd My Thuan Bridge	- METI F/S has been completed. (2011) - The section between Trung and My Thuan is under construction - The section between My Thuan and Can Tho is under negotiation by PMU7 and BOT company	Not yet determined	-

Source: JICA Survey Team

KOICA shows interests in the "HCMC-Moc Bai" project as stated in Table 7.2.2. However, MOT has been considering other donors to accelerate implementation of the project according to the hearing from Traffic Safety Projects Management Unit (TSPMU), the implementation agency. Therefore, monitoring of the project is required.

The 2nd My Thuan Bridge has been scheduled to be constructed at the crossing point of the Tien River along the North-South expressway, and the section HCMC - Trung Luong has already been in service. Furthermore, the next section, Trung Luong – My Thuan, has been under construction and its target for completion has been set as 2018. Under the circumstances, financing by ODA is adequate and the implementing body, PMU7, aims to apply this, however, the fund has not been determined. In consideration of the F/S completed by the Japanese Government (METI), the GOV is expecting further assistance from the Japanese Government.

8 PROJECT OPERATION AND EFFECT INDICATOR

8.1 Selection of Project Operation and Effect Indicator

8.1.1 Overview

JICA has been utilizing a system of operation and effect indicators in order to quantitatively inspect and evaluate project performance since 2000. The operation and effect indicators are both deemed as relevant to the outcome indicator, which is defined by the World Bank. In the log-frame of the JICA loan project, it is mentioned as an index of the "Project Objective".

The operation and effect indicators shall be utilized for measurement of facility operating status, project utility, and practicality in operation and maintenance.

8.1.2 Project Operation and Effect Indicator

Definitions of the operation and effect indicators are as follows:

- Operation Indicator: A quantitative indicator to measure the operational status of a project
- Effect Indicator: A quantitative indicator to measure the effects generated by a project

For quantitative evaluation of the project effectiveness, the criteria have been set based on available data and consultation with related organizations. Project monitoring and evaluation shall be held after two years of the project completion.

Table 8.1.1 Selection of Project Operation and Effect Indicator

Indicator		
Operation	Traffic Volume	Total traffic volume (pcu/day)
		Freight vehicle traffic volume (pcu/day)
		Bus & passenger vehicle traffic volume (pcu/day)
Effect	Traveler's Time	Traveler's time at morning peak hour, 8:00 am (minutes)
	Average Speed	Average speed at morning peak hour, 8:00 am (km/hour)

Source: JICA Survey Team

8.2 Considerations of Project Evaluation

Considerations for the operation of the project evaluation are shown in Table 8.2.1.

Table 8.2.1 Considerations for Operation of Project Evaluation

Item	Consideration
Policies / Institution / Framework	To confirm whether the policies, institution and framework are conducted without change.
Prioritization of Upper Level Plan	To confirm whether the prioritization of the upper level plan is conducted without change.
Project Effect (after completion of the project)	- To confirm the time crunch of access - To confirm the improvement of traffic safety for neighboring road - To confirm the improvement of traffic congestion for neighboring road - To confirm the change of income for neighboring households
Impact on Natural and Social Environment	To confirm the impact on natural and social environment by the project
Objective Project for Project Evaluation	To confirm the completion date, whether they are completed as scheduled

Source: JICA Survey Team

The correspondence between the development needs of Vietnam and the assistance policy of Japan must be verified according to Table 8.2.1. It is also important to verify the status of operation and maintenance after 2 years of completion.

Besides, the revalidation for the original project cost must be verified, whether the cost is sufficient or not. Especially, if the cost is greater than originally expected, the scope of the next project must be reviewed. In case of increase due to a land acquisition delay, it is expected to conduct capacity building assistance based on the monitoring and to utilize it when finding the next project.

9 SYNOPSIS AND RECOMMENDATIONS

9.1 Synopsis and Recommendations

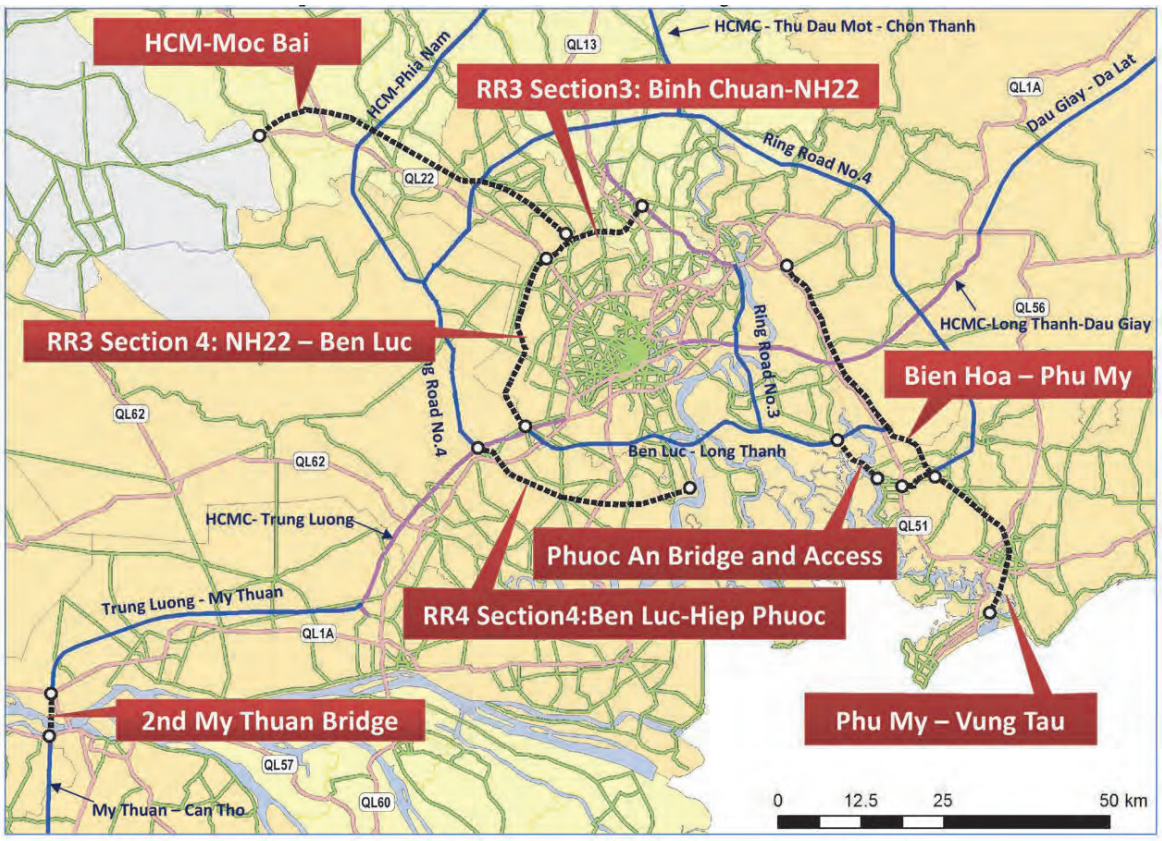
The survey that began with the data/information gathering and traffic surveys in February 2016 has come to this final stage in July 2016 to summarize major tasks and recommendations for the survey. After going through several screening steps, recommendations were prepared as follows:

- First of all, 22 long-list projects were selected after confirming the current status of road and bridge projects, which were collected by interviewing relevant authorities or enumerated from such plans as national, regional, provincial, urban development plans and transport development plans.
- Subsequently, the long-list projects were scrutinized by the multi-criteria method, which resulted in the shortlist of projects (6 projects or 8 sections, as presented in Figure 9.1.1) as the first priority group of projects.
- All short-list projects whose EIRR exceeded 12% were found economically feasible.
- Financial analysis of the shortlist projects revealed their financial viability. That is, Section 4 of the 3rd Ring Road (NH 22 – Ben Luc section) and Phase 1 (Bien Hoa – Phu My section) of Bien Hoa – Vung Tau Expressway are financially feasible (FIRR$\geq$18%) and worth pursuing implementation by BOT method. Especially, the implementation method of Bien Hoa – Phu My section project is compatible with the intention of the project executing authority.
- On the contrary, Section 4 of the 4th Ring Road (Ben Luc – Hiep Phuoc section) and the 2nd My Thuan Bridge projects were found financially not feasible. That is, those are not suitable for the BOT method.
- Section 3 of the 3rd Ring Road (Binh Chuan – NH 22 section) shows a FIRR of 15.9%, which is a little lower than the feasibility criterion of 18%. Meanwhile, its economic feasibility indicators, such as EIRR (37.0%) and B/C (6.29) are significantly high, and especially, the NPV exceeds more than 3-fold the cost, which could imply that the project users could afford to pay a tariff higher than those assumed in this survey. It is therefore recommendable that a more detailed investigation should be carried out to examine the possibility to apply either PPP or BOT for this project implementation.
- As the consequence of applicability analysis on the ODA financing (regardless of Japanese ODA), the following 4 projects were selected: (1) Section 4 of the 4th Ring Road (Ben Luc –

Hiep Phuoc), (2) HCMC – Moc Bai Expressway, (3) the 2nd My Thuan Bridge, and (4) Phuoc An Bridge.

- Among the 4 projects mentioned above, Section 4 of the 4th Ring Road (Ben Luc – Hiep Phuouc) is eliminated from the ODA project candidates because of its immaturity of planned linkages with the 3rd Ring Road and Hiep Phuoc Port developments.
- Similar to Section 3 of the 3rd Ring Road, the FIRR of Phuoc An Bridge shows a very low rate of 1.4% but its economic feasibility indicators show relatively high rates, such as 16.5% EIRR and 3.0 B/C, and especially the NPV exceeds more than 1.2 times the cost. In addition, since the area adjacent to the project bridge is to include such development plans as industrial parks and new ports, the project cost could be affordable by PPP/BOT method or covered by the overall costs for the area development and shared by all the development beneficiaries. The intention of the DOT of Ba Ria – Vung Tau Province is to implement the project by BOT and therefore, BOT is recommended for this project.
- Further, the possibility of employing Japanese technology is discussed when selecting potential priority projects relevant to the Japanese ODA. As a consequence, the following 2 projects are recommended but it should be noted that HCMC – Moc Bai Expressway project needs to confirm that the MOT's intention is in line with commitments made by other donors.

  1. HCMC – Moc Bai Expressway
  2. The 2nd My Thuan Bridge



Source: JICA Survey Team

Figure 9.1.1 Location Map of Shortlisted Projects