No.

SOCIALIST REPUBLIC OF VIETNAM
MINISTRY OF TRANSPORT
PROJECT MANAGEMENT UNIT NO.2
(PMU2)

PREPARATORY SURVEY
ON
LACH HUYEN PORT INFRASTRUCTURE CONSTRUCTION PROJECT
(ROAD AND BRIDGE PORTION)
IN
THE SOCIALIST REPUBLIC OF VIETNAM

FINAL REPORT

July 2010

JAPAN INTERNATIONAL COOPERATION AGENCY

NIPPON KOEI CO., LTD.
JAPAN BRIDGE & STUCTURE INSTITUTE, INC.

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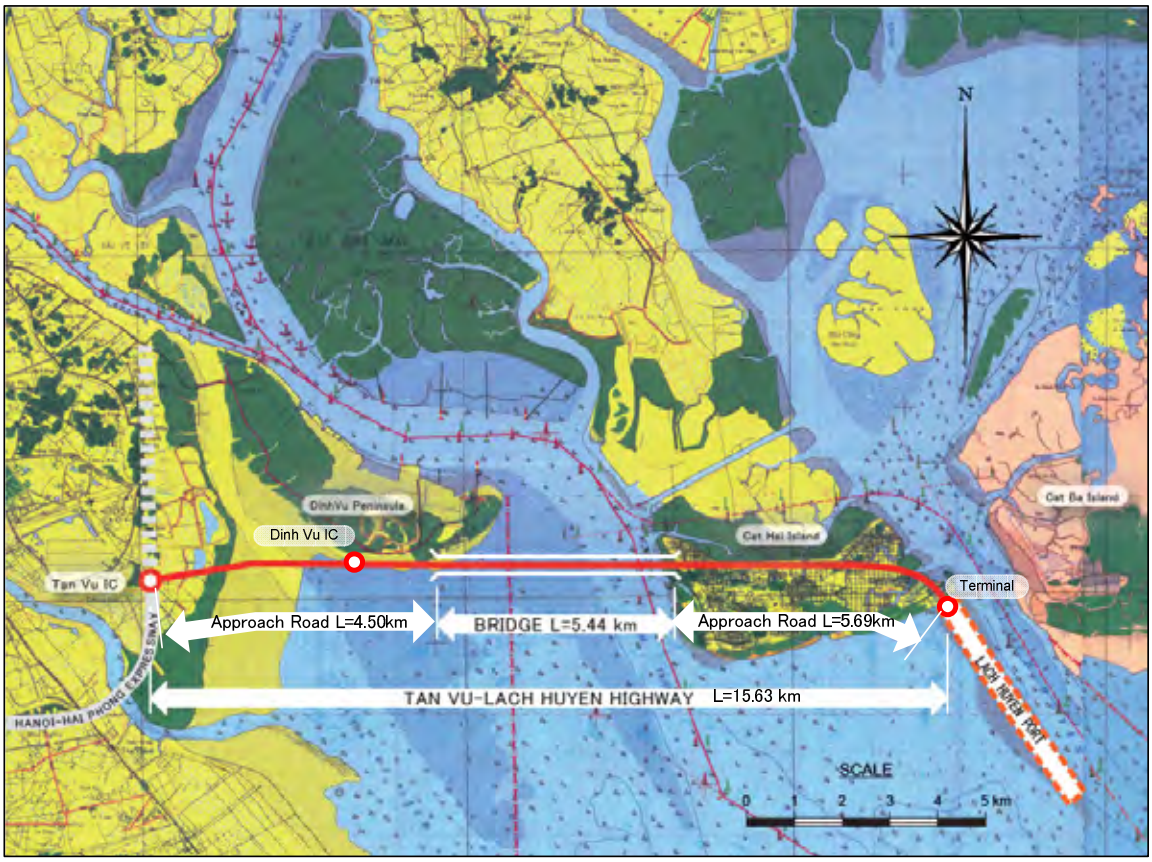

LEGEND

- Tan Vu - Lach Huyen Highway
- Express Highway (Plan)
- International Boundary
- Province Boundary
- National Road
- Main Road
- River
- International Capital
- Port

LOCATION MAP
TAN VU-LACH HUYEN HIGHWAY

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DEFINITIONS AND ABBREVIATIONS

(1) Agencies

AASHOTO	American Association of State Highway and Transportation Officials
ADB	Asian Development Bank
CPRGS	Comprehensive Poverty Reduction and Growth Strategy
DDOT	District Department of Transport
DRVN	Directorate of Roads for Vietnam
EPZ	Export Processing Zone
ERC	Environmental Research Center
HCMC	Ho Chi Minh City
HPPC	Hai Phong People's Committee
IBRD/WB	International Bank for Reconstruction and Development/World Bank
JICA	Japan International Cooperation Agency
L/A	Loan Agreement
LGU	Local Government Unit
MOD	Ministry of Defense
MOF	Ministry of Finance
MOHC	Ministry of Health Control
MONRE	Ministry of Natural Resources and Environment
MOP	Ministry of Public Security
MOT	Ministry of Transport
MOTE	Ministry of Training and Education
MPI	Ministry of Planning and Investment
MPMU2	Maritime Project Management Unit No.2
NOT	National Organization of Transport
PC	People's Committee
PCI	Pacific Consultants International
PDI	Project Implementation Division
PDOT	Thai Nguyen Provincial Department of Transport
PMU2	Project Management Unit No.2
PPC	Provincial People's Committee
PPIC	Provincial Planning and Investment Committee
PTA	Provincial Transport Authorities
RRMC	Road Repair and Management Company
RRMU	Regional Road Management Unit
SAPROF	Special Assistance for Project Formation
SEAGAMES	South East Asian Games
TEDI	Transport Engineering Design Incorporation
TID	Traffic Inspection Department
TMD	Traffic Management Department
TP	Transport Police
TPB	Transport Police Bureau
TRANCO	Transport Company
VIDIFI	Vietnam Infrastructure Development and Finance Investment Joint Stock Company
VITRANSS	Vietnam Transport Development Strategy Study
VRA	Vietnam Road Association, Ministry of Transport
NTSC	National Transport Safety Committee
UNDP	United Nations Development Program
WB	World Bank

(2) Technical, Traffic and Economic Terms

AC	Asphalt Concrete
ADT	Average Daily Traffic
B/C	Benefit/Cost
CBR	California Bearing Ratio
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
FIRR	Financial Internal Rate o Return
FR	Feeder Road
FS	Feasibility Study
GDP	Gross Domestic Product
GRDP	Gross Regional Domestic Product
HWL	High Water Level
IC	Interchange
ICB	International Competitive Bidding
IRI	International Roughness Index
LCB	Local Competitive Bidding
MSS	Movable Scaffolding System
MD	Man-Day
MM	Man-Month
MCI	Maintenance Control Index
NH	National Highway
NPTS	National Program for Traffic Safety
NPV	Net Present Value
OD	Origin Destination
ODA	Official Development Assistance
O&M	Operation & Maintenance
PAP	Project Affected People
PCU	Passenger Car Unit
RAP	Resettlement Action Plan
ROW	Right of Way
SBS	Span by Span
TCVN	Standard of Vietnam
TSAS	Traffic Safety Audit System
TV-LH HWY	Tan Vu-Lach Huyen Highway
USD	US Dollar
VLSS	Vietnam Living Standard Survey
VND	Vietnam Dong
VOC	Vehicle Operation Cost

1. INTRODUCTION

1.1. Background of the Project

In northern Vietnam, various foreign and domestic companies are contributing to the economic development in the region connecting the capital city of Hanoi and the coastal city of Hai Phong. Supporting the activities of these companies are the main ports in the region, Cai Lan Port and Hai Phong Port, which were rehabilitated under Japanese ODA Loan. The total capacity of these ports has been expanded to 75 million tons. However, considering the rapid socio-economic development in the region and that the required expansion of these ports is technically and socially difficult, it is urgently needed to develop a new port to cover the future demand of cargo volume which is expected to surpass 100 million tons in 2020.

Under these circumstances, the Ministry of Transport (MOT) in Vietnam requested JICA for an ODA Loan to support the project which consists of construction of container terminals for Lach Huyen Port, and the access road and bridge to the port. This scope is intended to implement the plans proposed in the feasibility studies related to both the port development and the road development. In response to this request, JICA is now carrying out a preparatory survey for the project formation in order to verify the necessity and validity of the project, mainly for the port portion, starting from October 2009.

In addition to the port development, JICA carried out a preparatory survey for the road and bridge portion, i.e., Tan Vu - Lach Huyen Highway. This includes review and update of the feasibility study (F/S) which is being finalized by MOT.

1.2. Objectives of the Survey

In order to assist the project formation for the road and bridge portion, this survey aims to complement the F/S and EIA by reviewing and updating the validity of the implementation plan from the viewpoints of scope, work methodology and work schedule, on the basis of a Japanese ODA loan with STEP scheme application.

1.3. Survey Area

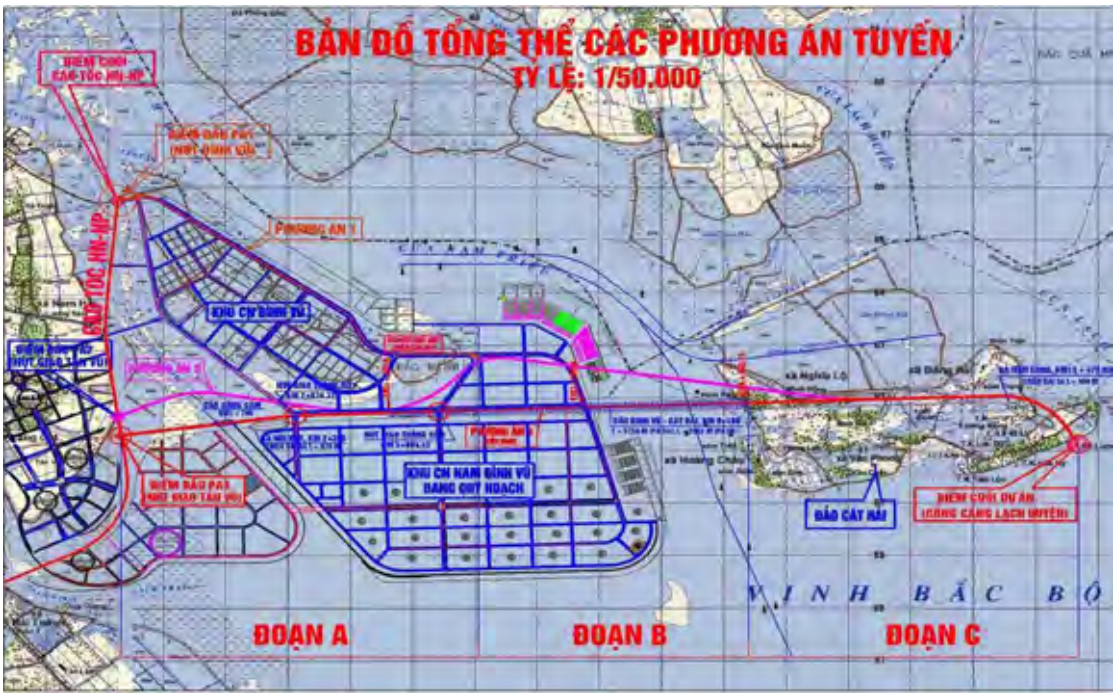
The study area covers the section between Tan Vu and Lach Huyen as shown in Figure 1.3-1.

Table 1.3-1 Study Areas

Proposed beginning point:	End point of Hanoi- Hai Phong Expressway at Tan Vu, Hai Phong City.
Proposed ending point:	Lach Huen International Gateway Port on Cat Hai Island, Hai Phong City.
Length of Route:	About 16 km in total, including the 5.44-km Cat Hai Bridge.

Presently, Dinh Vu Industrial Zone is actively being developed in accordance with the master development plan of Hai Phong City. Traffic volume from the industrial zone, through the

urban area, to National Highway No.5, is increasing rapidly due to the development of the industrial zone. As a result, traffic congestion often occurs and adversely affects the regional economic activities.



Source: Hai Phong City Master Plan

Figure 1.3-1 Study Area

1.4. Study Revision Chronicle

The Draft Final Report was submitted on 7 June 2010. Subsequently, a JICA Follow-up Mission had been carried out from 7 to 18 June 2010 on the basis of the report.

The materials for discussions between the JICA mission and MOT are attached in Appendix-9. Updates of the study in accordance with the result of discussions between the JICA mission and MOT are attached in Appendix-10.

2. PROJECT OUTLINES

2.1. Project Objectives

The Lach Huyen International Gateway Port Construction Project consists of the following two work portions:

(1) To build a new international deep-sea port and related basic infrastructure in Lach Huyen area at Cat Hai District in Hai Phong City, in order to respond to the rapid increase of demand in cargo volume, thereby contributing to economic development and greater competitiveness in the international market, and

(2) To build a road and bridge section between Tan Vu District in Hai Phong City and the Lach Huyen Port.

This Survey covers the abovementioned road and bridge work portion, i.e., Tan Vu – Lach Huyen Highway Construction Project.

2.2. Tentative Project Outlines

The scope and schedule of the project were updated during the discussion between JICA and MOT from June 7 to June 18, 2010. The updated scope and schedule are summarized in Appendix-10.

2.2.1. Overview of the Project

Tan Vu – Lach Huyen Highway Construction Project is a new highway construction investment project aimed at connecting developing areas, which have been planned and constructed rapidly in the southeast of Hai Phong City including new Lach Huyen International Port and Dinh Vu Industrial Zone, to Hanoi – Hai Phong Expressway which has been under construction.

The project area is located in the jurisdiction of Hai Phong City, which is the third largest city in Vietnam with a population of 1.9 million and population density of 1,250 persons/km^2 as of 2008. Hai Phong City is located in the mouth of the Red River, approximately 100 km away from the capital Hanoi. Hai Phong City serves as the primary seaport for the northern focal economic region in Vietnam.

The project is very necessary for the development program of Dinh Vu – Cat Hai Economic Zone with the aim of connecting Lach Huyen International Port and Nam Dinh Vu Industrial Zone to Hanoi – Hai Phong Expressway. In the Statement No. 6061/BGTVT-KHDT dated August 18, 2008 sent to the Prime Minister, the Ministry of Transport (MOT) has evaluated that "this project is very important to be conducted simultaneously with the project of building the Hanoi – Hai Phong Expressway, meeting the needs of regional development and implementating the Lach Huyen International Gateway Port".

The project was originally planned to be delivered as a build-operate-transfer (BOT) scheme project financed by Vietnam Infrastructure Development and Finance Investment Joint Stock Company (VIDIFI). The draft feasibility study (F/S) report was prepared for the BOT scheme in July 2009. However, project ownership was transferred to MOT in December 2009 through

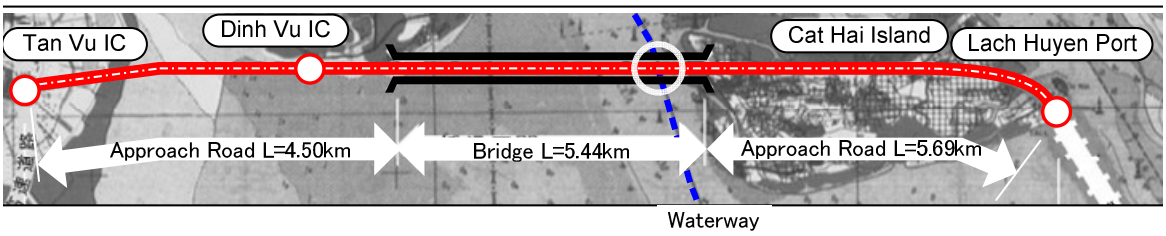
Letter No.8677/VPCP-KTN. The F/S report was then officially handed over from VIDIFI by Notice No. 73/TB-BGTVT dated March 3, 2010. Since the transfer, the project has been prepared as a project financed under Japanese ODA Loan.

2.2.2. Summary of Construction Works

(1) Route

In the F/S, the project route was 15.63 km long, including three main sections as follows:

- Section 1: Tan Vu Intersection to the west abutment of the approach bridge, 4.50 km long, consisting of embankment section with the Cam River box-culvert and Dinh Vu Intersection.
- Section 2: Bridge section, 5,442.9 km long, consisting of west approach bridge (Hoi An side, 4,433.7 m), main bridge (490.0 m) and east approach bridge (Cat Hai side, 519.2 m).
- Section 3: The east abutment of the east approach bridge to the end point, 5.69 km long, consisting of embankment section with one underpass box-culvert, four waterway box-culverts and 1,100 m of slope protection works (stone masonry).



Source: Study Team

Figure 2.2-1 Route and Location of Major Components

(2) Design Standard

The highway is designed according to TCVN 4054 - 2005, design grade III, plain terrain, and design speed of 80 km/h.

(3) Construction Components

The major construction components are shown in Table 2.2-1 below. The plans and drawings are presented in Appendix-1 “Drawings”. **(Table 2.2-1 is updated in Appendix-10)**.

Table 2.2-1 Major Construction Components

Construction Components		Contents
Length	Total Length	15.630 km
	Bridge Length	Total: 5.443 km Approach Bridge, Hai An side: 4,434 m (including 2 flyovers) Main Bridge: 490 m Approach Bridge, Cat Hai side: 519 m
	Road Length	10.19 km (Hai An side: 4.50 km, Cat Hai side: 5.69 km)
Number of Lanes		4-lane (6-lane in the 2nd stage)
Width	Width of Road Width of Bridge	29.50m 14.5m (Stage Construction) **(See Appendix-10)**
Structure Type	Main Bridge Approach Bridge Flyover	Pre-stressed concrete (PC) box girder with V-shaped pier Pre-stressed concrete box girder with double wall pier Pre-stressed concrete box girder with double wall pier
Intersection (IS)	Tan Vu IS Din Vu IS	At-grade (Grade-separated in the 2nd stage) At-grade (Grade-separated in the 2nd stage)
Other Major Components		Pavement construction Soft ground treatment Culvert construction
Consulting Service		Construction Supervision

Source: Study Team

(4) Applied Technical Specifications

1) Road Works

Stage construction method is applied in order to reduce the initial investment cost. Earthworks will consider a 6-lane construction from the initial stage. However, the pavement works will be limited to 4-lane construction at the initial stage and 6-lane in the second development stage.

Cross section elements of the project road are summarized in the following tables:

Table 2.2-2 Cross Section Elements of Road (1), 1st Stage Construction (4-lane)

Component	Width (m)
Carriageway	2@3.50×2=14.0
Median strip	2@3.75+1+0.5×2=9.5
Shoulder	2.0×2=4.0
Protection shoulder	0.5×2=1.0
Total roadbed width	29.5

Source: Study Team

Table 2.2-3 Cross Section Elements of Road (2), 2nd Stage Construction (6-lane)

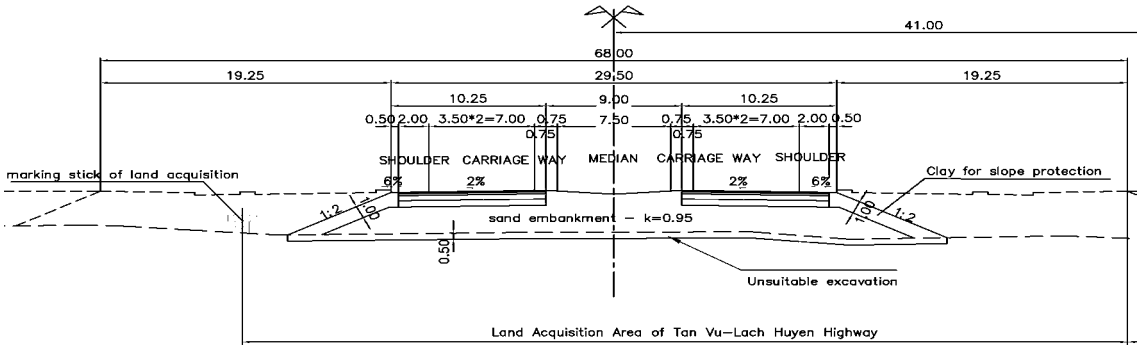
Component	Width (m)
Carriageway	3@3.75×2=22.5
Median strip	1.0+0.5×2=2.0
Shoulder	2.0×2=4.0
Protection shoulder	0.5×2=1.0
Total roadbed width	29.5

Source: Study Team

Right-of-way (ROW) shall be 20 m from the foot of embankment in accordance with Decree of the Government No. 172/1999/ND. Thus, the width of the land strip for Tan Vu-Lach Huyen Highway (6-lane) is about 90 m.

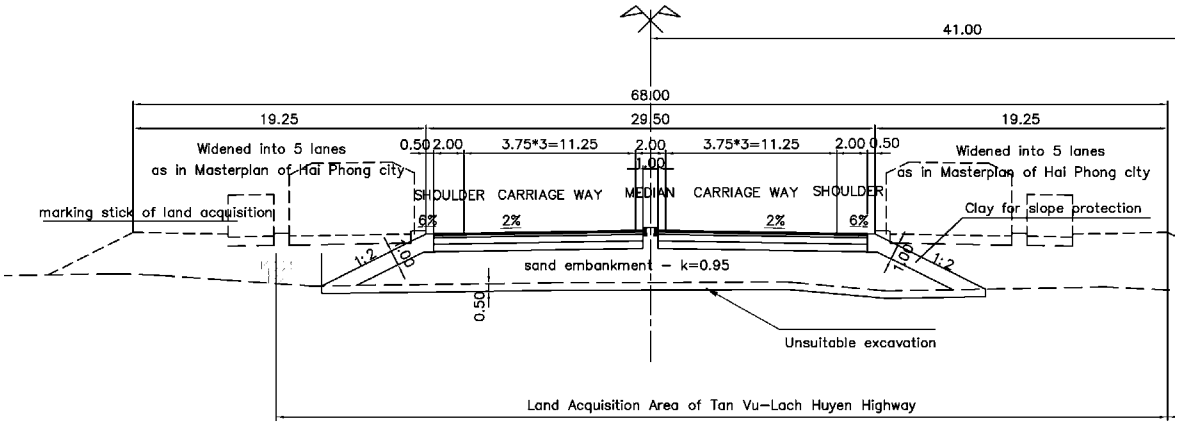
Figures 2.2-2 and 2.2.3 show the typical cross sections for the first stage and second stage, respectively. Details for the application of the stage construction are described in Section 2.4.3.

In accordance with the updated traffic demand forecast, the second stage construction should be completed before 2027.



Source: Study Team

Figure 2.2-2 Typical Cross Section (1), First Stage



Source: Study Team

Figure 2.2-3 Typical Cross Section (2), Second Stage

2) Stage Construction of Bridge Works

As with the road works, stage construction method was adopted for the bridge works in order to reduce the initial investment cost.

3) Bridge Structure Type

Width of the bridge is updated in Appendix-10.

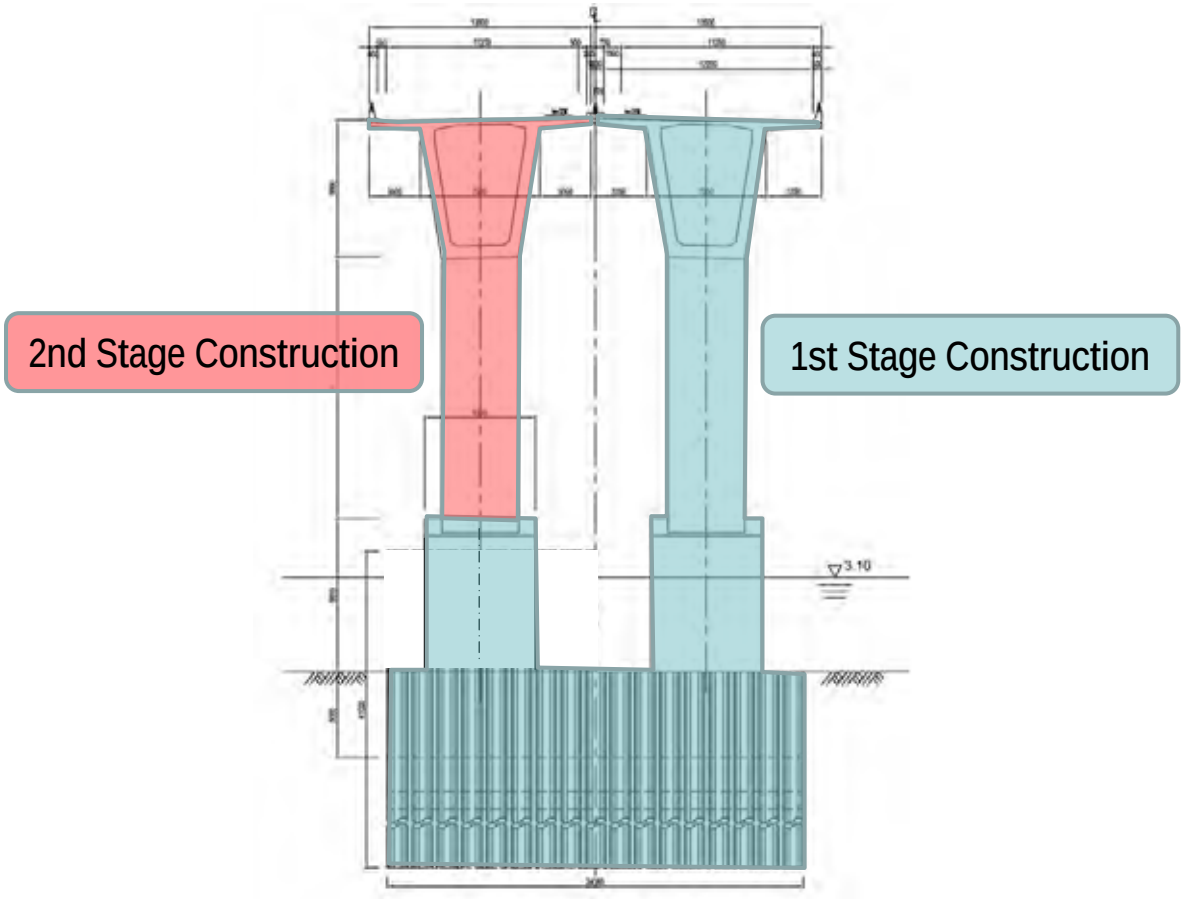
Considering the stage construction, including the future extension works, the following structure types were selected for the bridge works:

Structure type of the main bridge is PC-box girder with V-shaped pier and steel pipe well foundation.

Structure type of the approach bridge, including flyover section, is PC-box girder with double wall pillar and steel pipe foundation or bored pile foundation.

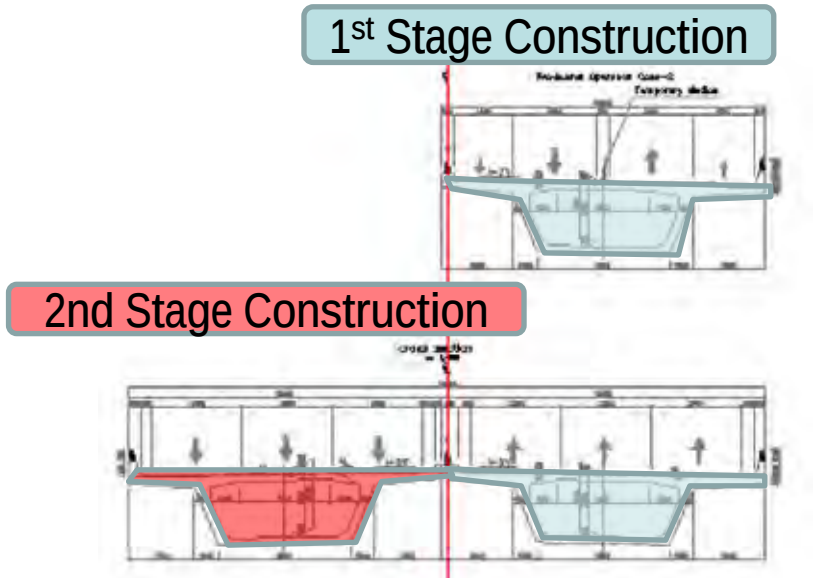
Figures 2.2-4 and 2.2-5 show the typical cross sections for stage construction of the bridges, which are described in Section 2.4.3.

For the main bridge, **the foundation and pile-cap structure in the sub-structure will be built in the initial stage** in order to ease the construction work during the second stage.



Source: Study Team

Figure 2.2-4 Typical Cross Section of Main Bridge (Stage Construction)



Source: Study Team

Figure 2.2-5 Typical Cross Section of Approach Bridges (Stage Construction)

(5) Tentative Total Investment Cost

According to the F/S report in July 2009, transferred from VIDIFI to MOT in December 2009, the total construction cost is VND 5,789 billion and the total investment cost is VND 8,729 billion, which includes the construction, land acquisition and compensation costs.

However, these costs do not properly cover some preparation works, recent price increases, and increments in land acquisition costs and compensation fees, which are subject to be updated in this Study.

The above cost was updated during the discussion between JICA and MOT in accordance with optimization of the scope and schedule of works. Updated cost is summarized in Appendix-10.

2.3. Traffic Demand Forecast

2.3.1. Review of Existing Traffic Demand Forecast

(1) Traffic Forecast Target Year

Target year of traffic forecast was changed to 2035 during the discussion between JICA and MOT as shown in Appendix-10.

Target years of the traffic analysis in the F/S were 2015-2020 and 2030 which were shown in MOT Decision No. 501/QD-BGTVT dated February 29, 2008. Furthermore, consistency with traffic volume in 2022-2032 after the Hanoi - Hai Phong Expressway is open to the public and connected to the project road was taken into consideration.

In accordance with the terms of reference (TOR) of this Study, 2020 was set as the target year after the Lach Huyen Port is assumed to be open in 2015, and traffic demand in the following two durations were forecasted:

- 2015 to 2020: The first target fiscal year (Lach Huyen Port 2 berth operation stage)
- 2020 to 2030: The second target fiscal year (forward planning stage of Lach Huyen Port)

(2) Traffic Forecast Method

1) Traffic Network

Same as that used in the F/S.

2) Input data

The following input data were updated:

- Basic Socio-economic Data
- Development of Industrial Zones (IZ)
- Updated Socio-economic Data of Cat Hai Island
- Updated Socio-economic Data of Cat Ba Island

Basic Socio-economic Data

In the F/S, Statistic Book in 2006 was used for the socio-economic data. In this Study, that in 2008 is used.

Development of Industrial Zones

In the F/S, Master Plan of Hai Phong City in 2007 was used. In this Study, updated and latest individual development programs were referred to.

Development of Dinh Vu Industrial Zone

The development project of Dinh Vu area covers two zones, namely, Dinh Vu Industrial Zone and Nam Dinh Vu Industrial Zone. The amount of investment by new and additional foreign direct investment (FDI), invited by Hai Phong City, became maximum in 2009 with USD 1,300

million, which is five times that of 2008.

As for Dinh Vu Industrial Zone in the north side, the first term construction is progressing. The first term construction invited investment from 17 entities amounting to USD 368 million. Moreover, 91.5% of lease was already contracted.

Meanwhile, the Nam Dinh Vu Industrial Zone in the south is divided into east and west sides, with each side managed by a different investment management company. The west side is by Hapaco Joint Stock Company (JSC) and the east side is by Southern Dinh Vu Investment JSC. This area is now calling for international investors.

After the previous F/S was conducted, Hai Phong People Committee announced two decisions, namely, No. 644/QD-UBND dated April 16, 2009 and No. 795/QD-UBND dated May 29, 2009. Supported by these decisions, the construction of shore protection works has progressed well and will be completed by 2013. Reclamation works using the dredged soil will be carried out after the slope protection works and will be completed by 2025.

Table 2.3-1 summarizes the updated land use plan on the basis of the above two decisions

Table 2.3-1 Future Land Use on in Dinh Vu Peninsula

DINH VU PENINSULA						
No.	**Item**		**Revised value of forecast**			**Preparatory Survey**
			2015	**2020**	**2030**	**Verification method**
I	Dinh Vu IZ JSC (100 m^2)		(32,750) 16,375	(65,500) 32,750	(78,600) 39,300	The area of the industrial area is revised from the latest master plan of Hai Phong. **Conversion ratio:50%**
	Hapaco JSC (100m^2)		(0) 0	(0) 0	(44,700) 35,760	The area of the industrial area is revised from the latest master plan of Hai Phong. Decision No.644/QD-UBND dated April 16, 2009, **The operation in 2030 assumes that it is 50%.** **Conversion ratio:80%**
	Southern Dinh Vu Investment JSC (100m^2)	Non-tax zone	(0) 0	(0) 0	(9,775) 7,820	The area of the industrial area is revised from the latest master plan of Hai Phong. Decision No. 795/QD-UBND dated May 29, 2009 **The operation in 2030 assumes that it is 50%.** **Conversion ratio:80%**
		Industrial zone	(0) 0	(0) 0	(18,500) 14,800	
	Total		(32,750) 16,375	(65,500) 32,750	(151,575) 97,680	
II	Dinh Vu Port (tons/yr)		4,500,000	6,000,000	10,000,000	The area of the industrial area is revised from the latest master plan of Hai Phong.
III	Apartment block for rent (m^2)		162,500	325,000	650,000	The area of the industrial area is revised from the latest master plan of Hai Phong.

Source: Study Team

<u>Updated Socio-economic Data of Cat Hai Island</u>

According to MOT Decision No. 501/QD-BGTVT dated February 29, 2008, for the Lach

Huyen Port Development Project, it is shown in the attachment that the whole region in Cat Hai Island could be developed as industrial zone. However, the development plan is still at the conception level. Therefore, land use of the Cat Hai Island was predicted to remain as "undeveloped" similar to the forecast in the F/S. Socio-economic data of Cat Hai Island was updated from the F/S as shown in Table 2.3-2.

Table 2.3-2 Future Land Use in Cat Hai Island

CAT HAI ISLAND					
No.	Item	Revised value of forecast			Preparatory Survey
		2015	2020	2030	Verification method
I	Population (persons)	19,000	19,300	20,100	Transition of population is revised using Statistical Yearbook 2008 of Hai Phong.
II	Port Area (tons/yr)	5,394,000	29,525,000	78,300,000	The forecast result of the Study Team of Lach Huyen Port Middle Growth Case
III	Tourists (persons/yr)	500,000	1,600,000	2,600,000	Transition of population is revised using Statistical Yearbook 2008 of Hai Phong and traffic count result

Source: Study Team

Updated Socio-economic Data of Cat Ba Island

Socio-economic data of Cat Ba Island was updated from the F/S as shown in Table 2.3-3.

Table 2.3-3 Future Land Use on Cat Ba Island

CAT BA ISLAND					
No.	Item	Revised value of forecast			Preparatory Survey
		2015	2020	2030	Verification method
I	Population (persons)	12,000	13,000	14,600	Transition of population is revised using Statistical Yearbook 2008 of Hai Phong.
II	Tourists (persons/yr)	500,000	1,600,000	2,600,000	Transition of population is revised using Statistical Yearbook 2008 of Hai Phong and traffic counts result

Source: Study Team

3) Trip Generation Model for Peak Hour Traffic

In the F/S, a Chinese traffic generation model was used because economic development in both China and Vietnam is similar.

In this Study, the same model is used to estimate the trip generation.

Table 2.3-4 Applied Traffic Generation Model

Trip Generation Rates					
Land Use	Unit	AM		PM	
		Generation	Attraction	Generation	Attraction
Apartment	pcu/hr/unit	0.250	0.080	0.080	0.250
Industrial	pcu/hr/100 m^2	0.110	0.150	0.060	0.040
Tourist	pcu/hr/person	0.400	0.400	0.400	0.400
Port	pcu/hr/ton*	0.082	0.082	0.082	0.082

* Average load per container truck is approx. 30 tons.

Source: Study Team

4) Traffic Diversion Rate Using the New Bridge to Cat Ba Island

The number of passengers to Cat Ba Island consists of i) via Cat Hai Island, ii) from Hai Phong City by high-speed boat, and iii) from Bai Chay by high-speed boat. In case the project road is developed, it was assumed that 76% of all travelers to the island would use this route.

5) Possibility of Railway (Freight) Development

Railway alignment is indicated in the F/S in accordance with the master plan of Hai Phong City.

In this Study, during the target years of the traffic demand, it was assumed that there is no railway freight traffic in 2020. However, it was assumed that 30% of freight would be carried by railways in 2030.

6) Share of Traffic Mode

In the application of the above traffic generation model, the generated values should be adjusted in accordance with the share of the traffic mode.

In this Study, the same share of traffic mode was applied in each area, as follows:

Dinh Vu Area

- Traffic generating area of an industrial area: Zones whose 30% of whole surface products and others are landscape, road network, utilities, warehouse, etc.
- Dinh Vu Port: The rate of peak of cargo volume is 5% per hour.
- Apartment block for rent: Apartment footprint is 50% of total residential block with a plot ratio of 5. Each unit occupied 1,000 m^2.
- Generating percentage of traffic: as shown in the table below.

Table 2.3-5 Applied Traffic Share in Dinh Vu Area

Item	2015	2020	2030
Rail service	Without rail service	Without rail service	With rail service
Motorcycle	70%	50%	30%
Car	30%	30%	50%
（Public transport）	-----	(20%)	(20%)

Source: Study Team

Cat Hai Island

- Four average family members =>1 unit
- Lach Huyen Port: The rate of peak of cargo volume is 5% per hour.
- Tourist: 20% of public transportation facility use, 70% of other transportation use
- Generating percentage of traffic

Table 2.3-6 Applied Traffic Share in Cat Hai Island

Item	2015	2020	2030
Rail service	Without rail service	Without rail service	With rail service
Motorcycle	50%	30%	20%
Car	50%	70%	60%
（Public transport）	-----	-----	(20%)

Source: Study Team

Cat Ba Island

- Four average family members =>1 unit
- Generating percentage of traffic

Table 2.3-7 Applied Traffic Share in Cat Ba Island

Item	2015	2020	2030
Rail service	Without rail service	Without rail service	With rail service
Motorcycle	50%	30%	20%
Car	50%	70%	60%
（Public transport）	-----	-----	(20%)

Source: Study Team

7) Daily Traffic Forecasting

In the F/S, daily traffic was calculated backwards from the peak hour traffic. In this Study, same calculation method is used. The peak ratio to be used for calculation of daily traffic is 7% for large-size car and bus and 5% for passenger car.

2.3.2. Supplementary Traffic Survey in Cat Hai Island

Since the traffic count in Cat Hai Island is not carried out in the F/S investigation, it is carried out by the Study Team and the transport demand forecasting is revised. The traffic count carried out in Cat Hai Island is as follows:

- Traffic count: three places in Cat Hai Island.
- Time-required investigation: Running time investigation between the ferry terminals at both ends of Cat Hai Island
- Ferry traffic: Investigate the ferry traffic for the past ten years from records of the operation company.

The traffic, which will mostly come from accommodation or living spaces and deduced from the distribution of population with the generated traffic in the F/S investigation, will range from 54% to 78% in 2020. The present traffic condition is investigated in the Study. Moreover, the F/S forecast traffic is verified based on the passage traffic from Hai Phong City to Cat Ba Island, and the intra district transport system of Cat Hai Island. In the time-required investigation in Cat Hai Island, the present condition of time required from Cat Hai Island to Dinh Vu area is checked together with the operation time of ferry service. Then, it is considered in the calculation of benefit by comparing it with the time required after the road is open to the public.

(1) Traffic Count Survey Location

The traffic count was carried out in the following three places shown in Figure 2.3-1.

- Ferry terminal to Dinh Vu
- Halfway point between the two ferry terminals
- Ferry terminal to Cai Ba Island

Source: Study Team

Figure 2.3-1 Location Map of Traffic Counts

(2) Survey Method

1) Manual Classified Counts

Vehicle classification in the F/S involves five types, namely: 2/3-Wheel, Car, Light Truck, Heavy Truck, and Bus. In this Study, the classification stipulated in the Vietnam standard (Section 3.3.2, TCVN4054-2005) was used.

Traffic count method is manual counting with traffic counter. Investigation time is 12 hours from 6:00 a.m. to 6:00 p.m. Investigation days were Tuesday, Wednesday, and Thursday.

Table 2.3-8 Investigation type of car

Number	Type-of-car	Passenger Car Unit Conversion Factors
1	Bicycle	0.2
2	Motorcycle	0.3
3	Car	1.0
4	Trucks with 2 axles and mini bus with less than 25 seats	2.0
5	Truck with more than 3 axles and large bus	2.5
6	Trailer and bus with trailer	4.0

Source: TCVN4054-2005 (Section 3.3.2)

2) Link Speed Surveys

The average vehicle travel speed between the two ferry terminals was surveyed using two methods, namely: 1) traveling by motorcycle along the route, and 2) static travel speed observations. Results of this survey were referred in the planning of next analysis (travel speed, reduction rate of traffic accident).

Survey based on motorcycle traveling is deemed the most effective because motorcycle is the predominant vehicle type in traffic. Therefore, this survey method would provide the most representative traveling speed.

3) Ferry Traffic Track Record Survey

Sightseeing ferries from Hai Phong City to Cat Ba Island pass through Cat Hai Island. This tourism traffic will be converted to land transport if Tan Vu - Lach Huyen Highway is opened. It is important to investigate the present ferry traffic for the traffic demand of the highway.

Operation record of the ferry company between 2002 and 2009 was collected with their transport records.

(3) Result of Traffic Volume

The traffic count survey was carried out on April 27, 2010. The following results were obtained.

1) Manual Classified Counts

Results of traffic manual classified counts are as follows:

Table 2.3-9 Results of Manual Classified Counts

Summary of Counted Vehicles Number

Unit: Vehicle

	Ninh Tiếp			Cat Hai			Ben Got		
Time	To Cat Ba Direction	To Dinh Vu Direction	Total	To Cat Ba Direction	To Dinh Vu Direction	Total	To Cat Ba Direction	To Dinh Vu Direction	Total
6:00-7:00	12	89	101	66	76	142	47	72	119
7:00-8:00	85	53	138	84	44	128	62	21	83
8:00-9:00	31	21	52	42	40	82	36	35	71
9:00-10:00	53	16	69	72	34	106	45	31	76
10:00-11:00	31	11	42	47	21	68	19	18	37
11:00-12:00	23	21	44	32	19	51	24	39	63
12:00-13:00	0	15	15	28	34	62	9	0	9
13:00-14:00	46	28	74	56	79	135	26	53	79
14:00-15:00	28	35	63	45	35	80	18	19	37
15:00-16:00	27	28	55	69	47	116	53	24	77
16:00-17:00	23	40	63	67	61	128	32	38	70
17:00-18:00	86	0	86	76	54	130	24	30	54
12hr Total	445	357	802	684	544	1228	395	380	775

Summary of PCU Number

Unit: pcu

	Ninh Tiếp			Cat Hai			Ben Got		
Time	To Cat Ba Direction	To Dinh Vu Direction	Total	To Cat Ba Direction	To Dinh Vu Direction	Total	To Cat Ba Direction	To Dinh Vu Direction	Total
6:00-7:00	3	24	27	22	31	53	12	31	43
7:00-8:00	55	33	88	53	10	63	39	7	46
8:00-9:00	20	6	26	29	12	41	17	10	27
9:00-10:00	18	5	23	30	11	41	15	9	24
10:00-11:00	25	5	30	27	10	37	8	7	15
11:00-12:00	11	21	32	11	12	23	20	30	50
12:00-13:00	0	9	9	7	11	18	3	0	3
13:00-14:00	23	18	41	25	26	51	13	26	39
14:00-15:00	27	17	44	19	12	31	5	7	12
15:00-16:00	14	21	35	30	27	57	34	20	54
16:00-17:00	15	29	44	21	25	46	8	18	26
17:00-18:00	23	0	23	31	14	45	17	8	25
12hr Total	234	188	422	305	201	506	191	173	364
D value	55.5%	44.5%		60.3%	39.7%		52.5%	47.5%	

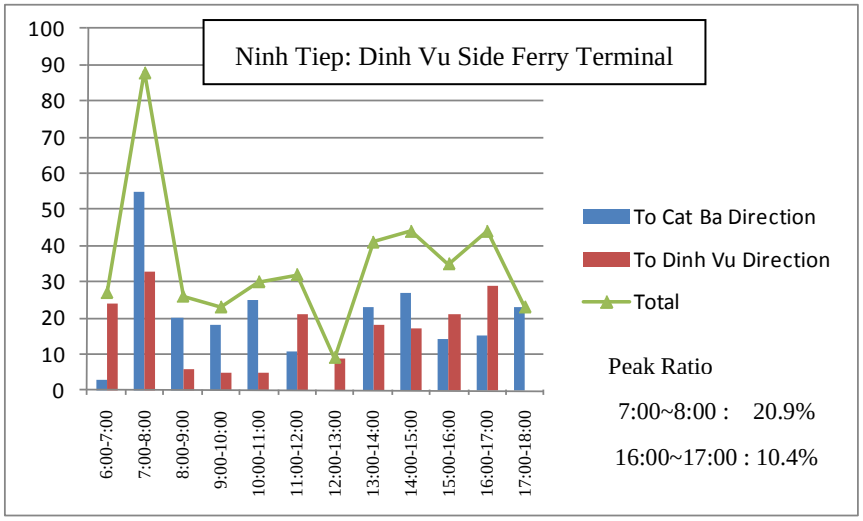
Source: Study Team

In summary, the following are observed:

- The peak hours at the Dinh Vu side were 7:00- 8:00 and 16:00-17:00.
- The peak hours at the Cat Ba side were 7:00-8:00 and 15:00-16:00.

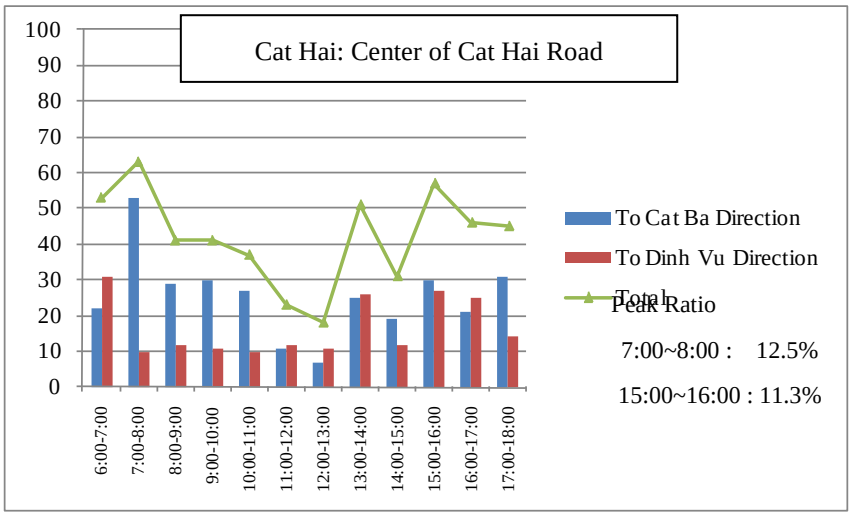
As for the proportion of peak-hour traffic in the peak direction of the three points, the direction to Cat Ba Island shares 55%. Refer to Appendix-2 “Traffic Data” for the details of the survey.

It was confirmed that 30% of travelers to Cat Ba Island pass through Cat Hai Island from the result of this traffic count survey.



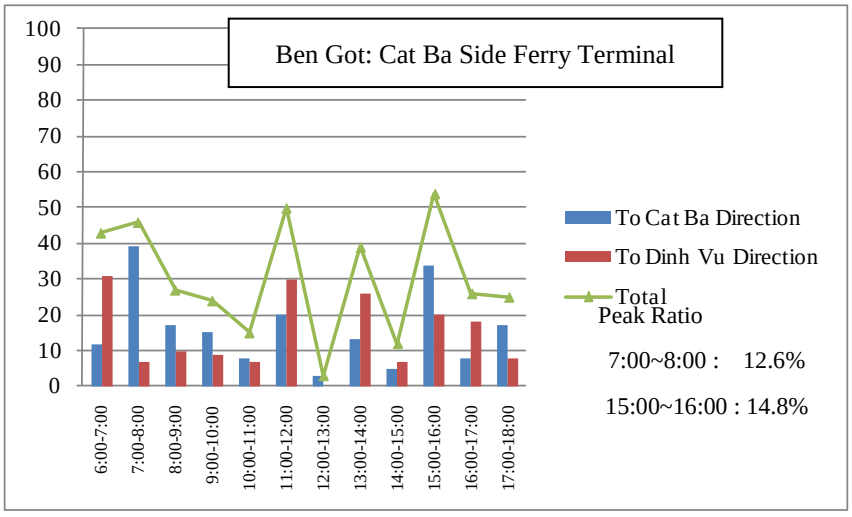
Source: Study Team

Figure 2.3-2 Result of Traffic Counts at Dinh Vu Side Ferry Terminal



Source: Study Team

Figure 2.3-3 Result of Traffic Counts at Center of Cat Hai Road



Source: Study Team

Figure 2.3-4 Result of Traffic Counts at Cat Ba Side Ferry Terminal

2) Link Speed Survey

The result of the link speed survey is summarized in the following table.

Table 2.3-10 Link Speed Survey

Time	From Ninh Tiep to Ben Got			From Ben Got to Ninh Tiep		
	Departure	Arrival	Duration	Departure	Arrival	Duration
AM 7:00	7h40'	8h01'	21'	7h11'	7h32'	21'
AM 9:00	8h35'	8h54'	19'	8h05'	8h27'	22'
AM 11:00	11h05'	11h25'	20'	11h40'	11h59'	19'
PM 1:00	13h45'	14h06'	21'	14h20'	14h42'	22'
PM 3:00	15h10'	15h30'	20'	16h15'	16h33'	18'
PM 5:00	17h05'	17h26'	21'	17h35'	17h55'	20'

Source: Study Team

The ferry travel time from Dinh Vu to Cat Hai is 75 minutes while the ferry travel time from Cat Hai to Cat Ba is 30 minutes. Accordingly, the travel time from Dinh Vu to Cat Ba will be approximately 125 minutes from the above-mentioned result.

3) Ferry Traffic Track Record Survey

The survey results are shown in Tables 3.2-11 and 3.2-13. (Refer to Appendix-2 "Traffic Data" for the details of investigation.)

Table 2.3-11 Transition of Monthly Average Traffic (Dinh Vu - Cat Hai)

Unit: pcu/month

Type of vehicles	2002	2003	2004	2005	2006	2007	2008	2009
Bicycle	705	577	504	370	303	246	246	220
Motorcycle	3,893	2,921	2,907	2,926	2,526	2,313	2,489	2,586
Car 4-6 seats	510	453	558	643	559	604	564	573
Bus	2,520	1,669	2,114	2,578	2,874	3,246	3,076	2,897
Truck	1,222	1,286	1,350	1,366	1,532	1,472	1,696	1,742
Total	8,850	6,905	7,434	7,884	7,794	7,882	8,071	8,018

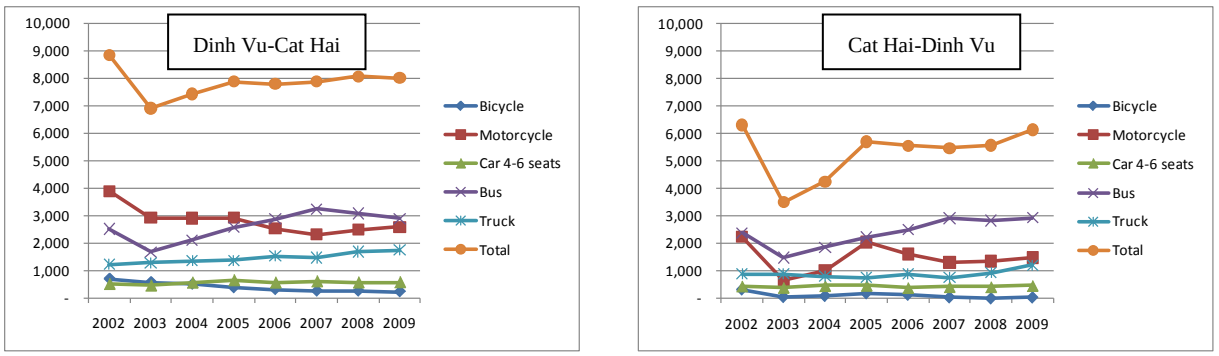
Source: Study Team

Table 2.3-12 Transition of Monthly Average Traffic (Cat Hai - Cat Ba)

Unit: pcu/month

Type of vehicles	2002	2003	2004	2005	2006	2007	2008	2009
Bicycle	334	63	102	196	145	49	14	46
Motorcycle	2,242	664	1,012	2,046	1,625	1,307	1,358	1,485
Car 4-6 seats	455	401	467	478	394	429	426	471
Bus	2,386	1,486	1,870	2,223	2,501	2,930	2,841	2,932
Truck	894	886	809	767	893	763	933	1,213
Total	6,309	3,500	4,261	5,709	5,556	5,479	5,572	6,147

Source: Study Team



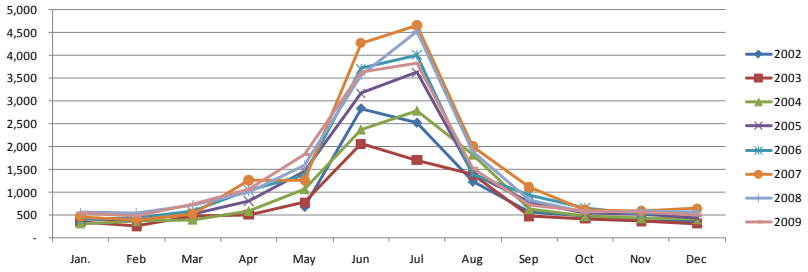
Source: Study Team

Figure 2.3-5 Transition of Monthly Average Traffic of Each Type of Vehicles

In summary, the following are observed:

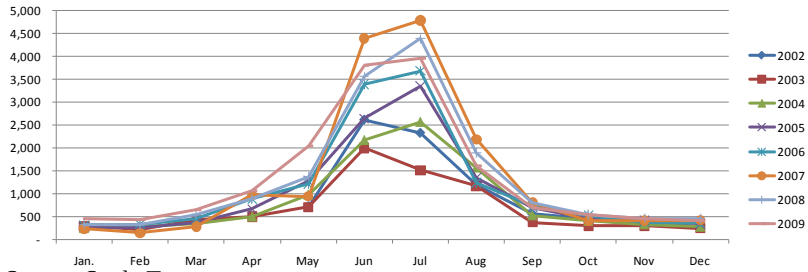
- After 2003, traffic volume gradually increases.
- Taking the on site observation into consideration, the traffic capacity has reached its full limit. Thus, there is no further increase of traffic volume if the capacity is not increased.
- Traffic along the Dinh Vu – Cat Hai route is approximately 8,000 pcu/month. Along Cat Hai – Cat Ba route, it is approximately 6,000pcu/month.
- Bus traffic increases up to 5 to 10 times during summer season. This indicates that the tourists to Cat Ba Island use buses.

- Bus traffic along Dinh Vu – Cat Hai and along Cat Hai – Cat Ba are almost the same. Accordingly, all tourists by bus are bound for Cat Ba Island.



Source: Study Team

Figure 2.3-6 Annual Change of Bus Traffic (Dinh Vu-Cat Hai)



Source: Study Team

Figure 2.3-7 Annual Change of Bus Traffic (Cat Hai – Cat Ba)

4) Ferry Traffic in July of Each Year

The ferry traffic in July of each year is as follows.

Table 2.3-13 Ferry Traffic in July of Each Year (Dinh Vu - Cat Hai)

Unit: pcu/month

Type of vehicle	2002	2003	2004	2005	2006	2007	2008	2009	Average
Bicycle	842	420	472	370	329	363	259	168	403
Motorcycle	4,968	2,957	3,449	3,299	2,824	2,679	3,306	3,164	3,331
Car 4-6 seats	1,020	821	1,178	1,474	1,222	1,352	1,480	1,324	1,234
Bus	5,581	3,732	6,049	7,933	8,776	10,167	9,836	8,226	7,538
Truck	1,110	1,178	1,432	1,254	1,776	1,756	2,031	2,280	1,602
Total (month)	13,521	9,108	12,580	14,330	14,927	16,317	16,912	15,162	14,107
PCU/peak hour	1,352	911	1,258	1,433	1,493	1,632	1,691	1,516	1,411
Dinh Vu to Cat Hai PCU/peak hour	744	501	692	788	821	898	930	834	776
Cat Hai to Dinh Vu PCU/peak hour	608	410	566	645	672	734	761	682	635

Source: Study Team

Table 2.3-14 Ferry Traffic in July of Each Year (Cat Hai - Cat Ba)

Unit: pcu/month

Type of vehicle	2002	2003	2004	2005	2006	2007	2008	2009	Average
Bicycle	507	7	215	150	170	73	9	12	143
Motorcycle	3,126	384	2,301	2,676	1,729	1,673	1,806	1,871	1,946
Car 4-6 seats	918	799	1,116	1,234	996	1,190	1,326	1,255	1,104
Bus	5,151	3,315	5,604	7,331	8,056	10,492	9,532	8,560	7,255
Truck	634	615	879	730	1,045	1,146	1,138	1,569	970
Total (month)	10,336	5,120	10,115	12,121	11,996	14,574	13,811	13,267	11,418
PCU/peak hour	1,034	512	1,012	1,212	1,200	1,457	1,381	1,327	1,142
Dinh Vu to Cat Hai PCU/peak hour	569	282	557	667	660	801	760	730	628
Cat Hai to Dinh Vu PCU/peak hour	465	230	455	545	540	656	621	597	514

Source: Study Team

2.3.3. Current Implementation Plan of Dinh Vu IZ and Nam Dinh Vu IZ

(1) Current Development Situation of Dinh Vu IZ

Dinh Vu Industrial Zone is being developed by the Dinh Vu Industrial Zone Joint Stock Company. Dinh Vu Industrial Zone is included in the Development Master Plan of Dinh Vu – Cat Hai Economic Zone according to Socio-Economic Development Orientation Plan of Hai Phong City by 2020 and Announcement No. 304-TB/TU dated December 29, 2004 on the conclusion of Hai Phong City.

In the master plan of port development, general cargo, container, dry bulk and combined terminals are foreseen along a 3,000 m straight quay designed to accommodate up to 20,000 dead weight ton (DWT) vessels.

The first phase of Dinh Vu Port has been operational since May 2005 with two new berths for dry, bulk cargo and containers to accommodate vessels up to 20,000 DWT in the Dinh Vu IZ.

Phase 2 of the Port commenced construction in May 2006 for the four new general cargo and container berths. The four new berths shall be developed on an area of 47.5 ha. The new berths, operational in 2008, shall have total berthing length of 785 m.

Other terminals are in the feasibility study stage. In addition, 10 container and general cargo berths are being studied. The whole port development is expected to be fully completed in 2012.

Table 2.3-15 Land Balance at Dinh Vu IZ

No.	Type of Land	Area (ha)	Rate (%)
1	General Industrial Park	655.0	44.77
2	Port Area	130.0	8.89
3	Residential Zone	65.0	4.44
4	Utilities and Green Area	613.0	41.90
Total		1,463.0	100.0

Source: Master Plan of Dinh Vu IZ

(2) Future Development Plan

The development plan of Nam Dinh Vu Industrial Zone shows an industrial complex of 2,000 ha located at the river mouth of the Nam Trieu River, which is southern land of the Dinh Vu IZ.

Hai Phong People Committee issued two decisions in connection with Nam Dinh Vu IZ in 2009. Nam Dinh Vu IZ was divided into two areas by this decision. The details are described below.

1) Nam Dinh Vu IZ (Zone 1)

The details of this area were defined by Decision No. 795/QD-UBND dated May 5, 2009. According to this decision, this area is further divided into IZ area and non-tax zone. The investor of the assigned Zone 1 is Nam Dinh Vu Investment JSC (see Figure 2.3-8).

Non-tax Zone (448 ha)

Table 2.3-16 Land Allocation Plan of Non-tax Zone

No.	Type of Land	Area (ha)	Rate (%)
1	Producing Land	118.0	26.34
2	Warehouse	98.5	21.99
3	Service Trade	70.0	15.62
4	Land for Trees and Sports	73.5	16.40
5	Hub Technical Land	2.5	0.56
6	Land for Traffic and Parking	80.5	17.97
7	Military Land	5.0	1.12
Total		448.0	100.0

Source: Master Plan of Dinh Vu IZ

Industrial Zone (906ha)

Table 2.3-17 Land Allocation Plan of Industrial Zone

No.	Type of Land	Area (ha)	Rate (%)
1	Producing Land	307.0	33.88
2	Warehouse + Container	187.5	20.70
3	Port Zone	143.6	15.85
4	Operating Center + Port Service	56.0	6.18
5	Land for Trees and Sport	91.0	10.04
6	Hub Technical Land	7.0	0.77
7	Land for Traffic and Parking	113.9	12.58
Total		906.0	100.0

Source: Master plan of Dinh Vu IZ

2) Nam Dinh Vu IZ (Zone 2)

T The details of this area were defined by Decision No. 644/QD-UBND dated April 16, 2009. The investor of the assigned Zone 2 is Hapaco Investment JSC (see Figure 2.3-8).

Table 2.3-18 Land Allocation Plan of Zone 2

No.	Type of Land	Area (ha)	Rate (%)
1	Producing Land	190.0	28.88
	Land for heavy industry zone	144.5	
	Land for light industry zone	75.5	
2	Warehouse	201.0	30.55
3	Operating Center + Port Service	29.0	4.41
4	Land for Trees and Sport	67.0	10.18
5	Isolated Tree Land	45.0	6.84
6	Hub Technical Land	8.0	1.22
7	Land for Traffic and Parking	118.0	17.92
Total		658.0	100.0

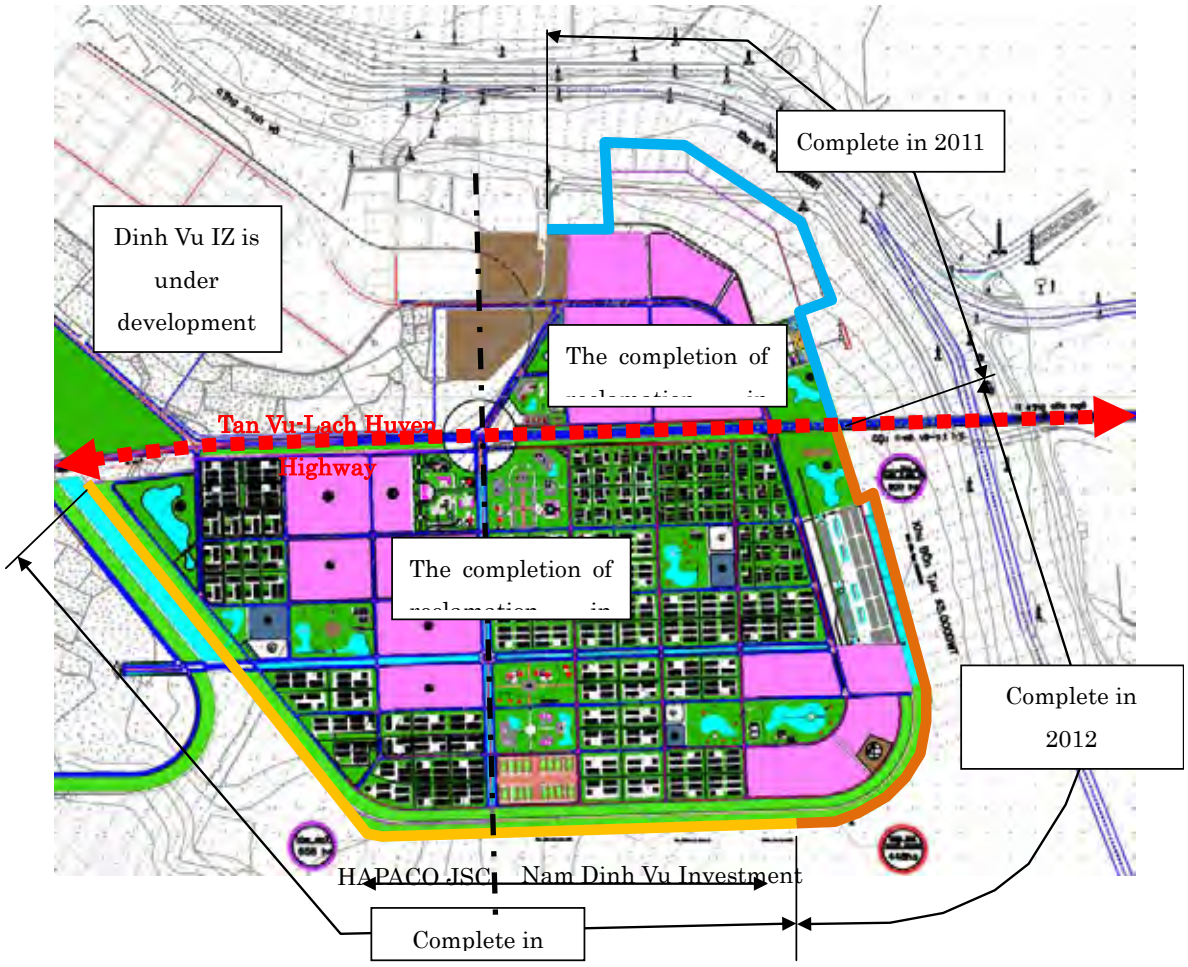
Source: Decision No.644/QD-BND dated 16 April 2009

3) Construction Schedule of Nam Dinh Vu IZ and Dinh Vu IZ

The development process of Nam Dinh Vu IZ was confirmed with the Planning Institute of Hai Phong City on May 7, 2010. The confirmed contents are as follows:

Table 2.3-19 Confirmation of Nam Dinh Vu IZ and Dinh Vu IZ

Question	Answer by Planning Institute of Hai Phong City
Existence of additional change about Decision No. 795 and No. 644.	No change
Development schedule of Nam Dinh Vu IZ	Shore protection works will be completed by 2011-2013. Then, reclamation will be completed in 2025.
Completion period of Dinh Vu IZ under present construction	It will be completed in 2025.
Amount of freight handling at Dinh Vu Port	The present amount of handling is 2,500,000 tons.
Number of workers at present Dinh Vu IZ	About 30,000 persons.



Source: Prepared by Study Team based on material provided by Hai Phong City

Figure 2.3-8 Development Program of Nam Dinh Vu IZ

2.3.4. Current Implementation Plan of Lach Huyen International Gateway Port

(1) Development Plan of Port

Lach Huyen Port consists of infrastructure improvement by ODA of Japan, and the harbor equipment, maintenance and operation by a PPP (Public Private Partnership) enterprise. About this project, the preparatory survey of JICA is being carried out and the draft final report was submitted in May 2010.

It is reported in the draft final report that the marine freight demand of northern Vietnam areas is extended 3.2 times by the data of 2004-2008, and it is forecast by 2020 that the amount of freight handling exceeds the total capacity of the Hai Phong Port and the Cai Lan Port. In order to handle these cargoes in the Lach Huyen Port in 2020, the five (5) container berths (L=375m x 5, D=-14m CDL) for 50,000 DWT fully loaded vessel and 100,000 DWT partial loaded vessels and three (3) multi-purpose berths (L=250m x 3, D=-13m CDL) for 50,000 DWT fully loaded vessels need to be constructed.

In the frame work of Medium Term Development Plan of the Lach Huyen Port for target year of 2020, the first two (2) container berths has been decided to be implemented by VINALINES as Project Owner by the Prime Minister Decision dated April 11, 2007 and MOT Decision on December 22, 2008.

Therefore, this initial development plan for the target year of 2015 is prepared for the first two (2) container berths development and other related port infrastructure development.

(2) Revised Cargo Volume

Yearly cargo volume of Lach Huyen Port is as follows:

Table 2.3-20 Forecast Cargo Volume of Lach Huyen Port

Cargo Type	Unit	2015	2016	2017	2018	2019	2020
High Growth Case							
Container	1,000 ton	10,182	15,077	20,000	24,951	29,930	34,937
	1,000 TEU	878	1,300	1,724	2,151	2,580	3,012
GC+Bulk	1,000 ton	-	-	1,947	2,610	3,246	3,853
Total	1,000 ton	10,182	15,077	21,947	27,561	33,176	38,790
Middle Growth Case							
Container	1,000 ton	5,394	9,607	13,843	18,102	22,385	26,691
	1,000 TEU	463	826	1,191	1,559	1,928	2,299
GC+Bulk	1,000 ton	-	-	1,119	1,714	2,286	2,834
Total	1,000 ton	5,394	9,607	14,962	19,817	24,671	29,525
Low Growth Case							
Container	1,000 ton	3,678	4,741	7,660	11,228	14,815	18,421
	1,000 TEU	317	409	658	966	1,275	1,586
GC+Bulk	1,000 ton	-	-	1,102	1,610	2,098	2,379
Total	1,000 ton	3,678	4,741	8,762	12,838	16,914	20,800

Source: Port Study Team

Compared with the forecast cargo volume in the F/S investigation, the port demand forecasting for the Lach Huyen Port is mostly equivalent to the middle growth case.

Source: Study Team

Figure 2.3-9 Forecast Cargo Volume of Lach Huyen Port

Cargo volume of the Lach Huyen Port used for transport demand forecasting is carried out as follows:

Table 2.3-21 Middle Growth Case

		2015	2016	2017	2018	2019	2020	2030
Container	1,000ton	5,394	9,607	13,843	18,102	22,385	26,691	
	1,000TEU	463	826	1,191	1,559	1,928	2,299	
GC+Bulk	1,000ton	-	-	1,119	1,714	2,286	2,834	
Total	1,000ton	5,394	9,607	14,962	19,817	24,671	29,525	120,000

Source: Port Study Team

Since the cargo volume in 2030 was not forecasted in the preparation investigation of the Lach Huyen Port, the predicted value of MOT was adopted.

2.3.5. Update of Traffic Demand Forecast

(1) Modified Part of Transport Demand Forecasting

Transport demand forecasting updated and carried out the following items:

Table 2.3-22 Updated Item and Contents

ITEM	F/S Study	Preparatory Study
Traffic forecasted method	➢ Use generation rate	➢ Use generation rate ➢ Prediction using a GDP growth rate was carried out based on the traffic census from the above-mentioned verification.
Analysis fiscal year	➢ 2015-2032	➢ 2015-2020(First target) ➢ 2020-2030(Second target)
Assumptions		
Conversion ratio of generating traffic	➢ Dinh Vu IZ:100%	➢ Dinh Vu IZ:50% ➢ Nam Dinh Vu IZ:80%
Development process	➢ Dinh Vu IZ: 2015(50% of 2020) 2020(100%) 2030(add 20%)	➢ Dinh Vu IZ: same as F/S ➢ Nam Dinh Vu IZ: 2015(0%) 2020(0%) 2030(50%)
Population	➢ Cat Hai : 2015(31,000) 2020(33,000) 2030(38,500) ➢ Cat Ba : 2015(12,000) 2020(14,500) 2030(16,500) Based on Statistical Yearbook 2006	➢ Cat Hai : 2015(19,000) 2020(19,300) 2030(20,100) ➢ Cat Ba : 2015(12,000) 2020(13,000) 2030(14,600) Based on Statistical Yearbook 2008
Lach Huyen Port	Based on MOT Decision No.501	Based on result of Lach Huyen Port Preparatory Study

Source: Study Team

In comparison with the above, it is observed that:

- **Conversion ratio was too high in the F/S**: How many people from the industrial zone are willing to use the project road? In the F/S, it was 100%. It is not realistic; people working in the northern area of Dinh Vu IZ will use TL356 and move to Hai Phong City. In this Study, the conversion rate was revised to 50% for Dinh Vu IZ and 80% for Nam Dinh Vu IZ.

- **Population in Cat Hai Island was counted twice**: In this Study, all socio-economic data were updated based on Statistical Yearbook 2008. It seems that the population of Cat Hai Island in the F/S was doubled.

(2) Traffic Generated in Each Section

The updated results of transport demand forecasting for Dinh Vu IZ, Cat Hai Island and Cat Ba Island are as follows:

Table 2.3-23 Result of Traffic Demand Forecast for Dinh Vu IZ, Cat Hai and Cat Ba Islands

Position	Year	AM Peak		PM Peak	
		Generation (outbound)	Attraction (inbound)	Generation (outbound)	Attraction (inbound)
Dinh Vu	2015	349	394	200	198
	2020	654	706	353	379
	2030	2,138	2,618	1,141	1,770
Cat Hai	2015	792	307	307	792
	2020	1,309	686	686	1,309
	2030	1,846	1,300	1,300	1,846
Cat Ba	2015	135	43	43	135
	2020	185	59	59	185
	2030	156	50	50	156

Source: Study Team

Refer to Appendix-2 “Traffic Data” for the details of each section.

(3) Summary of Updated Traffic Demand Forecast

The road section was divided into Tan Vu IC – Dinh Vu IZ and Dinh Vu – Cat Hai Island. Transport demand was summed up as follows:

Table 2.3-24 Summary of Future Traffic Demands

Section	Peak Hour	Direction	Year		
			2015	2020	2030
Tan Vu IC - Dinh Vu	AM	To Tan Vu IC	1,276	2,149	4,140
		From Tan Vu IC	745	1,451	3,967
	PM	To Tan Vu IC	550	1,098	2,490
		From Tan Vu IC	1,125	1,874	3,772
Dinh Vu - Cat Hai	AM	Cat Hai to Dinh Vu	927	1,494	2,002
		Dinh Vu to Cat Hai	351	745	1,350
	PM	Cat Hai to Dinh Vu	351	745	1,350
		Dinh Vu to Cat Hai	927	1,494	2,002

Source: Study Team

Note: Traffic volume in 2035 is estimated in Appendix-10.

2.3.6. Traffic Demand Forecast by Statistical Method for Comparison

In this section, the F/S traffic forecast using the statistical method is verified. Statistical method is based on the annual statistical data and forecast of socio-economic development index in the whole country and the researched area.

This method is based on the theory that traffic volume and gross domestic product (GDP) growth rate have good correlation since the resulting regional socio-economic development from the project will lead to a reasonable growing scenario of the traffic volume.

(1) Socio-economic and Transport Development Index in Whole County

Statistical data on the past volume of goods and passenger transport by road and GDP of the county are shown in Table 2.3-25 and Table 2.3-26.

According to statistical data, the Vietnamese economy, with continued growth from 1995 to 2007, encountered big depression for the first time due to the global economic depression in 2008. Although GDP growth rate fell to 3% in the first quarter of 2009, it recovered after that and became 6.5% at the end of the fourth quarter.

According to "Asian Development Outlook 2010" of ADB, under some assumption, GDP growth is projected to accelerate to 6.5% in 2010 and to 6.8% in 2011.

Trade with the People's Republic of China (PRC) is expected to expand rapidly now that a free trade agreement between the PRC and the Association of Southeast Asian Nations has come into force starting January 1, 2010. It will be linked to the economy of PRC through this, and GDP growth rate will be maintained up until 2011 and subsequent years.

Table 2.3-25 Volume of Nationwide Transported and Circulated Goods, 1995-2008

Year	GDP (price in 1994) (billion VND)	Volume of transported freight (thousand tons)	Volume of circulated freight (million tons/km)	GDP growing rate (%)	Growth rate/tons (%)	Growth rate/tons/km (%)
1995	195,567	140,709.9	30,910.5			
1996	213,833	157,201.9	38,710.0	9.3%	11.7%	25.2%
1997	231,264	176,258.8	45,306.7	8.2%	12.1%	17.0%
1998	244,596	189,184.0	46,336.7	5.8%	7.3%	2.3%
1999	256,272	203,212.7	50,054.6	4.8%	7.4%	8.0%
2000	273,666	223,823.0	55,629.7	6.8%	10.1%	11.1%
2001	292,535	252,146.0	63,164.4	6.9%	12.7%	13.5%
2002	313,247	292,869.2	69,417.9	7.1%	16.2%	9.9%
2003	336,242	347,232.7	80,029.5	7.3%	18.6%	15.3%
2004	362,435	403,002.2	90,504.8	7.8%	16.1%	13.1%
2005	393,031	460,146.3	100,728.3	8.4%	14.2%	11.3%
2006	425,373	513,575.1	113,550.0	8.2%	11.6%	12.7%
2007	461,344	596,800.9	134,883.0	8.5%	16.2%	18.8%
2008	489,833	648,681.5	180,694.7	6.2%	8.7%	34.0%
1995-2008				7.3%	12.5%	14.8%

Source: Statistic Yearbook 2008

Table 2.3-26 Data of Nationwide Passenger Transport by Road, 1995-2008

Year	GDP (price in 1994, billion VND)	Population (thousand person)	Transported passengers (billion person)	Circulated passengers (million person/ km)	GDP growing rate (%)	Rate of transported passengers (%)	Rate of circulated passengers (%)
1995	195,567	71995.5	441.3	15,944.4			
1996	213,833	73156.7	478.2	18,024.8	9.3%	8.4%	13.0%
1997	231,264	74306.9	514.6	19,074.4	8.2%	7.6%	5.8%
1998	244,596	75456.3	549.9	20,179.3	5.8%	6.9%	5.8%
1999	256,272	76596.7	587.8	21,276.8	4.8%	6.9%	5.4%
2000	273,666	77635.4	620.7	22,375.8	6.8%	5.6%	5.2%
2001	292,535	78685.8	677.3	23,394.9	6.9%	9.1%	4.6%
2002	313,247	79727.4	727.7	25,597.5	7.1%	7.4%	9.4%
2003	336,242	80902.4	931.3	30,458.5	7.3%	28.0%	19.0%
2004	362,435	82031.7	1,041.9	34,265.6	7.8%	11.9%	12.5%
2005	393,031	83106.3	1,173.4	38,601.7	8.4%	12.6%	12.7%
2006	425,373	84136.8	1,331.6	43,569.1	8.2%	13.5%	12.9%
2007	461,344	85171.7	1,473.0	49,372.1	8.5%	10.6%	13.3%
2008	489,833	86210.8	1,602.7	53,420.6	6.2%	8.8%	8.2%
1995-2008					7.3%	10.6%	9.8%

Source: Statistic Yearbook 2008

(2) Socio-economic and Transport Development Index of Hai Phong City

Statistical data on the past volumes of goods transport and passenger transport by road and GDP of Hai Phong City are shown in Tables 2.3-27 and 2.3-28.

According to statistical data in the past eight years from 2000-2008, Hai Phong City has fair development level.

Table 2.3-27 Volume of Transported and Circulated Goods in Hai Phong City, 2000-2008

Year	GDP (price in 1994, billion VND)	Volume of transported freight (thousand tons)	Volume of circulated freight (million tons/km)	GDP growing rate (%)	Growth rate/tons (%)	Growth rate/tons/km (%)
2000	8,313.7	10,594.0	3,383.2			
2001	9,176.5	16,074.0	4,036.3	10.4%	51.7%	19.3%
2002	10,153.8	22,751.0	4,282.8	10.7%	41.5%	6.1%
2003	11,241.6	22,709.0	4,667.4	10.7%	-0.2%	9.0%
2004	12,536.0	24,319.0	5,638.7	11.5%	7.1%	20.8%
2005	14,043.1	25,373.0	6,419.4	12.0%	4.3%	13.8%
2006	15,801.4	26,123.0	7,030.0	12.5%	3.0%	9.5%
2007	17,814.6	31,871.0	8,137.8	12.7%	22.0%	15.8%
2008	20,133.2	37,395.0	9,595.0	13.0%	17.3%	17.9%
1995-2008				11.7%	18.3%	14.0%

Source: Study Team

Table 2.3-28 Volume of Transported and Circulated Goods in Hai Phong City 2000-2008

Year	GDP (price in 1994, billion VND	Population (thousand person)	Transported passengers (thousand person)	Circulated passengers (million person/km)	GDP growing rate (%)	Rate of transported passengers (%)	Rate of circulated passengers (%)
2000	8,313.7	1700.5	11,013.0	244.7			
2001	9,176.5	1723.5	11,764.0	287.4	10.4%	6.8%	17.4%
2002	10,153.8	1743.4	12,347.0	326.2	10.7%	5.0%	13.5%
2003	11,241.6	1754.2	13,875.0	355.3	10.7%	12.4%	8.9%
2004	12,536.0	1770.8	15,677.0	393.4	11.5%	13.0%	10.7%
2005	14,043.1	1792.7	17,860.0	598.7	12.0%	13.9%	52.2%
2006	15,801.4	1812.7	22,692.0	756.0	12.5%	27.1%	26.3%
2007	17,814.6	1826.9	25,938.0	1,017.0	12.7%	14.3%	34.5%
2008	20,133.2	1845.9	27,562.0	1,081.0	13.0%	6.3%	6.3%
1995-2008					11.7%	12.4%	21.2%

Source: Study Team

(3) Forecast of Transport Growth

National GDP has recovered after the depression in 2008 to the same level as before. Also, the GDP level of 7% will be kept up from now on. Growth rate of Hai Phong City compared with the nationwide growth rate is as follows:

- GDP is 1.60 times.
- Transported freight is 1.46 times.
- Transported passengers are 1.17 times.

Project site, being located in Hai Phong, needs to assume a high growth rate to some extent. Along the Hanoi – Hai Phong Expressway, 1.2 and 1.05 times of nationwide growth rate are expected.

The growth rate of future traffic along Tan Vu – Lach Huyen Highway is assumed as follows:

Table 2.3-29 Forecast of Transport Growth Rate

Stage	2010-2015	2016-2020	2021-2025	2026-2030
Nationwide	7.0%	6.5%	6.5%	6.0%
Hanoi-Hai Phong Expressway	7.67%	7.67%	6.67%	6.67%
Preparatory survey on Lach Huyen Port (Road and Bridge portion)	8.00%	8.00%	7.00%	7.00%

Source: Study Team

Note: Traffic volume in 2035 is estimated in Appendix-10.

It is estimated that the growth rate of the project is 1.3 times of the nationwide rate considering the high growth rate of Hai Phong City.

(4) Traffic Demand Forecast for Comparison of Updated Traffic

Based on the socio-economic data and summarized result of real traffic count at Cat Hai Island, the traffic volume, according to vehicle and passenger car unit (pcu) for future years, was calculated as shown in Tables 2.3-30 and 2.3-31.

Table 2.3-30 Traffic Demand Forecast Based on Socio-economic Data

Year	Dinh Vu-Cat Hai Ferry and Ninh Tiep Ferry terminal			Cat Hai Roa			Ben Got Ferry Terminal and Cat Hai-Cat Ba Ferry		
	Total (pcu/day-night)	To Tan Vu IC Direction (pcu/peak hr)	To Cat Ba Direction (pcu/peak hr)	Total (pcu/day-night)	To Tan Vu IC Direction (pcu/peak hr)	To Cat Ba Direction (pcu/peak hr)	Total (pcu/day-night)	To Tan Vu IC Direction (pcu/peak hr)	To Cat Ba Direction (pcu/peak hr)
2010	506	28	23	607	33	27	439	24	20
2011	547	30	25	655	36	29	474	26	21
2012	591	33	27	706	39	32	511	28	23
2013	638	35	29	763	42	34	551	30	25
2014	688	38	31	824	45	37	596	33	27
2015	3,913	215	176	4,060	223	183	643	35	29
2016	6,462	355	291	6,619	364	298	695	38	31
2017	9,026	496	406	9,196	506	414	751	41	34
2018	11,615	639	523	11,800	649	531	811	45	36
2019	14,216	782	640	14,417	793	649	875	48	39
2020	16,841	926	758	17,057	938	768	945	52	43
2021	23,032	1,267	1,036	23,263	1,279	1,047	1,011	56	45
2022	27,286	1,501	1,228	27,534	1,514	1,239	1,081	59	49
2023	31,852	1,752	1,433	32,116	1,766	1,445	1,156	64	52
2024	36,747	2,021	1,654	37,030	2,037	1,666	1,237	68	56
2025	41,965	2,308	1,888	42,268	2,325	1,902	1,323	73	60
2026*	33,743	1,856	1,518	34,066	1,874	1,533	1,416	78	64
2027*	37,885	2,084	1,705	38,231	2,103	1,720	1,515	83	68
2028*	42,254	2,324	1,901	42,626	2,344	1,918	1,622	89	73
2029*	46,851	2,577	2,108	47,248	2,599	2,126	1,735	95	78
2030*	51,703	2,844	2,327	52,128	2,867	2,346	1,857	102	84

Source: Study Team

2026*-2030*: Railway transportation is taken into consideration.

Note: Traffic volume in 2035 is estimated in Appendix-10.

The number of large-sized trailer is based on demand forecasting of Lach Huyen Port. Based on TEU forecast from the demand forecasting of the Lach Huyen Port, container traffic vehicles were calculated considering the following conditions:

- Ratio of 20-feet container to 40-feet container is set at 1:2 from statistics of an international harbor.
- Trailer has two types, namely, 20-feet and 40-feet container, from results of an investigation per unit time of container traffic.
- Rail transportation is taken into consideration at 30% in 2026 and afterwards.
- The peak rate is made at 10%.
- Freight demand in 2030 was set to 120 million tons as shown in MOT Decision No. 501.

Table 2.3-31 Estimated Cargo Volume and Container Vehicles

	Cargo	TEU	Truck of more than 3 axles			
	1,000 ton/year	1,000 TEU	vehicle/year	vehicle/day	pcu/day	pcu/peak hr
2015	5,394	463	463,000	1,268	3,170	317
2016	9,607	826	826,000	2,263	5,658	566
2017	14,962	1,191	1,191,000	3,263	8,158	816
2018	19,816	1,559	1,559,000	4,271	10,678	1,068
2019	24,671	1,928	1,928,000	5,282	13,205	1,321
2020	29,525	2,299	2,299,000	6,299	15,748	1,575
2021	37,061	3,192	3,192,000	8,745	21,863	2,186
2022	44,126	3,801	3,801,000	10,414	26,035	2,604
2023	51,726	4,455	4,455,000	12,205	30,513	3,051
2024	59,863	5,156	5,156,000	14,126	35,315	3,532
2025	68,536	5,903	5,903,000	16,173	40,433	4,043
2026	54,421	4,687	4,687,000	12,841	32,103	3,210
2027	61,243	5,275	5,275,000	14,452	36,130	3,613
2028	68,439	5,895	5,895,000	16,151	40,378	4,038
2029	76,011	6,547	6,547,000	17,937	44,843	4,484
2030	84,000	7,235	7,235,000	19,822	49,555	4,956

Source: Study Team

Note: Traffic volume in 2035 is estimated in Appendix-10.

Comparison is made on the future traffic demand along the section between Dinh Vu and Cat Hai Island. The revised F/S transport demand forecasting and demand forecasting based on the traffic census carried out this time were summarized in Table 2.3-32.

Table 2.3-32 Comparison of Traffic Forecast between Revised F/S and Traffic Survey Basis

Forecast Method	Peak Hour	Direction	Year			
			2015	2020	2025	2030
Revised FS Traffic	AM	Cat Hai to Dinh Vu	927	1,494	1,748	2,002*
		Dinh Vu to Cat Hai	351	745	1,047	1,350*
	PM	Cat Hai to Dinh Vu	351	745	1,047	1,350*
		Dinh Vu to Cat Hai	927	1,494	1,748	2,002*
Based on Traffic Survey in Cat Hai	AM	Cat Hai to Dinh Vu	215	926	2,308	2,844*
		Dinh Vu to Cat Hai	176	758	1,888	2,327*
	PM	Cat Hai to Dinh Vu	176	758	1,888	2,327*
		Dinh Vu to Cat Hai	215	926	2,308	2,844*

Source: Study Team

2030*: Railway transportation is taken into consideration.

Note: Traffic volume in 2035 is estimated in Appendix-10.

Lane operation:

- Revised F/S traffic can be operated with four lanes until 2025.

- In the forecast based on traffic census, four-lane operation will be possible until 2023.
- In both examination cases, six-lane operation will be realized in 2030.

2.3.7. Conclusion of Traffic Demand Forecast

As a result of updating the conditions of the F/S study with the latest information, the forecasted traffic volume was decreased.

The reduction in each fiscal year is as follows:

- Tan Vu IC – Dinh Vu IZ section: 44% reduction in 2015, 43% reduction in 2020 and 10% reduction in 2030.
- Dinh Vu IZ – Cat Hai Island: 45% reduction in 2015, 44% reduction in 2020 and 31% reduction in 2030.

The F/S Study concluded that the period for four-lane operation is as short as five years and six lanes are built from the start. In this Study, it has been judged that the period for four-lane operation is ten years, and **provisional operation was effective**.

The result showed that four-lane operation is possible until 2023 based on the traffic census at Cat Hai Island. Provisional operation is also effective based on the result.

2.4. Alternative Studies of Civil Works

2.4.1. General

In this Study, the following alternative studies are carried out in order to examine the appropriateness of the F/S in terms of 1) Construction cost, 2) Construction period, 3) Constructability, and so on.

- Stage Construction
- Bridge Length
- Bridge Type (1), Main Bridge
- Bridge Type (2), Approach Bridge
- Construction Schedule

It is considered that other alternative studies should be carried out during the detailed design stage, if necessary.

2.4.2. Route Alignment

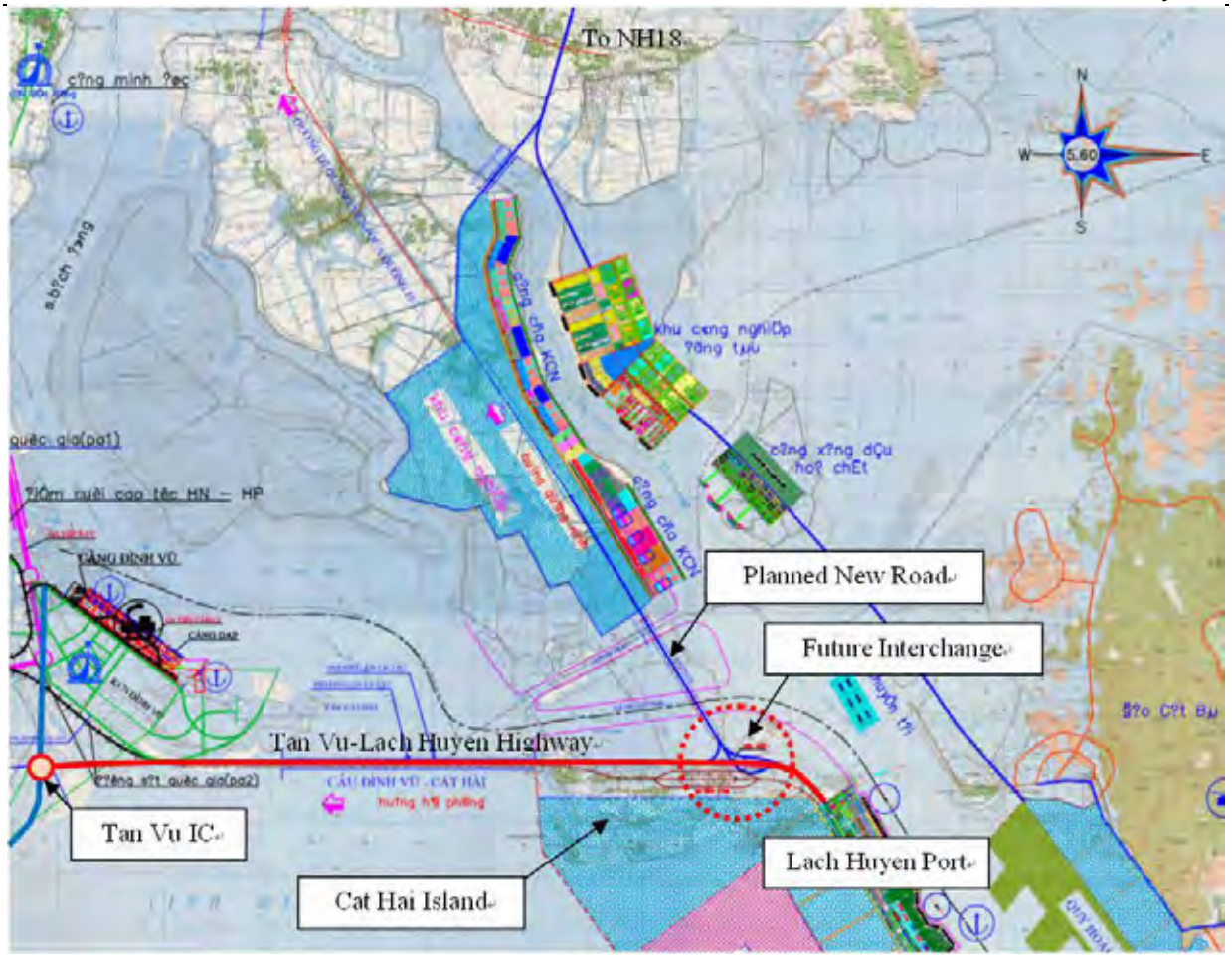
(1) Review of Previous Study

The concept of route alignment connecting Hoi An and Cat Hai Island was developed a long time ago. The wide area development plan was prepared by TEDI in 2007.

In the F/S, the horizontal alignment was developed on the basis of 1 to 1,000 topographic maps. The alignment was approved by MOT through Letter No. 273/TB-BGTVT dated June 24, 2008.

In this Study, the F/S alignment was reviewed. Moreover, its appropriateness was confirmed with regard to the following aspects:

- Considering the Hanoi – Hai Phong Expressway and spatial relationship, location of the Tan Vu IC is appropriate.
- Considering the Hai Phong City master plan, subsequent industrial zone development plan, and position of the intersection with the local road in Dinh Vu IZ area, the route alignment is appropriate.
- Considering the future connection with NH18 in Cat Hai Island and fixed intersection location, the alignment in the island is mostly fixed in the F/S and it is appropriate.



Source: Detailed Design of Lach Huyen Port (TEDI Port, 2004)

Figure 2.4-1 Future Road Network in Cat Hai Island

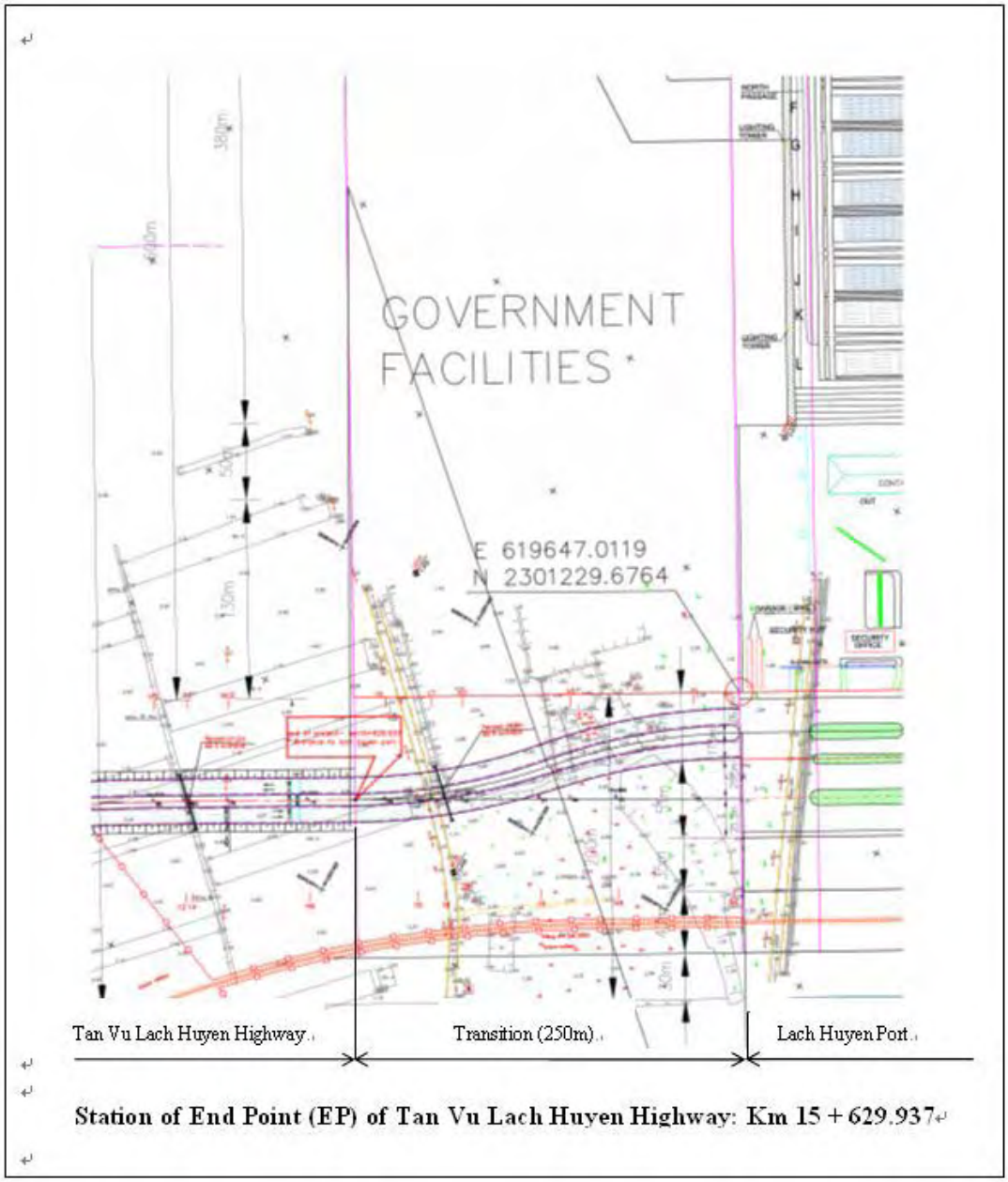
(2) Change of Alignment at End Point

The boundary between the road works portion and port work portion was confirmed with the Port Study Team.

Table 2.4-1 Boundary between Road Works and Port Works

Edge of Government Facility Area (250 m offset from the Edge of Port Terminal Area)

As the result in this Study, the road length is changed into **15 km 630m**



Source: Study Team

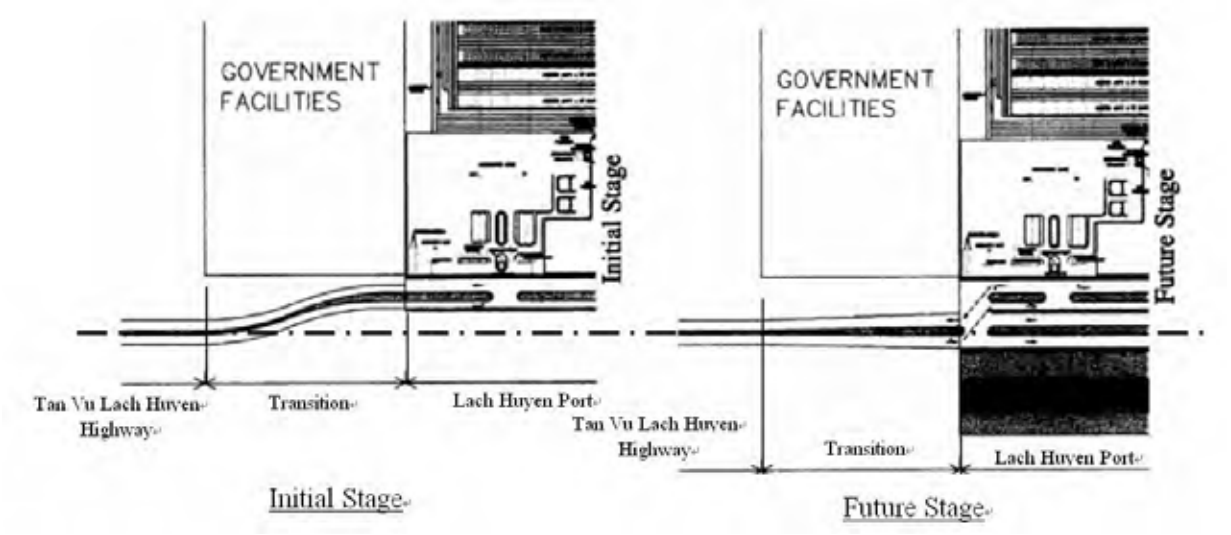
Figure 2.4-2 Updated End Point Position of Tan Vu -Lach Huyen Highway

Table 2.4-2 Project Road Length

Project Road Length = 15.630 km

(3) Future Alignment Updates

In accordance with the port development plan shown in the report of Port Portion Preparatory Survey, the alignment of the "transition" section will be updated in the future in accordance with port development.



Source: Port Portion Study Team

Figure 2.4-3 Future Alignment Update at Transition Section

2.4.3. Alternative Study on Stage Construction Options

(1) Future Traffic Lane Requirements

The number of required lanes is calculated from peak traffic volume according to TCVN4054-2005. The number of lanes is calculated using the following formula, in accordance with Section 4.2.2 in TCVN4054-2005, on the basis of the forecast traffic volume of Table 2.3-30:

< Section 4.2.2 in TCVN4054-2005>

$$n_{lane} = \frac{N_{rush\text{-}hour}}{Z * N_{actual\text{-}capacity}}$$

Where:

n_{lane}: required number of lane

$N_{rush\text{-}hour}$: peak-hour design traffic volume: (Section 3.3.3) $N_{Peak\text{-}hour} = (0.10 \div 0.12)\ N_{average\ daily}$

Z: volume to capacity ratio

- V_{tt} = 80 km/h, Z = 0.55;
- V_{tt} = 60 km/h, Z = 0.55 for the flat area
  Z = 0.77 for the rolling-mountainous areas;
- $V_{tt} \leq$ 40 km/h, Z = 0.85 V_{tt} is Design Speed

$N_{actual\text{-}capacity}$:

- 1800 pcu/hr/lane: When there is median separator between the vehicles in opposite directions and side separator between motor vehicles and non-motorized ones.
- 1500 pcu/hr/lane: When there is median separator between the vehicles in opposite directions but no side separator for motor vehicles and non-motorized ones.
- 1000 pcu/hr/lane: When there is median separator between the vehicles in opposite directions but no side separator for motor vehicles and non-motorized ones.

In accordance with the above, the future traffic lane requirements are calculated as shown in Table 2.4-3.

Table 2.4-3 Number of Lane

Section	Peak Hour	Direction	Year							
			2015		2020		2025		2030	
Tan Vu IC - Dinh Vu	AM	To Tan Vu Interchange	1,276	2	2,149	3	3,145	4	4,140	5
		From Tan Vu Interchange	745	1	1,451	2	2,709	3	3,967	5
	PM	To Tan Vu Interchange	550	1	1,098	2	1,794	2	2,490	3
		From Tan Vu Interchange	1,125	2	1,874	2	2,823	3	3,772	4
Dinh Vu - Cat Hai	AM	Cat Hai to Dinh Vu	927	1	1,494	2	1,748	2	2,002	3
		Dinh Vu to Cat Hai	351	1	745	1	1,047	2	1,350	2
	PM	Cat Hai to Dinh Vu	351	1	745	1	1,047	2	1,350	2
		Dinh Vu to Cat Hai	927	1	1,494	2	1,748	2	2,002	3

Source: Study Team

(2) Alternative Study on Stage Construction Options

1) Stage Construction Assumed from Traffic Forecast

As described in the above, four lanes of the highway would bear the traffic demand in the future. In order to reduce the initial construction cost, “stage construction method” should be applied for the road development.

However, future widening should be considered in the planning at the initial stage so as to enable easier construction work at that time.

2) Stage Construction Options (1) Tan Vu Intersection

In the F/S, major traffic direction is between Hanoi – Hai Phong Expressway (HHE) and Lach Huyen Port (LHP), and this tendency will not be changed.

Ring Road No. 3 (RR3) of Hai Phong City is planned to connect to this intersection in the future, however, there is no time envisaged regarding its materialization.

3) Stage Construction Options (2) Section between Tan Vu and Cat Hai

These are the following alternatives for stage construction, in general, considering the 4-lane highway at the initial stage and 6-lane in the second development stage.

Alternatives

Considering the above traffic requirement and in order to reduce the initial construction cost reasonably, “stage construction method” is recommended and its application was studied.

Table 2.4-4 Alternatives of Stage Construction

Alternative No.	Hai An Side			Cat Hai Side
	Tan Vu IC	Pavement	Bridge	Pavement
		Embankment		Embankment
SC-1	At-grade	4	4	4
		4		4
SC-2	At-grade	4	4	4
		6		6

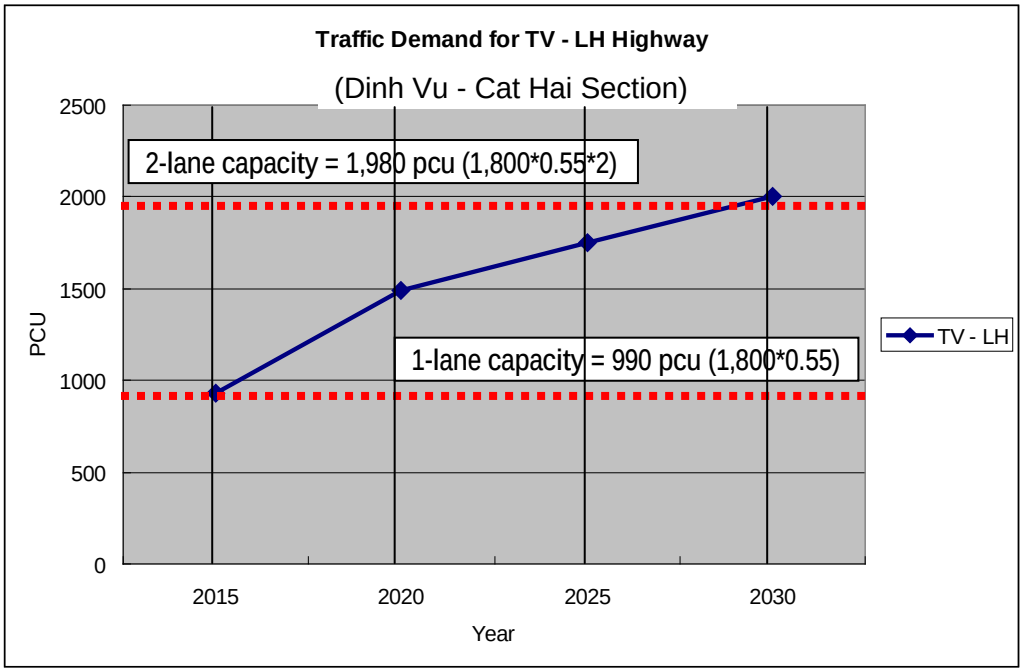
Comparison Study

Alternatives are compared in terms of 1) traffic demand, 2) construction cost, 3) construction period, 4) ease in future widening works in Table 2.4-5.

Table 2.4-5 Alternatives of Stage Construction

Alternative No.	Traffic Demand	Construction Cost	Construction Period	Future Widening
SC-1	- Sufficient	- VND 939 billion	- Controlled by bridge works	- Difficult to widen embankment
SC-2	- Sufficient	- VND 1,128 billion (+VND 189 billion) (+20%)	- Controlled by bridge works	- No need to widen embankment

Source: Study Team



Source: Study Team

Figure 2.4-4 Future Lane Requirement

- 2-lane per direction could serve sufficient traffic capacity until 2027.
- Construction cost: Alternative SC-2 has 20% higher construction cost (around USD 10 million) than Alternative SC-1.
- Construction period: Construction period of Alternative SC-2 could be two months longer than that of Alternative SC-1. However, overall construction period is controlled by the bridge works so difference of the construction period between alternatives is negligible.
- Easiness of future widening works: Construction site is soft-ground area. It is technically a little difficult to widen the embankment (said levy widening) from 4-lane to 6-lane in the future because of unequal consolidation status in the ground at that time.

Recommended Stage Construction Option

Considering the above results of the comparison, the following is the recommended stage construction option.

Table 2.4-6 Recommended Stage Construction Program

Stage	Tan Vu IS	Hai An Side		Bridge	Cat Hai Side	
		Embankment	Pavement		Embankment	Pavement
1st	At-grade	6-lane	4-lane	4-lane	6-lane	4-lane
2nd	Grade-separated	No work	6-lane	6-lane	No work	6-lane
		Flyover in Dinh Vu IZ				

1st Stage

- Tan Vu intersection is built as at-grade type.
- Embankment of highway is built as 6-lane.
- Pavement is 4-lane.
- Bridge is 4-lane.

2nd Stage

- Tan Vu intersection will be grade-separated when Ring Road No. 3 is connected.
- No highway embankment works.
- Pavement will be widened to 6-lane.
- Bridge will be widened to 6-lane.
- Flyover in Dinh Vu IZ will be built.

2.4.4. Alternative Study on Bridge Length

In accordance with the recommended stage construction, the following alternative studies were carried out.

(1) Main Bridge

1) Design Conditions

Length of the main bridge is controlled by the following design conditions:

- Required navigation clearance
- Bridge superstructure type

Navigation Clearance

In accordance with VINAMARINE Letter No. 192/TB-BGTVT dated May 14, 2009, it was confirmed that the following navigation clearance is required:

Table 2.4-7 Required Navigation Clearance

2 channels of 100 m wide for the vessels under 1,000 DWT

Bridge Structure Type

Concrete PC-box girder is selected in the F/S and it is reasonable because of the following reasons:

- Materials can be procured locally,
- Popular structure which local contractor can build,
- Initial construction cost is least cost,
- No influence to on-going traffic during 2nd stage construction in the future, and
- Maintenance-free; it is suitable as an offshore structure.

Ratio between Main Spans and Side Spans

Standard ratio between main spans and side spans of the PC-box girder bridge is as follows:

Table 2.4-8 Ratio between Main Span and Side Spans (Four Spans Bridge)

Side Span : Main Span : Main Span : Side Span = 0.63 : 1.00 : 1.00 : 0.63

2) Selection of Optimum Bridge Length

Considering the above design conditions, the following bridge length is selected as the optimum bridge length for the main bridge.

Table 2.4-9 Selection of Optimum Length of Main Bridge

Side Span : Main Span : Main Span : Side Span = 95m : 150m : 150m : 95m = 490m

(2) Approach Bridge (1) Hai An Side

1) Design Conditions

Length of the approach bridge is controlled by the following design conditions:

- Position of the east abutment and edge of the Main Bridge

Alternative Positions of Abutment of Approach Bridge (Hai An Side):

The east abutment should be located on the land area because approaching embankment to the abutment should be on the land. Otherwise, the embankment work would be very costly.

Abutment height should be determined by slope stability analysis of approach embankment. The critical height of the embankment was determined to be 5.5 m. The bridge structure should be higher than this value.

Table 2.4-10 Critical Height of Embankment (Hai An Side)

Critical Height of Embankment H_{max} = 5.5 m

Considering the above, the following are the two alternative positions of the abutment of the approach bridge at Hai An side.

Table 2.4-11 Alternative Abutment Positions of Approach Bridge (Hai An Side)

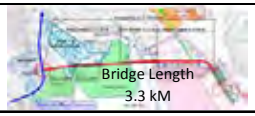
Alternative No.	Abutment Position
AB-HA-1	Edge of Existing Land
AB-HA-2	Edge of Land in Future (After development of South Dinh Vu IZ)

2) Alternative Study and Selection of Optimum Bridge Length of Approach Bridge (Hai An Side)

Considering the above design conditions, the comparison study was carried out and summarized in Table 2.4-12.

"Delay risk" was considered because it will have a very strong adverse effect to the project implementation.

Table 2.4-12 Comparison of Abutment Position of Approach Bridge (Hai An Side)

Schedule of Dinh Vu Improvement Project	On Schedule		Delay	
Alternatives	Alternative 3A	Alternative 3B	Alternative 3A	Alternative 3B
Layout				
1. Construction Cost (Million VND)	Bridge L=2,100m: 1,170,000 ・Temporary road and cofferdam are not required. ・Access to bridge construction works become easy.	Road L= 2,100m : 444,000 Soft ground countermeasure: 325,000 Total: 769,000 ・Soft ground countermeasure is required.	Bridge L=2,100m: 1,419,000 ・Temporary road and cofferdam are required.	Road L= 2,100m : 616,000 Soft ground countermeasure: 325,000 Dyke: 52,000 Total: 993,000 ・Soft ground countermeasure and dyke works are required
2. Construction Period	19.5 months	17.5 months	19.5 months	17.5 months
3. Workability	・Reclamation, bridge and road construction works will be done simultaneously, so construction management and schedule control by mutual executing organization is quite difficult.		・Bridge construction will be individually done, so construction management and schedule control can be correctly done on schedule.	・Even though road construction will be individually done, construction management and schedule control for not only soft ground countermeasure but also dike works are required longer period in the sea.
4. Maintenance	・Bigger range of bridge maintenance, on the other hand smaller range of road maintenance.	・Smaller range of bridge maintenance, on the other hand bigger range of road maintenance, especially maintenance for consolidation settlement.	・Bigger range of bridge maintenance, on the other hand smaller range of road maintenance.	・Smaller range of bridge maintenance, on the other hand bigger range of road maintenance, especially maintenance for consolidation settlement and dyke.
5. Convenience	・It can be served all year because a viaduct on the Dinh Vu IZ improvement area is not affected by wind waves and others. ・It connects to Dinh Vu IZ at 1 location.	・It can be served all year because a road on the Dinh Vu IZ improvement area is not affected by wind waves and others. ・It connects to Dinh Vu IZ at 2 location.	・It can be served all year because a viaduct in the sea is not affected by wind waves and others. ・It connects to Dinh Vu IZ at 1 location.	・Until completion of Dinh Vu IZ, a marine road could be affected by wind waves arising from typhoon and others. ・It connects to Dinh Vu IZ at 2 locations.
6.Environmental Impact	・Environmental impact is controlled by Dinh Vu IZ improvement project, therefore both construction of bridge and road is under same conditions.		・Works affecting environmental impact until completion of Dinh Vu IZ improvement project are temporary roads for pier and foundation of bridge construction in case of delay of Dinh Vu IZ improvement project. ・The environmental impact is smaller that of Alternative 3B.	・Works affecting environmental impact until completion of Dinh Vu IZ improvement project are road embankment for stopping ocean current, soft ground countermeasure and dyke in case of delay of Dinh Vu IZ improvement project. ・The environmental impact is larger that of Alternative 3A.
7. Issues to be resolved	・Completion of road and bridge construction before open of Luch Huyen Port ・Mutual deep coordination between different two Projects.	・Completion of road and bridge construction before open of Luch Huyen Port. ・Mutual deep coordination between different two Projects. ・Road construction in the sea. ・Selection of construction methods for soft ground countermeasure. ・Monitoring and maintenance of road on soft ground.	・Completion of road and bridge construction before open of Luch Huyen Port	・Completion of road and bridge construction before open of Luch Huyen Port. ・Mutual deep coordination between different two Projects. ・Road construction in the sea. ・Selection of construction methods for soft ground countermeasure. ・Monitoring and maintenance of road on soft ground.
8. Conclusion	Recommendation	・No recommendation according to evaluation of Maintenance and Issued to be resolved.	Recommendation	・No recommendation according to evaluation of Maintenance, Covienience, Environmental impact and Issued to be resolved.
	・Recommendation of bridge construction alternatives in the existing sea			is described as disadvantages.

(3) Approach Bridge (2) Cat Hai Side

Abutment height should be determined by slope stability analysis of approach embankment. The critical height of the embankment was determined to be 5.5 m. The bridge structure should be higher than this value.

(4) Recommended Length of Approach Bridges

Approach Bridge at Hai An Side:

B Bridge length is controlled by the location of abutment and it is selected to be located at the existing land area (Alternative-3A in the F/S). Alternative 3B (abutment in the future reclaimed area) would take a very long construction period which could not meet the port opening in early 2015.

Table 2.4-13 Selection of Optimum Length of Approach Bridge (Hai An Side)

Approach Bridge at Hai An Side = 4,433.7 m (Abutment at edge of existing land area)

Approach Bridge at Cat Hai Side:

Bridge length is controlled by the location of abutment and it is selected to be located just behind the dyke. This position would not be shortened.

Table 2.4-14 Selection of Optimum Length of Approach Bridge (Cat Hai Side)

Approach Bridge at Cat Hai Side = 519.2 m (Abutment behind of the dyke)

2.4.5. Alternative Study on Bridge Type (1) Main Bridge

(1) Structural Alternatives

Structural alternatives are prepared for superstructure and pile foundation.

1) Superstructure

Considering the application of stage construction and the required 30 month construction period, the following three types of superstructure were selected for the alternative study.

1) MSB-2: PC Box Girder Separated Type
   - 3 lanes/4 lanes to 6 lanes, 2 stages construction

2) MUBR: PC Box Girder with Rib
   - 4 lanes to 6 lanes, 2 stages construction

3) MUBS: PC Box Girder with Strut Unified
   - 4 lanes to 6 lanes, 2 stages construction

Table 2.4-15 Alternative types of Superstructure for Main Bridge

Type		MSB-2 PC Box Girder Separated type	MUBR PC Box Girder with Rib Unified type	MUBS PC Box Girder with Strut Unified type
Span Arrangement		95m+150m+150m+95m		
Width	1st Stage	13.5m	19.0m	
	2nd Stage	13.0m	7.5m	
	Total	26.5m	26.5m	
Girder Depth		H= 3.0m-8.0m		

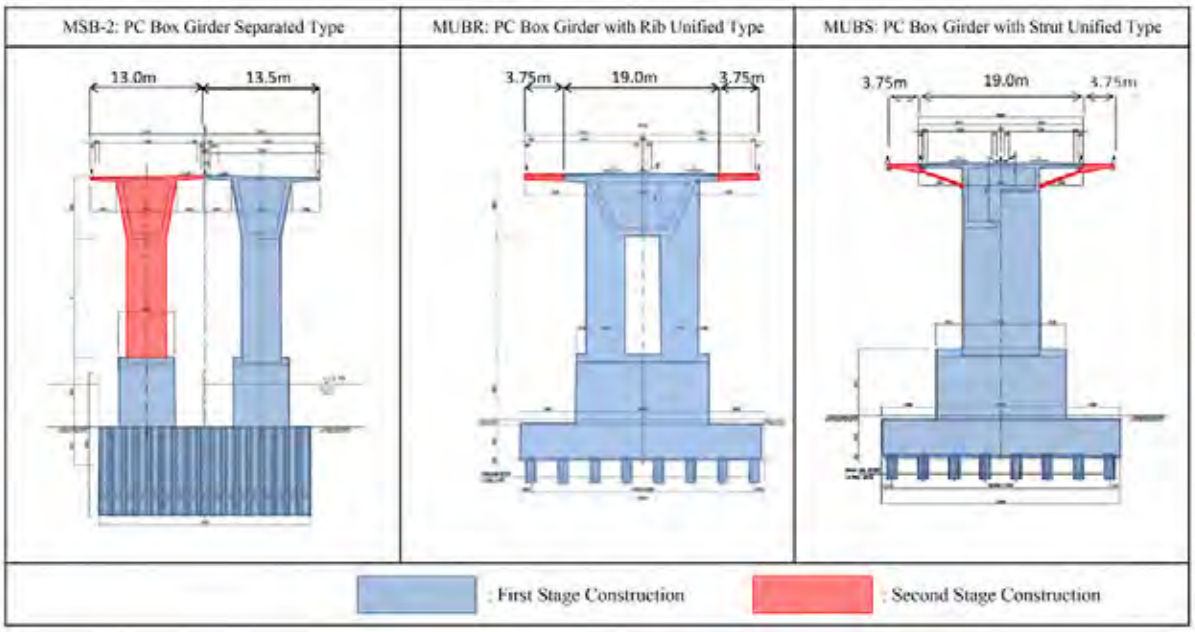
2) Pier

- V-shaped pier is selected similar to the recommendation in the F/S.

3) Foundation

- Bored Pile ϕ 1.2m based on the F/S
- Steel Pipe Well Foundation

Table 2.4-16 Alternative Types of Superstructure for Main Bridge



(2) Evaluation Criteria

In order to select the optimum bridge type, the following evaluation criteria were established:

- 1st stage initial construction cost and 2nd stage cost
- 1st stage construction period and 2nd stage period
- Maintenance aspect
- Consideration of 2nd stage constructability
- Required traffic control in 2nd stage widening

1st Stage Initial Construction Cost and 2nd Stage Construction Cost

Construction cost should be quantitatively evaluated based on the updated project cost.

1st Stage Initial Construction Period and 2nd Stage Construction Period

Construction period should be quantitatively evaluated based on the updated construction planning.

Maintenance Aspect

Maintenance aspect will be evaluated considering the difference between bridge types with respect to salt damage. It is possible to evaluate durability of structural members according to exposed surface area. It is also possible to evaluate durability of bridge accessories such as bearing shoe and expansion joint according to number and quality.

No remarkable difference was found among the alternative types of superstructure for the main

bridge with regard to maintenance.

Consideration of 2nd Stage Constructability

MSB-2: Both abutments of the approach bridge and substructure of the main bridge should be built during the 1st stage. During the 2nd stage, all bridge structural entities shall be built including pile foundation, substructure and superstructure.

MUBR and MUBS: Only additional cantilever slab with rib and cantilever slab with strut shall be built during the 2nd stage. However, these works require high construction technology and know-how.

Required Traffic Control in 2nd Stage Widening

MSB-2: No special traffic control is required when the 2nd stage works are carried out.

MUBR and MUBS: Strict traffic regulation is required for the widening works during the 2nd stage.

(3) Comparative Study

Considering the above evaluation criteria, the comparative study was carried out and summarized in Tables 2.4-17 and 2.4-18.

Table 2.4-17 Comparison of Superstructure Type for Main Bridge

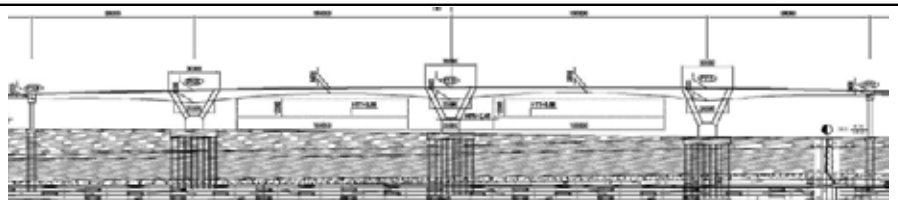
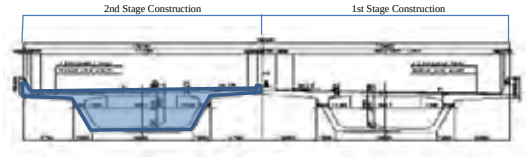
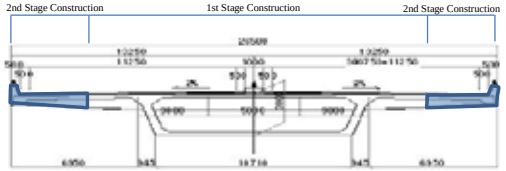
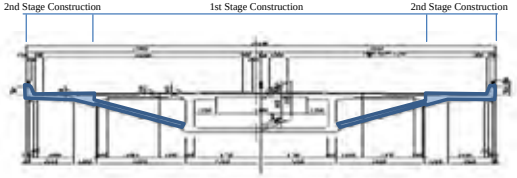
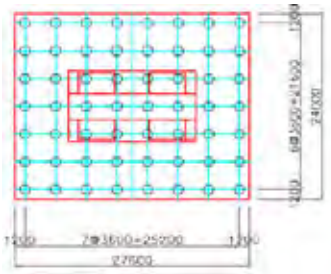
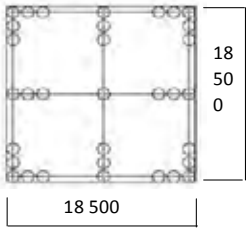
Alternatives	MSB-2: PC Box Girder Separated Type			MUBR: PC Box Girder with Rib, Unified Type			MUBS: PC Box Girder with Strut, Unified Type		
Span Component	95m + 150m + 150m + 95m = 490m								
Side View									
Cross Section	 3 Lanes/4 lanes to 6 lanes			 4 Lanes to 6 lanes			 4 Lanes to 6 lanes		
Construction Cost (MVND)	1 st Stage	2nd Stage	Total	1 st Stage	2nd Stage	Total	1 st Stage	2nd Stage	Total
Superstructure	171,621	168,687	340,308	281,499	48,354	329,853	241,055	79,085	320,140
Substructure	274,548	14,391	288,939	289,658	-----	289,658	278,385	-----	278,385
Total	446,169	183,078	629,247	571,157	48,354	619,511	519,440	79,085	598,525
Cost Ratio	1.00	1.00	1.00	1.28	0.26	0.98	1.16	0.43	0.95
	(MSB-2 : MUBR : MUBS); **1st Stage Initial Cost = 1.00 : 1.28 : 1.16** and 2nd Stage Widening Cost = 1.00 : 0.26: 0.43 and **Overall Final Cost = 1.00 : 0.98 : 0.95**								
Construction Period	20 months	18 months	38 months	24 months	12 months	36 months	24 months	15 months	39 months
Maintenance	To give attention against salt damages on strucural members and bridge accessories No remarkable difference between each alternative			To give attention against salt damages on strucural members and bridge accessories No remarkable difference between each alternative			To give attention against salt damages on strucural members and bridge accessories No remarkable difference between each alternative		
Project Merit	Possession of project scale merit for 2nd stage construction in the future			No Possession of project scale merit for 2nd stage construction in the future To require high construction technology and know-how			No Possession of project scale merit for 2nd stage construction in the future To require high construction technology and know-how		
Workability	No influence to opened traffic during 2nd stage construction in the future			Big influence to opened traffic during 2nd stage construction in the future To design considering unbalance loads during 2nd stage construction			Big influence to opened traffic during 2nd stage construction in the future To design considering unbalance loads during 2nd stage construction		
Conclusion	Recommendable for 4-lanes bridge (can be opearted as 4-lanes bridge)			Not Recommendable			Recommendable for full 6-lanes bridge		
	※ Initial construction cost is least cost. ※ No influence to opened traffic.						※ MUBR and MUBS don't have project scale merit in the 2nd Stage. ※ Big influence to opened traffic in case of 2 stage construction. ※ Overall construction cost is least cost.		

Table 2.4-18 Comparison of Foundation Type for Main Bridge

	Main Bridge	
Alternative Pile Type	Altrenative-1 Cast-in-place pile D=1.2m	Altrenative-2 Steel pipe well D=1.2m
Plan of Pile Cap		
	L=29.0m , n=56nos	L=29.0m , n=69nos
Amount	70,076 Million VND	104,167 Million VND
Cost ratio	1.000	1.486
Construction Period	4.0 months ・Longer period	2.5 months ・Shorter period
Workability	・Very common in Vietnam ・Machines and equipments is available ・Double temporary cofferdam is required in case of 10m or more sea water depth.	・A little rare adoption in Vietnam ・Steel pipe well is used both for foundation of bridge and temporary cofferdam ・Steel pipe well can be safely constructed in deep sea water depth.
Environmental impact	・Much turbid water ・Much discharged soils	・Even though larger noise and vibration is generated, residential area is far from the construction site.
STEP requirement	・Japanese products are not much used.	・Japanese products are much used.
Conclusion	Not Recommendable	**Recomendable** ※ Shorter construction period ※ More safety construction ※ Smaller environmental impact ※ Japanese products are much used.

(4) Selection of Optimum Bridge Type of Main Bridge

According to the result of the comparative study above, the following bridge type is selected as the optimum bridge type for the main bridge:

1) Superstructure

In case of adoption of stage construction, PC box girder, separated type is selected due to the following reasons:

- Materials can be produced locally,
- Popular structure which local contractors can build,
- Initial construction cost is least costly,
- No influence to present traffic during 2nd stage construction in the future, and
- Maintenance-free; it is suitable as an offshore structure.

In case of adoption of full scale 6-lane construction, PC box girder with strut, unified type is selected due to the following reasons:

- Materials can be produced locally,
- Overall construction cost is least costly,
- New technology can be introduced in Vietnam as a STEP loan project, and
- Maintenance free; it is suitable as an offshore structure.

Reference: PC Box Girder with Strut, Unified type

This strut-type superstructure has been adopted in the two-stage construction of one project without any open traffic in Japan. It consists of one core box segment and additional strut wing slab. This type is also planned in the two-stage construction of two different projects. Firstly, the required bridge width according to future traffic volume will be constructed. Next, it will be opened to traffic. Finally, only additional strut wing slab will be constructed in the future while there is ongoing traffic. The latter stage construction type has no practical construction records while traffic is open; therefore, it is required to improve construction technology and know-how in order to secure the structural safety of connection parts between the constructed PC box and additional strut wing slab.

Table 2.4-19 Selection of Optimum Superstructure Type for Main Bridge

In case of adoption of stage construction : PC Box Girder, separated type
In case of adoption of full scale 6-lane construction: PC Box Girder with strut, unified type

2) Substructure (1), Pier

Double V-shaped Pier was selected from landscaping view point, the Study Team has no objection to the selected pier type in the F/S.

Table 2.4-20 Selection of Optimum Pier Type of Main Bridge

Double V-shaped Pier

3) Substructure (2), Foundation

Steel Pipe Well Foundation is selected due to the following reasons (refer to Table 2.4-18):

- Even if construction cost is a little higher, it is the best and safest construction option against deep sea, high wave and strong winds during typhoon seasons,
- Construction period is shortest because the steel pipe functions both as temporary cofferdam and permanent foundation,
- Environmental influence of turbid water and discharged soil is smaller, and
- Amount of Japanese products would increase, making the project eligible to apply for STEP loan.

Table 2.4-21 Selection of Optimum Foundation Type of Main Bridge

Steel Pipe Well Foundation

2.4.6. Alternative Study on Bridge Type (2), Approach Bridge

(1) Structural Alternatives

Structural alternatives are prepared for the superstructure and pile foundation.

1) Superstructure

According to the F/S, the Super-T girder, out of six superstructure types, was selected as the optimum bridge type in consideration of economical predominance. Even though construction cost varies significantly between Super-T and PC-I girder, the cost between Super-T and PC box is slightly different. Therefore, four types of superstructure, excluding the PC-I girder, are considered for the comparative study in this Survey.

AST: Super-T Girder and ASB-2: PC Box Girder, Separated type

- 3 lanes/4 lanes to 6 lanes, 2 stages construction

AUBR: PC Box Girder with Rib and AUBS: PC Box Girder with Strut, Unified type

- 4 lanes to 6 lanes, 2 stages construction

Table 2.4-22 Alternative Types of Superstructure for Approach Bridge

Type		AST Super-T Girder Separated type	ASB-2 PC Box Girder Separated type	AUBR PC Box Girder with Rib Unified type	AUBS PC Box Girder with Strut Unified type
Span Arrangement		40m	60m	60m	
Width	1st Stage	13.5m		19.0m	
	2nd Stage	13.0m		7.5m	
	Total	26.5m		26.5m	
Girder Depth		H=1.75m	H= 3.0m (1/20)	H=3.0m (1/20)	

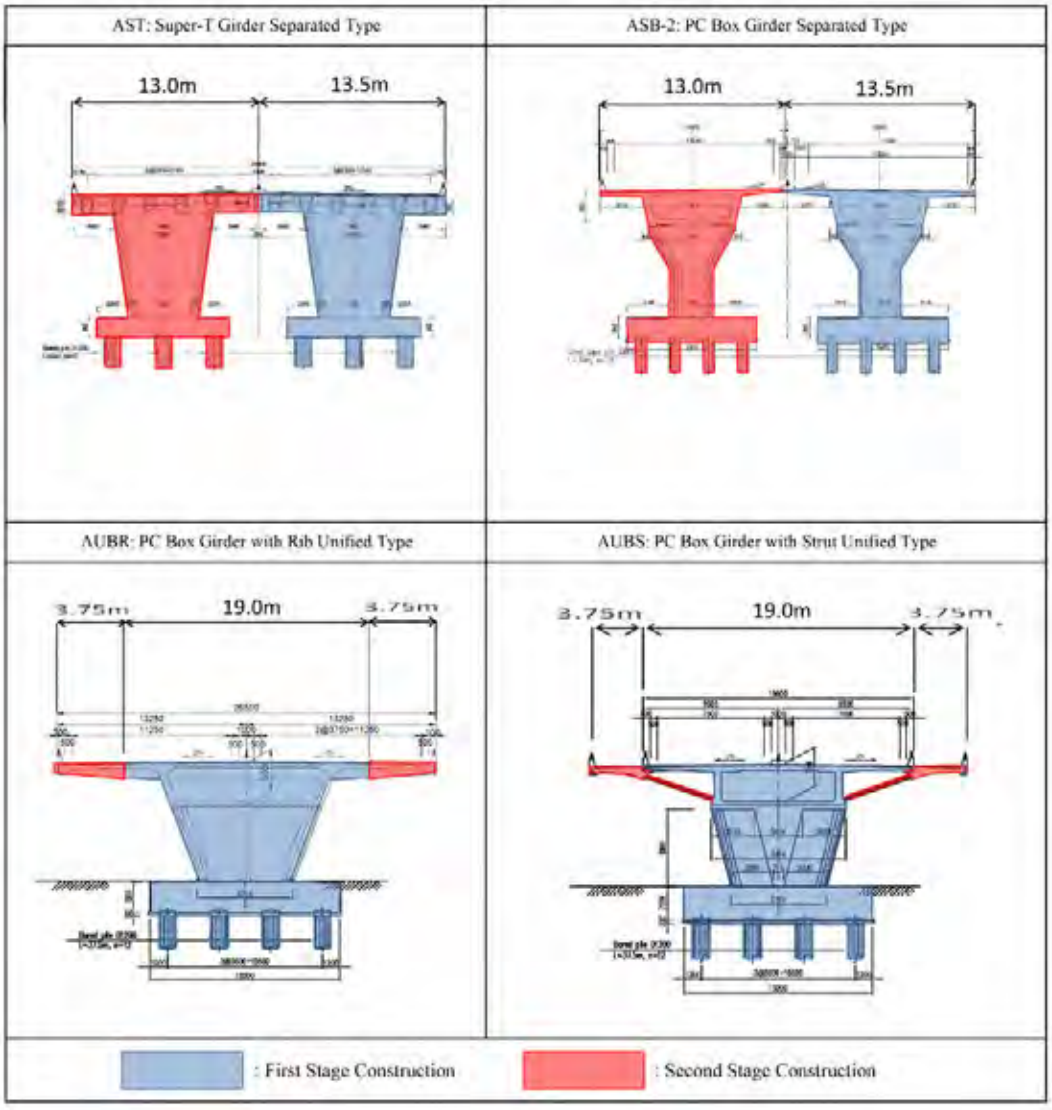
2) Pier

- Wall Pier based on the F/S

3) Foundation

- Bored Pile ϕ 1.2m based on the F/S
- Steel Pile Foundation

Table 2.4-23 Alternative Types of Superstructure for Approach Bridge



(2) Evaluation Criteria

Considering the above design conditions, the type of the approach bridge will be selected through comparative study based on the following evaluation criteria, which are same as those for the main bridge.

- 1st stage initial construction cost and 2nd stage cost
- 1st stage construction period and 2nd stage period
- Maintenance aspect
- Consideration of 2nd stage constructability
- Required traffic control during 2nd stage widening

(3) Comparative Study

Considering the above design conditions and evaluation criteria, the comparative study was carried out and summarized in Tables 2.4−24 and 2.4-25.

Table 2.4-24 Comparison of Superstructure Type for Approach Bridge

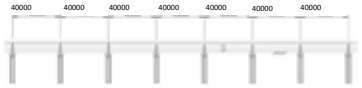
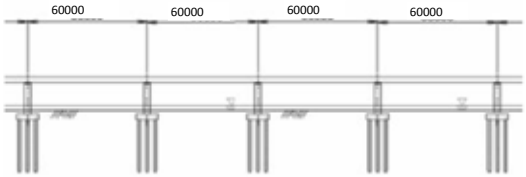
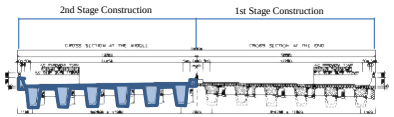
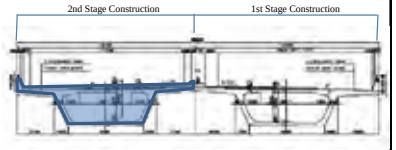
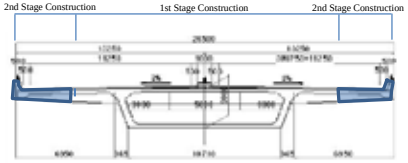
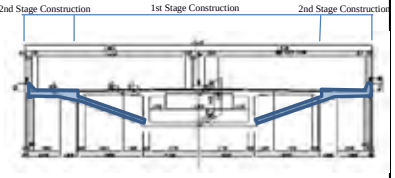
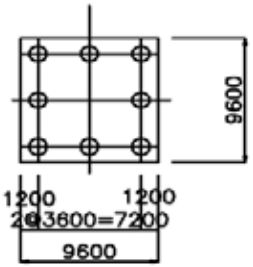
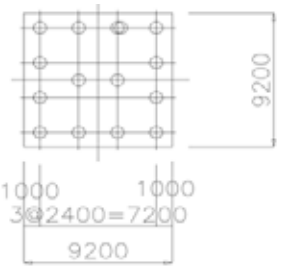
Alternatives	AST: Super-T Girder			ASB-2: PC Box Girder Separated Type			AUBR: PC Box Girder Separated Type			AUBS: PC Box Girder Separated Type		
Span Component	1 Span Length = 40m, Total objective length = 4748.4 m			1 Span Length = 60m, Total objective length = 4748.4 m								
Side View												
Cross Section	3 Lanes/4 lanes to 6 lanes 			3 Lanes/4 lanes to 6 lanes 			4 Lanes to 6 lanes 			4 Lanes to 6 lanes 		
Construction Cost (MVND)	1 st Stage	2nd Stage	Total	1 st Stage	2nd Stage	Total	1 st Stage	2nd Stage	Total	1 st Stage	2nd Stage	Total
Superstructure	604,446	596,906	1,201,352	1,006,271	988,529	1,994,800	1,851,380	475,169	2,326,549	1,572,815	667,147	2,239,962
Substructure	1,040,964	965,129	2,006,093	775,298	747,139	1,522,437	1,314,933	-----	1,314,933	1,219,081	-----	1,219,081
Total	1,645,410	1,562,035	3,207,445	1,781,569	1,735,668	3,517,237	3,166,313	475,169	3,641,482	2,791,896	667,147	3,459,043
Cost Ratio	1.00	1.00	1.00	1.08	1.11	1.10	1.92	0.30	1.14	1.70	0.43	1.08
	(AST : ASB-2 : AUBR : AUBS); 1st Stage Initial Cost = 1.00 : 1.08 : 1.92 : 1.70 and 2nd Stage Widening Cost = 1.00 : 1.11 : 0.30 : 0.43 and Overall Final Cost = 1.00 : 1.10 : 1.14 : 1.08											
Construction Period	28 months	24 months	52 months	26 months	22 months	48 months	28 months	12 months	40 months	28 months	15 months	43 months
Maintenance	Exposed surface area of Super-T is larger than PC Box types, so it will be severely affected by salty conditions. Number of Bearing Shoe is so many rather than PC Box types, so maintenance activities are required much more.			To give countermeasure against salt damages on strucural members and bridge accessories No remarkable difference between each alternative between PC Box types			To give countermeasure against salt damages on strucural members and bridge accessories No remarkable difference between each alternative between PC Box types			To give countermeasure against salt damages on strucural members and bridge accessories No remarkable difference between each alternative between PC Box types		
Project Merit	Possession of project scale merit for 2nd stage construction in the future			Possession of project scale merit for 2nd stage construction in the future			No Possession of project scale merit for 2nd stage construction in the future To require high construction technology and know-how			No Possession of project scale merit for 2nd stage construction in the future To require high construction technology and know-how		
Workability	Local resourse can be effectively applied. Construction of Girder is easier because of light weight girder. No influence to opened traffic during 2nd stage construction in the future			No influence to opened traffic during 2nd stage construction in the future			Big influence to opened traffic during 2nd stage construction in the future To design considering unbalance loads during 2nd stage construction			Big influence to opened traffic during 2nd stage construction in the future To design considering unbalance loads during 2nd stage construction		
Conclusion	No Recommendable			Recommendable for 4-lanes bridge (can be opearted as 4-lanes bridge)			No Recommendable			Recommendable for full 6-lanes bridge		
	Even if Initial construction cost is least cost (8 % less). ※ Maintenance activities are required much more ※ Construction Period is longest alternative because of large number of piers and piles.			Even if Initial construction cost is a little higher cost (8 % more). ※ Maintenance activities are not required much. ※ Construction Period is not longer alternative because of not so large number of piers and piles.						※ AUBR and AUBS don't have project scale merit in the 2nd Stage. ※ Big influence to opened traffic in case of 2 stage construction. ※ Overall construction cost is least cost as Box type. ※ Approach bridge should be harmonized with Main bridge. ※ Construction Period is a same as full scale construction.		

Table 2.4-25 Comparison of Foundation Type for Approach Bridge

	Approach Bridge	
Alternative Pile Type	Altrenative-1	Altrenative-2
	Cast-in-place pile D=1.2m	Steel pipe pile D=0.8m
Plan of Pile Cap		
	L=37.5m , n=8nos	L=37.5m , n=14nos
Amount	352 Million VND	447 Million VND
Cost ratio	1.000	1.270
Construction Period	16 days ・Longer period	8 days ・Shorter period
Workability	・Very common in Vietnam ・Machines and equipments is available ・Double temporary cofferdam is required in case of 10m or more sea water depth.	・A little rare adoption in Vietnam ・Machines and equipments is available ・Double temporary cofferdam is required in case of 10m or more sea water depth.
Environmental impact	・Much turbit water ・Much discharged soils	・Even though larger noise and vibration is generated, residential area is far from the construction site.
STEP requirement	・Japanese products are not much used.	・Japanese products are much used.
Conclusion	Not Recommendable	**Recomendable** ※ Shorter construction period ※ Smaller environmental impact ※ Japanese products are much used.

(4) Selection of Optimum Bridge Type of Approach Bridge

According to the comparative study result, the following bridge type is selected as the optimum bridge type for the approach bridge:

1) Superstructure

In case of adoption of stage construction, PC box girder, separated type is selected due to the following reasons:

- Materials can be produced locally,
- No influence to ongoing traffic during 2nd stage construction in the future

Even if initial construction cost is a little higher than that of the Super-T girder,

- Maintenance activities are not required much based on the number of bearing, length of expansion joint, exposed area of structure and so on, and
- Construction period is shorter based on the quantity of pier and piles.

In case of adoption of full scale 6-lane construction, PC box girder with strut, unified type is selected due to the following reasons:

- Materials can be produced locally,
- Overall construction cost is less costly than the PC box type, and
- New technology can be introduced in Vietnam as a STEP loan project.

Even if initial construction cost is a little higher than that of the Super-T girder,

- Maintenance activities are not required much based on the number of bearing, length of expansion joint, exposed area of structure and so on, and
- Construction period is shorter based on the quantity of pier and piles.

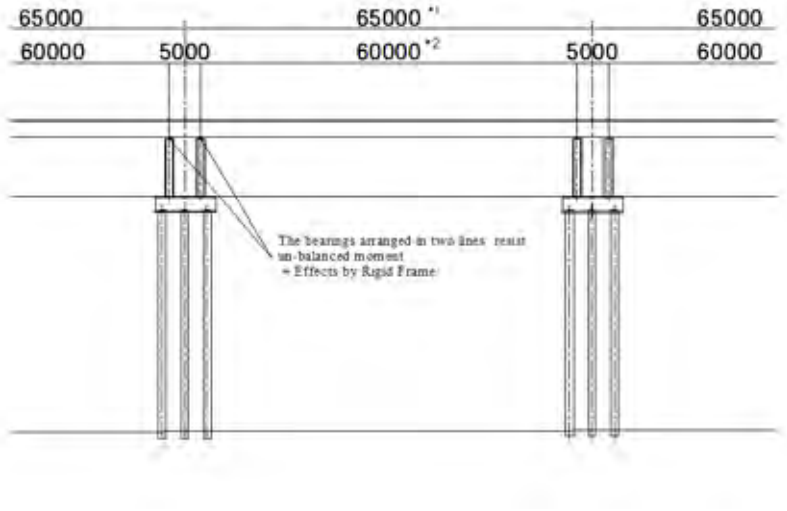
Table 2.4-26 Selection of Optimum Superstructure Type of Approach Bridge

In case of adoption of Stage Construction : PC Box Girder, separated type
In case of adoption of Full scale 6-lanes Construction: PC Box Girder with strut, unified type

2) Substructure (1), Pier

Wall pier was selected for supporting the Super-T girder and PC box girder superstructures.

Furthermore, as mentioned in the F/S, the pier shall be a double wall type in order to achieve cost savings through applying longer span as much as possible to reduce the numbers of piers as shown in Figure 2.4-4. In addition, the bearings are arranged on each double wall to make an equivalent short-period structure, which is similar to a rigid frame, in order to avoid the resonance between the bridge structure and soft soil ground during an earthquake.



*1 The pier shall be arranged in 65 m intervals = numbers of piers can be reduced by approx. 10%.

*2 The girder depth is determined considering a clear span of 60 m.

Figure 2.4-5 Effectiveness of Double Wall Pier

The Study Team has no objection to the selected pier type in the F/S.

Table 2.4-27 Selection of Optimum Pier Type of Approach Bridge

Double Wall Pier

3) Substructure (2), Foundation

Steel pile foundation is selected due to the following reasons:

- Even if construction cost is a little higher, its **construction period is shortest**,
- Environmental influence of turbid water and discharged soil is smaller, and
- Utilization of more Japanese products qualifies the project as a STEP loan scheme

2.4.7. Alternative Study on Construction Schedule

Construction schedule was agreed to be 32 months during the discussion between JICA and MOT as shown in Attachment-10.

The following is the result of the Study on the basis of 30 months construction.

(1) General

In the Terms of Reference (the TOR) of this Study, it was assumed that the construction period is 30 months because the highway opening is highly expected in 2014.

In accordance with the TOR, in order to achieve the 30 month construction period, the Study Team has proposed some "Accelerated Construction Methods" in this Study as follows:

Table 2.4-28 List of Accelerated Construction Methods[1)]

No.	Structure Type	Accelerated Construction Method	Time saved (months)
1	Superstructure	Span-By-Span (SBS) Erection Method	6[2)]
2	Foundation (Main Bridge)	Steel Pipe Well	2-3
3	Foundation (Approach Bridge)	Steel Pile	3-4

Note:
1) Time saving amount for 4.5km long Approach Bridge.
2) Time saving amount against "standard cast-in-situ" balanced cantilever method.

In addition to the above, time savings through the application of stage construction should also be compared.

(2) Schedule Alternatives

The following schedule alternatives were considered for the comparison study:

- Construction Period: 30 months (TOR)
- Construction Period: 36 months (F/S)

(3) Comparison Study

Comparison results on the construction cost and time are summarized in Table 2.4-29.

Table 2.4-29 Comparison of Construction Schedule[1)]

No.	Structure Type	Construction Method		Applicability		Cost		Structure Durability	Construction Safety	Ranking	
				30 months	36 months	30 months	36 months			30 months	36 months
1	Superstructure	PC-Box	SBS	◎	◎	100	100	◎	◎	1	1
			MSS	○	◎	100	100		◎	2	2
			Cast-in Situ	×	○	×	100		○	-	3
		Super-T		○	◎	90	90	△	○	3	4
2	Foundation (Main Bridge)	Steel Pipe Well		◎	◎	100	100	◎	◎	1	1
		Temporary Coffer		×	○	-	80	△	△	-	2
3	Foundation (Approach Bridge)	Steel Pile		◎	◎	100	100	◎	◎	1	**2**
		Bored Pile		×	○	-	80	◎	◎	-	**1**

◎: Suitable/Very Good, ○: Possible/Acceptable, △: Doubtful, ×: Impossible/Not Acceptable

Note:

1) Comparison for 4.5km long Approach Bridge.

(4) Selection of Optimum Construction Schedule

1) 30 Months (TOR Basis)

If 30 months construction period is required, accelerated construction methods shall be applied in order to timely complete the works.

2) 36 Months (Same as F/S)

If 36 month construction period is required, **bored pile could be used instead of the steel pile** due to economic reasons.

3) Construction Schedule of 6-lane Bridge

If 6-lane bridge is required, 30 months construction schedule can be achievable by utilizing the Span-by-Span method for the superstructure and steel pile for the foundation.

2.4.8. Summary of Alternative Studies

The Summary of the alternative studies is tabulated in Table 2.4-30.

Table 2.4-30 Summary of Alternative Studies

No.	Study Item		Study Result
1	Route Alignment		• End point is adjusted to the port works. • Other alignment was not changed from the F/S.
2	Stage Construction		• Application of Stage Construction is proposed in the view of updated traffic demand forecast. • Structural consideration for the stage construction was studied in depth. • Structural studies for the 6-lane bridge are also carried out.
3	Bridge Length		• Bridge length was decided: Approach Bridge (Hai An) = 4,434 m Main Bridge = 490 m Approach Bridge (Cat Hai) = 519 m Total = 5,443 m
4	Bridge Type (1), Main Bridge	Superstructure	Stage Construction (4-lane) PC Box Girder, separated type Full 6-lane PC Box Girder with strut, unified type
		Substructure	Double V-shaped Pier
		Foundation	Steel Pipe Well Foundation
5	Bridge Type (2), Approach Bridge	Superstructure	Stage Construction (4-lane) PC Box Girder, separated type Full 6-lane PC Box Girder with strut, unified type
		Substructure	Standard section: Double Wall Type Pier, Flyover section: Double V-shaped Pier
		Foundation	Steel Pile Foundation
6	Construction Schedule (30 months)	Stage Construction (4-lane)	• As proposed above.
		Full 6-lane	
7	Construction Schedule (36 months)	Stage Construction (4-lane)	• **<u>Bored pile can be used instead of steel pile.</u>** • PC-Box is selected for its durable structure. • Steel Sheet Pipe Pile Well Foundation is selected for construction safety with offshore construction at typhoon area.
		Full 6-lane	

2.5. Review of Preliminary Design

2.5.1. General

In this Study, the preliminary design of the F/S (July 2009) by JBSI JV was reviewed as follows. Correctness of most of the design contents was confirmed. Some works have been updated by the Study Team.

2.5.2. Road Design

(1) Road Classification of Tan Vu - Lach Huyen Highway

Classification of Tan Vu – Lach Huyen Highway is Technical Level 80 in Section 3.5 of TCVN4054-2005.

Table 2.5-1 Road Classification of Project Road

No.	Description	Value
1	Design Standard	TCVN4054-2005
2	Design Category	Technical Level 80
3	Design Speed	80 km/h

Source: Study Team

(2) Geometric Design Standards

The geometric design standards of Tan Vu – Lach Huyen Highway is set up as shown in the following Table 2.5-2.

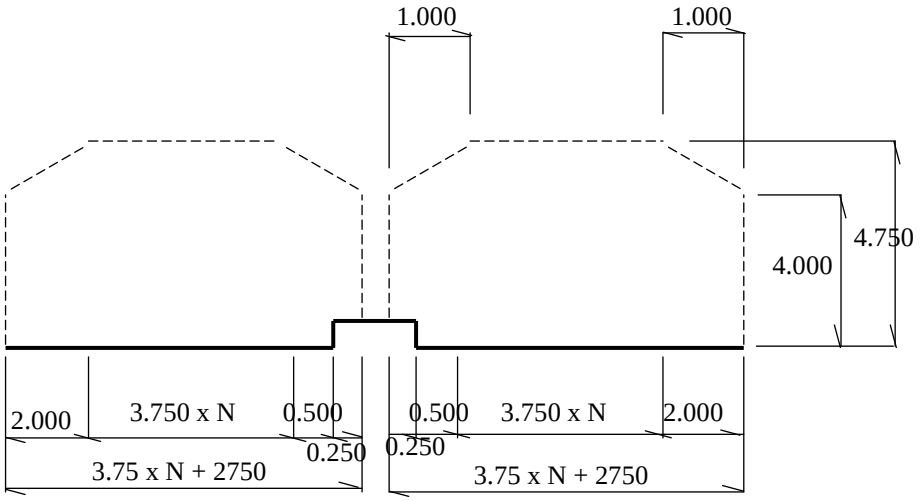
Table 2.5-2 Geometric Design Standards for Tan Vu – Lach Huyen Highway

Geometric Items			UNIT	TCVN 4054-98	TCVN 4054-2005	TCVN5729-97	Adoption
Road classification				Technical class 80	Design category III	Class B-grade 80	Design category III
Topography				Flat, Rolling	Flat, Rolling	Flat, Rolling	Flat, Rolling
Design speed			km/h	80	80	80	80
Cross section	Carriageway		m	2 x 3.50	2 x 3.50	4 x 3.75	6 x 3.75
	Shoulder		m	2 x 3.00	2 x 2.50	2 x 3.25	2 x 2.50
	Paved portion		m	2 x 2.50	2 x 2.00	2 x 2.50	2 x 2.00
Minimum radius			m	400(250)	400(250)	240	400(250)
Minimum radius of horizontal curves depending on deflection angle			m	10,000(1 degree) 6,000(2 degree) 4,000(3 degree) 3,000(4 degree) 2,000(5 degree) 1,000(6 degree) 800(8 degree)	10,000(1 degree) 6,000(2 degree) 4,000(3 degree) 3,000(4 degree) 2,000(5 degree) 1,000(6 degree) 800(8 degree)	___	10,000(1 degree) 6,000(2 degree) 4,000(3 degree) 3,000(4 degree) 2,000(5 degree) 1,000(6 degree) 800(8 degree)
Minimum length of curve			m	174	220(250≤R≤275) 200(275<R<300) 170(300<R<350) 140(350<R)	340	220(250≤R≤275) 200(275<R<300) 170(300<R<350) 140(350<R)
Minimum length of clothoid			m	87 ($L=Vc^3/23.5R$ $=80^3/23.5x250$)	110(250≤R≤275) 100(275<R<300) 85(300<R<350) 70(350<R)	170	110(250≤R≤275) 100(275<R<300) 85(300<R<350) 70(350<R)
Maximum grades			%	6	5	6	5
Maximum length of longitudinal grade			m	900(4%) 700(5%) 500(6%)	900(4%) 700(5%)	900(4%) 700(5%) 500(6%)	900(4%) 700(5%)
Vertical curves	Crest	Minimum	m	4000	4000	3000	4000
		Normal	m	___	5000	4500(12000)	5000
	Sag	Minimum	m	2000	2000	2000	2000
		Normal	m	___	3000	3000(8000)	3000
	Minimum Length of curves		m		70	70	70
Maximum super-elevation			%	6	8	7	8
Minimum Radius which allows an inverse super-elevation			%	1000	2500	2000	2500
Minimum stopping sight distance			m	100	100	100	100
Connecting interchange							
Minimum radius of the horizontal curve		Minimum	m	___	___	700	700
		Normal	m	___	___	1100	1100
Vertical curves	Crest	Minimum	m	___	___	6000	6000
		Normal	m	___	___	12000	12000
	Sag	Minimum	m	___	___	4000	4000
		Normal	m	___	___	8000	8000
Maximum grades		Minimum	%	___	___	4	4
		Normal	%	___	___	3	3

Source: Study Team

(3) Lateral and Vertical Clearances

According to TCVN4054-2005 (Section 4.10), the required clearance on highway is as shown in Figure 2.5-1.



Source: Section 4.10 of TCVN4054-2005

Figure 2.5-1 Traffic Clearance

The minimum vertical clearance for flyover or culvert is defined as follows:

Table 2.5-3 Required Vertical Clearance (Road) (Section 4.10, TCVN4054)

4.75m	Highway class I, II, III
4.5m	Highway class IV, V, VI
3.2m	District Road
2.7m	Bicycle way and sidewalk
2.5m	Pedestrian, bicycle and other non-motorized vehicles.

Source: Section 4.10 of TCVN4054-2005

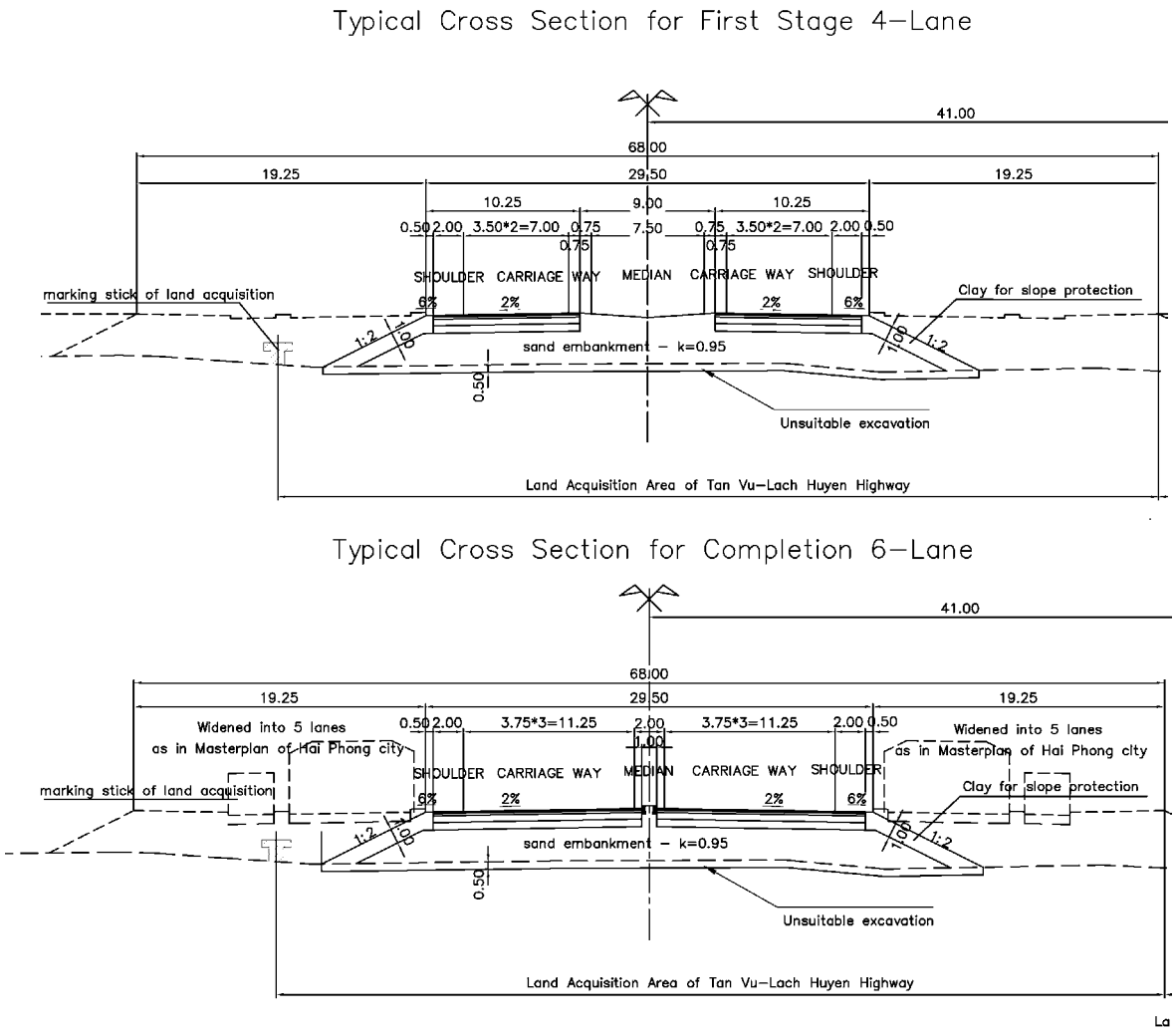
Table 2.5-4 Required Vertical Clearance (Railways)

	Railway (horizontal and vertical)	**Law of railway**
6,55m (vertical)	from the rail crest to the structure base	(Article 27-1)
7m (horizontal)	minimum horizontal clearance from the rail edge to the structure	(Article 27-2)
5m (horizontal)	from outer edge of the outermost rail applicable to unexcavated and unfilled embankment	
3m (horizontal)	from embankment footing to the structure from outer edge of the side ditch outwards applicable to the excavated embankment	

Source: Law of Railways

(4) Typical Cross Section

Typical cross sections, for the first stage and second stage, are as shown in the following figure. The lane width in the first stage is a 3.5 m per lane.



Source: Study Team

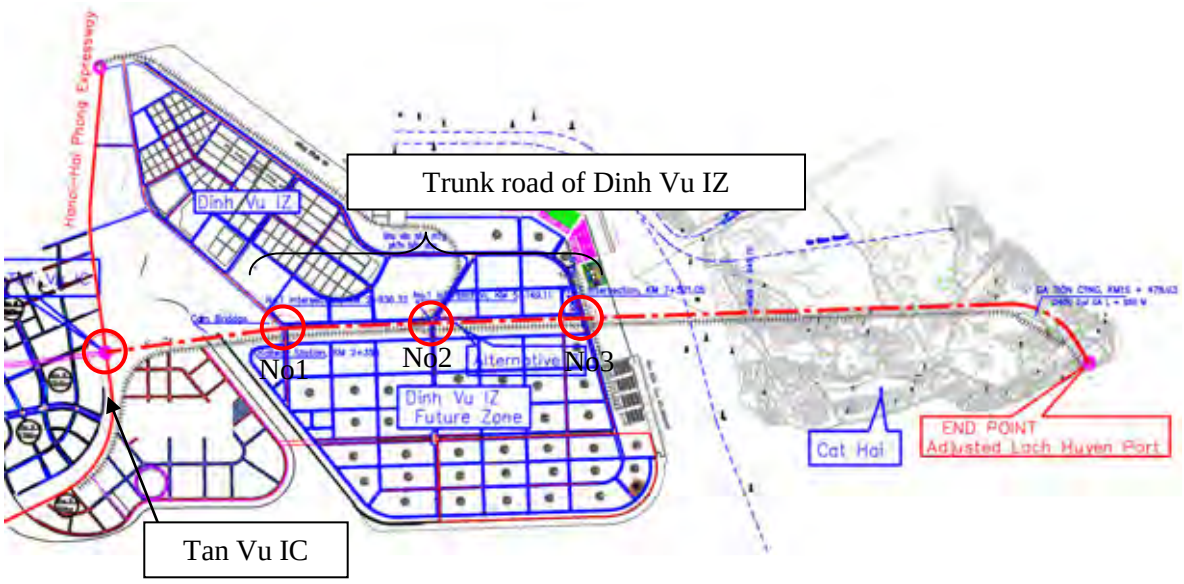
Figure 2.5-2 Typical Cross Section

2.5.3. Interchange and Intersections Design

(1) Interchange and Intersection Layout

For Hai An side, Tan Vu Interchange and three intersections with three arterial roads in the Dinh Vu Industrial Zone are updated.

For Cat Hai side, there is no major intersection except at the end point. The pavement elevation of the project road is the same level with the community road crossing, thus, local minor intersection will be connected without any major structural requirements. Such intersections will be designed during the detailed design stage.

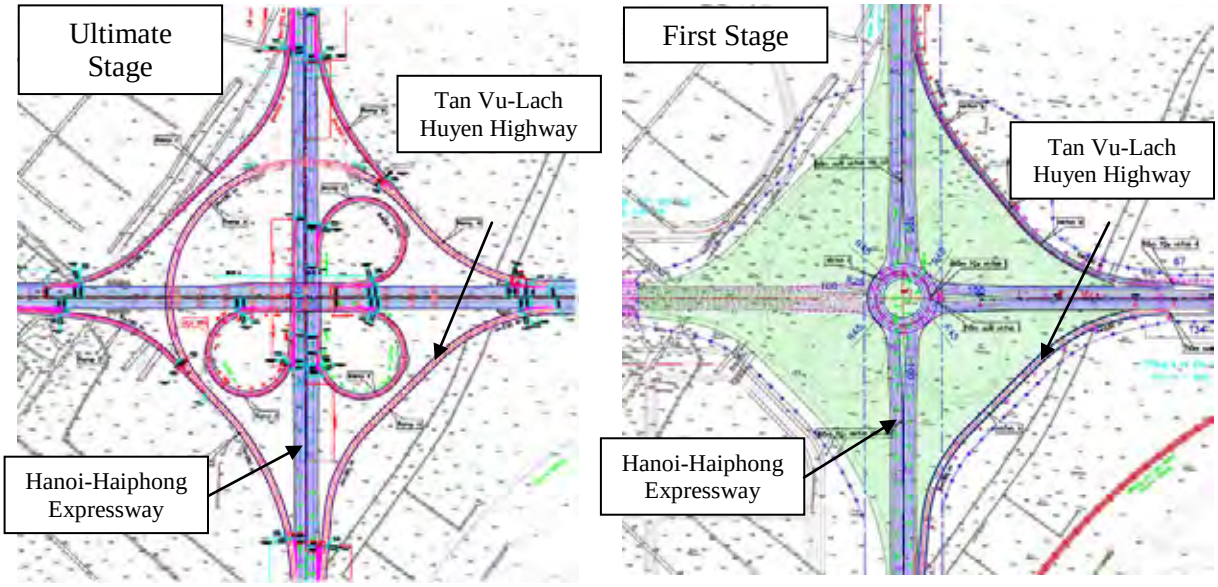


Source: Study Team

Figure 2.5-3 Location of Interchanges and Intersections

- **Tan Vu Interchange**

  Tan Vu IC is installed in Km 100+891.11 of Hanoi – Hai Phong Expressway. The ultimate development intersection type is “cloverleaf with semi-direct connection”. Since in the provisional period, before connection with Hai Phong Ring Road No. 3, there is not much traffic, an at-grade intersection is planned during the first stage.



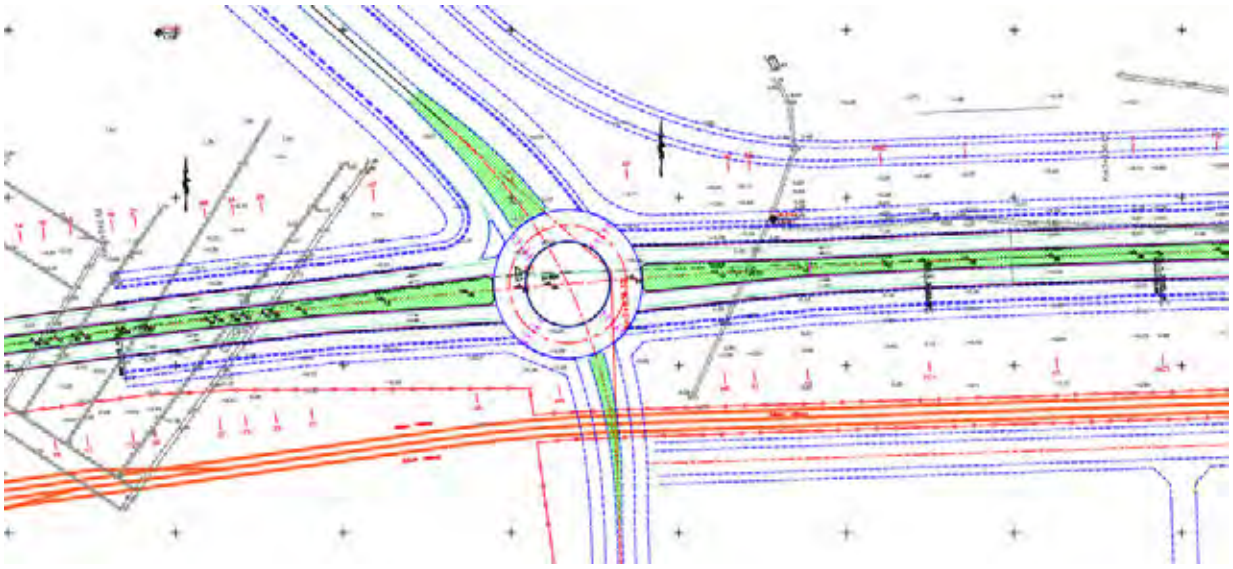
Source: F/S Report (July 2009)

Figure 2.5-4 Plan of Tan Vu Interchange

- **No. 1 Intersection**

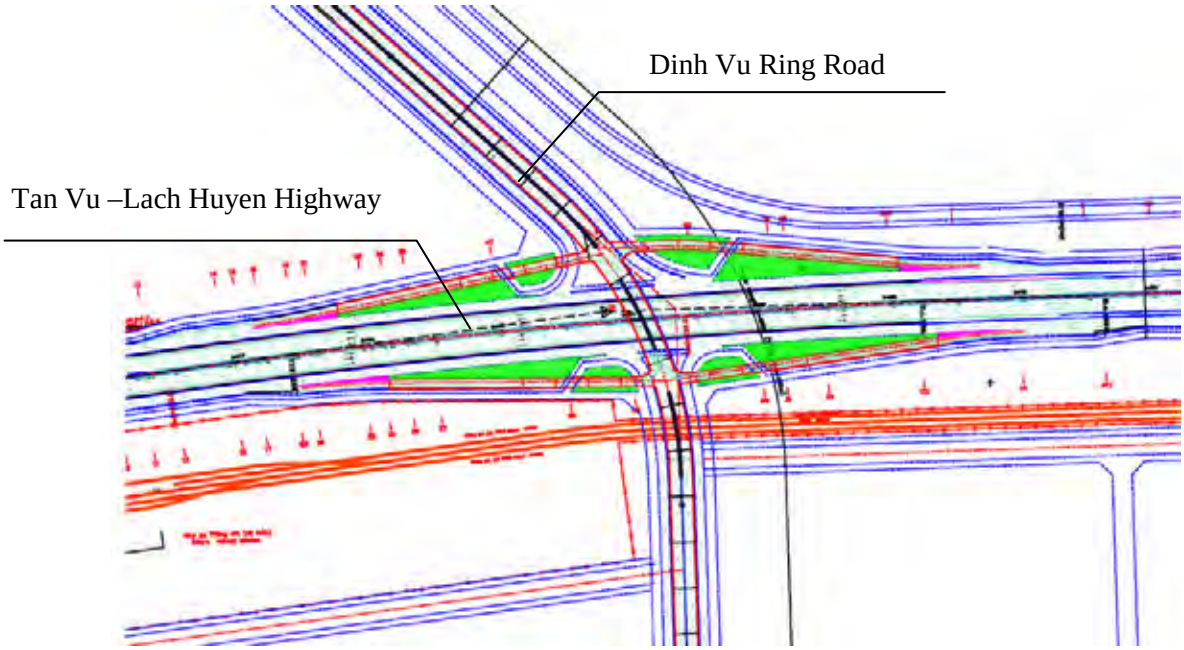
  No. 1 intersection is located at Km 2+836.32 of Dinh Vu Ring Road. Dinh Vu Ring Road is a trunk road of Dinh Vu IZ area, with four lanes per direction.

  As described in Section 4.3, the incoming and outgoing traffic volumes in the Dinh Vu IZ area will reach 3,859 pcu/hour in 2030. Accordingly, this intersection will be upgraded to grade-separated type by that time. In the F/S, the design consultant proposed the grade-separated type to Hai Phong City on February 11, 2009, which was then approved.



Source: Study Team

Figure 2.5-5 First Stage of No.1 Intersection

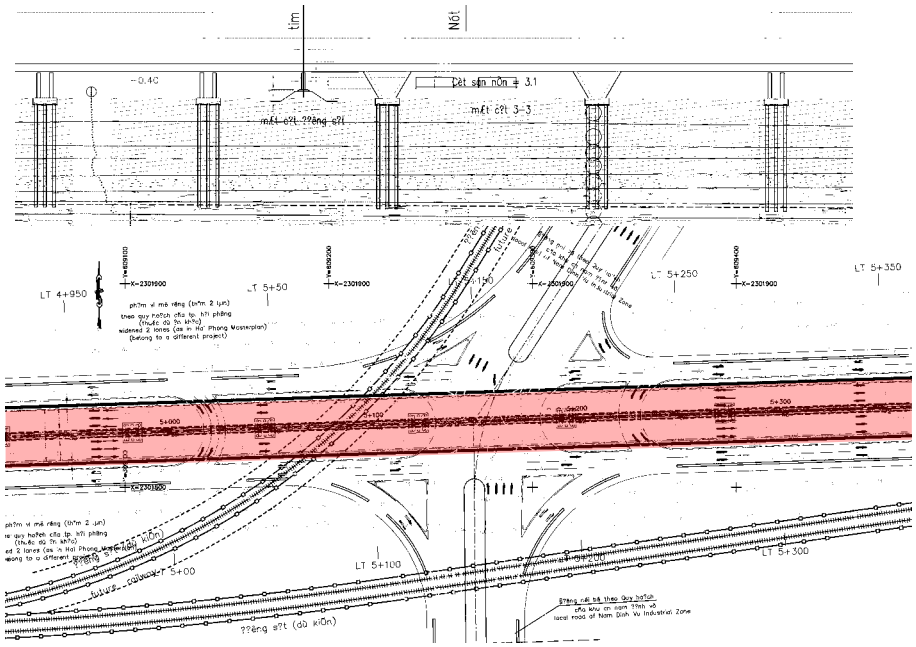


Source: F/S Report (July 2009)

Figure 2.5-6 Ultimate Stage of IC Plan of No.1 Intersection

- **No. 2 Intersection**

No. 2 intersection is located at Km 5+149.11 of Dinh Vu Ring Road. The ring road passes under the approach bridge as shown in the figure below. A flyover structure is planned and the piers are positioned so as not to disturb the intersection development.

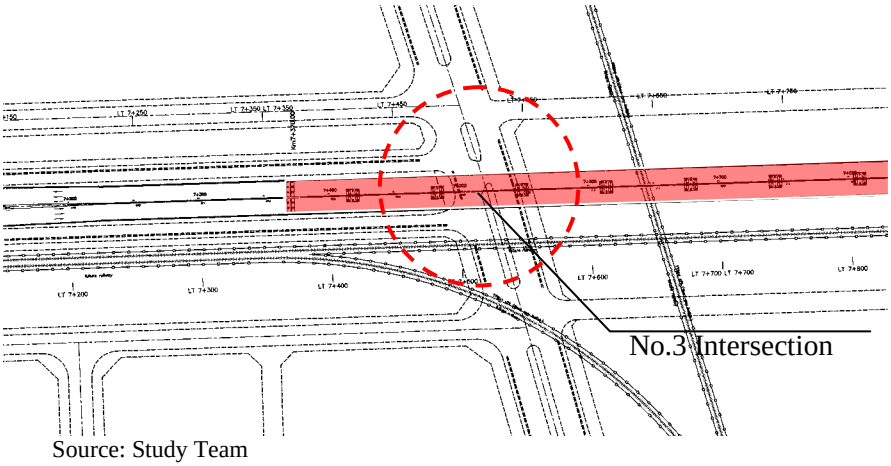


Source: Study Team

Figure 2.5-7 No.2 Intersection with Flyover Structure

- **No. 3 Intersection**

No. 3 intersection is located at Km 7+521.05 of Dinh Vu Ring Road. The ring road passes under the approach bridge as shown in the figure below.



Source: Study Team

Figure 2.5-8 No.3 Intersection

(2) Design Standards

The design standards for rampway at the intersection are based on Vietnamese Design Standards TCVN5729-97, 22 TCN 273-01 and TCVN4054-2005. The geometric items for this project are summarized in Table 2.5-5.

Table 2.5-5 Geometric Design Standard for Rampway at Intersection

Geometric Items			UNIT	TCVN 4054-2005	22TCN-273-01	Adoption
Design speed			km/h	40	40	40
Minimum radius		limited	m	60	50	50
		nomal	m	125	170	170
Minimum length of curve			m	---	82	82
Minimum parameter of spiral			m	---	45	45
Minimum length of spiral			m	---	41	41
Maximum grades			%	7	7	7
Vertical curves	Crest	Radius of curves	m	700 (limited) 1000 (nomal)	500	500
		Length of curves	m	35	24	24
	Sag	Radius of curves	m	450 (limited) 700 (nomal)	800	800
		Length of curves	m	35	24	24
Maximum super-elevation			%	8	8	8
Minimum Radius which allows an inverse super-elevation			%	600	800	800
Minimum stopping sight distance			m	40	60	60

Source: Study Team

The design standard for rampway of Tan Vu Interchange is TCVN5729-97. Geometric design standards for this interchange are shown in Tables 2.5-6 and 2.5-7

Table 2.5-6 Geometric Design Standard for Tan Vu Interchange

Geometric Items	Unit	Tan Vu-Lach Huyen Highway	Hanoi-Haiphong Expressway	Remarks
Design speed	km/h	80	120	
Deceleration lane	m	80	100	TCVN5729-97
Acceleration lane	m	160	200	TCVN5729-97
Taper	m	50	75	TCVN5729-97
Auxiliary lane	m	400(taper 60m)	——	22TCN273-01

Source: Study Team

Table 2.5-7 Adjustment factor of the speed-change lane length

The average grade of the speed-change lane(%)	≦2	>2-:-3	>3-:-4	>4-:-5
The factor of the deceleration lane of down grade	1.0	1.1	1.2	1.3
The factor of the acceleration lane of up grade	1.0	1.2	1.3	1.4

Source: Study Team

2.5.4. Pavement Design

(1) Design Standards

The 22 TCN 274-01 and AASHTO[1] are applied to the design of pavement structure.

Table 2.5-8 Design Standards for Flexible Pavement Design

Design Input Requirements			Value	Reference
1	Design Variables	Performance Period (years)	15	22TCN274-01
		Analysis Period (years)	20	22TCN274-01
		Traffic		
		Equivalent Single Axle Load (ton)	8.0	22TCN274-01
		Directional Distribution Factor, DD	0.5	22TCN274-01
		Lane Distribution Factor, DL	0.8	22TCN274-01
		Reliability (%)	90	22TCN274-01
		Overall Standard Deviation	0.45	22TCN274-01
2	Performance Criteria	Initial Serviceability Index, p_0	4.2	22TCN274-01
		Terminal Serviceability Index, p_t	2.2	22TCN274-01
		Design Serviceability Loss, ΔPSI	2.0	22TCN274-01
3	Material Properties	Effective Roadbed Soil Resilient Modulus, M_R (psi)	1500 × CBR	Asphalt Inst.
		Layer Coefficient for Sub-base Course, a_3	Figure 9.3.5-2	22TCN274-01
		Layer Coefficient for Base Course, a_2	Figure 9.3.5-3	22TCN274-01
		Layer Coefficient for Asphalt Concrete, a_1	Figure 9.3.5-4	22TCN274-01
4	Pavement Characteristics	Drainage Coefficients for Base Course and Sub-base Course, m_2, m_3	1.15	22TCN274-01

Source: Study Team

[1] AASHTO: Guide for Design of Pavement Structure-1993

(2) Design Method

1) Equivalent Single Axle Load (ESAL)

As regards the specification for the design of flexible pavements, 22TCN 274-01 and AASHTO method of pavement design uses the ESAL of 8.0 tons (18 kips).

The ESAL values are estimated based on the standard axle load of 8.0 tons of AASHTO method. The summary of the design equivalent factors shall be applied for the project following the 22TCN 274-01 specification.

Table 2.5-9 Equivalency Factor of Vehicles

Type of Vehicle	Equivalent Factor
Passenger Car	0.001
Buses	0.56
3-axle or more	0.71
4-axles or less	0.72

Source: 22TCN 274-01 Table 3.6

2) Material Properties

Design of flexible pavement by AASHTO method requires the selection of the elastic modulus of asphalt concrete (E_{AC}). AASHTO recommends using values based on local practices.

However, in 22TCN 274-01, it is supposed that E_{AC} of a densely grade asphalt concrete will be determined in the range of 1,930 MPa (28,000 psi) to 2,070 MPa (300,000 psi).

Table 2.5-10 Material Properties

S.N	Pavement Material	CBR (%)	Elastic modulus (psi)
1.	Sub-grade	≥ 8	1500 × CBR (M_R)
2.	Aggregate Sub-base	≥ 30	14,500 (100Mpa)
3.	Aggregate Base	≥ 80	29,000 (200Mpa)
4.	Asphalt Concrete		300,000 psi (2070Mpa)

Source: 22TCN 274-01

3) Layer Coefficients

The layer coefficients are calculated from the chart (equation) given in AASHTO. These layer coefficients are used to convert the thickness of each layer into the strength of pavement structure in terms of structural number.

Table 2.5-11 Summary of Layer Coefficients of Pavement Materials

Material Type	Layer Coefficient
Aggregate sub-base course CBR≥30	0.11 (a_3)
Aggregate base course CBR≥80	0.13 (a_2)
Asphalt Concrete E_{AC} = 300,000 psi	0.37 (a_1)

Source: AASHTO

4) Determination of Design Structural Number (SN)

Various design data and parameters required to use the AASHTO design equation or the design nomo-graph are as follows:

$$\log_{10} W_{18} = Z_R \times S_0 + 9.36 \times \log_{10}(SN+1) - 0.20 + \frac{\log_{10}\left[\frac{\Delta PSI}{4.2-1.5}\right]}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32 \times \log_{10} M_R - 8.07$$

where,

W_{18} = Estimated total 18-kip (8.0-ton) ESAL applications

Z_R = Standard Normal Deviate for the given Reliability (%)

S_0 = Overall Standard Deviation

M_R = Effective Roadbed Soil Resilient Modulus

ΔPSI = Design Serviceability Loss

SN = Design Structural Number

Table 2.5-12 Various Parameters in Solving the AASHTO Nomo-graph

No.	Parameters	Value	Remarks
1.	Reliability, R (%)	90	
2.	Standard Normal Deviate of R, Z_R	-1.282	
3.	Overall Standard Deviation, S_0	0.45	
4.	Estimated Total ESAL of 18-kips	Variable	
5.	Effective Roadbed Soil Resilient Modulus, M_R	1500×CBR	CBR≥ 8%
6.	Design Serviceability Loss, ΔPSI	2.0	

Source: AASHTO

5) Thickness of Asphalt Concrete Layers

AASHTO suggests a minimum thickness of asphalt concrete of 9 cm (3.5 inches) for traffic level from 2 to 7 million ESAL and 10 cm (4 inches) for traffic level greater than 7 million ESAL. However, it does not provide any information on asphalt concrete thickness requirement for different types of base strength.

At present, 12 cm of asphalt concrete (5 cm surface course and 7 cm binder course) on national highways is applied in Vietnamese practices for economical reasons

Based on this, it is concluded that 12 cm of asphalt concrete with 5 cm of surface course and 7 cm of binder course shall be taken as the minimum thickness requirement of asphalt concrete.

6) Thickness of Aggregate Base and Subbase Courses

The minimum thickness of base and sub-base layers is 15 cm (6 inches) as recommended by AASHTO. This minimum thickness is also judged to be practical during construction.

Various combinations of base and sub-base layer thickness are possible to satisfy the following SN equation;

$$2.54SN = a_1D_1 + a_2D_2m_2 + a_3D_3m_3$$

where,

- thicknesses are in cm
- a_1, a_2, a_3 are for asphalt concrete, base and sub-base courses as given in Table 2.5-7.
- m_2 and m_3 are 1.15 as given in Table 2.5-9.
- D_1, D_2, D_3 for thickness in cm of surface, base, and sub-base layers.

7) Drainage Coefficients

The drainage coefficients for base course and sub-base course are present for the quality of drainage of roadwork design.

Table 2.5-13 Drainage Coefficients

Quality of drainage	Percent of time that pavement structure is exposed to moisture levels approaching saturation		
	Less than 1%	1- 5%	5 – 25%
Excellent (2 hours)	1.40 – 1.35	1.35 – 1.30	1.30 – 1.20
Good (within 1 day)	1.35 – 1.25	1.25 – 1.15	1.15 – 1.00

Source: AASHTO

Considering the site conditions, where quality of drainage is not excellent, it is recommended that the drainage coefficient for both base course and sub-base course of m_i = 1.15 shall be applied.

(3) Pavement Design

1) Design Traffic Volume

Design traffic volumes in the two different directions in Tan Vu IC – Cat Hai Island are shown in Table 2.5-14.

Table 2.5-14 Forecasted Traffic Volume (Section Tan Vu IC-Dinh Vu IZ)

Unit: Vehicle

Section: Tan Vu-Dinh Vu	Car	LGV	HGV
2015	3,960	1,243	1,317
2020	13,540	2,571	3,049
2030	48,000	8,107	14,287

Source: Study Team

2) Equivalent Single Axle Load (ESAL)

Traffic annual growth rate: 2015=>2020 is 8.8% (refer to separated traffic forecast report)

2020=>2030 is 2.3%

ESALs per year = (Vehicles/day)(Lane Distribution Factor)(day/year)(ESALs/Vehicle)

Table 2.5-15 Calculation Table for Tan Vu IC – Dinh Vu IZ (2015)

Kind of car		Calculation	ESALs per Year (2015)	
Car	Passenger Car	=(3960/day)(0.8)(365)(0.001)	=1,156	ESALs/Yr
LGV	3-axle or more	=(1243/day)(0.8)(365)(0.71)	=257,699	ESALs/Yr
HGV	4-axles or less	=(1317/day)(0.8)(365)(0.72)	=276,886	ESALs/Yr
Total			=535,741	ESALs/Yr
Rounded total			=540,000	ESALs/Yr

Source: Study Team

Table 2.5-16 Calculation table of Tan Vu IC-Dinh Vu IZ (2020)

Kind of car		Calculation	ESALs per Year (2020)	
Car	Passenger Car	=(13540/day)(0.8)(365)(0.001)	=3,954	ESALs/Yr
LGV	3-axle or more	=(2571/day)(0.8)(365)(0.71)	=583,020	ESALs/Yr
HGV	4-axles or less	=(3049day)(0.8)(365)(0.72)	=641,022	ESALs/Yr
Total			=1,177,996	ESALs/Yr
Rounded total			=1,180,000	ESALs/Yr

Source: Study Team

3) Design ESAL

The standard multiplier to calculate the compound growth is:

$$\text{Multiplier} = \frac{(1+g)^n - 1}{g}$$

$$\text{15 years design life: } 1{,}130{,}000 \left(\frac{(1+0.088)^5 - 1}{0.088}\right) + 2{,}380{,}000 \left(\frac{(1+0.023)^{10} - 1}{0.023}\right) \approx 16{,}300{,}000$$

4) Elastic Modulus

a) Effective Roadbed Soil Resilient Modulus, MR

MR (psi) = 1500 × CBR (%)

Table 2.5-17 Design CBR Adopted Average Value of Material Survey Borrow Pit

Material Properties	Unit	Borrow Pit Name		
		Kinh Thay River Sand Pit	Van Uc River Sand Pit	Thai Binh River Sand Pit
Specific gravity	g/m^3	2.64	2.64	2.65
Max dry density	g/m^3	1.602	1.601	1.637
Optimum moisture content	%	18.02	17.90	17.18
Dry rest angle	degree	30^0 37'	25^o 15'	25^o 15'
CBR	%	7.5	8.3	9.3

Source: Study Team

Average CBR=8%, M_R (psi) = 1500 x 8 = 12,000 psi = 83MPa

5) Pavement Material Properties

Material properties are as follows:

Table 2.5-18 Pavement Material Properties

Pavement Material	CBR (%)	Elastic modulus (psi)
Aggregate Subbase	≥ 30	14,500 (E_{SB}, 100Mpa)
Aggregate Base	≥ 80	29,000 (E_{BS}, 200Mpa)
Asphalt Concrete		300,000 psi (E_{AC}, 2,070Mpa)

6) Determination of Design Structural Number (SN)

$$\log_{10} W_{18} = Z_R \times S_0 + 9.36 \times \log_{10}(SN+1) - 0.20 + \frac{\log_{10}\left[\frac{\Delta PSI}{4.2-1.5}\right]}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32 \times \log_{10} M_R - 8.07$$

SN = 4.305

7) Thickness of Asphalt Concrete and Base layers

Thicknesses of layers are determined using the following equations:

$2.54SN = a_1D_1 + a_2D_2m_2 + a_3D_3m_3$

---> $2.54*4.305=0.37*D_1+0.13*D_{2*}1.15+0.11*D_{3*}1.15$

The thickness of base of 15cm is temporarily selected.

---> 2.54*4.305 = 0.37*12+0.13*15*1.15+0.11*D3*1.15

D3 = ---------- = 34cm

The thickness of base of 20cm is temporarily selected.

---> 2.54*4.305 = 0.37*12+0.13*20*1.15+0.11*D3*1.15

$$D3 = \frac{\text{----------}}{\text{----------}} = 28\text{cm}$$

The thickness of base of 25cm is temporarily selected.

---> 2.54*4.305 = 0.37*12+0.13*25*1.15+0.11*D3*1.15

$$D3 = \frac{\text{----------}}{\text{----------}} = 22\text{cm}$$

The calculated results are given in Table 2.5-19

Table 2.5-19 Calculated Layer Thickness

W18	SN	mi	Calculated thickness (cm)				
			SB	BS	ACB	ACS	Total
16,300,000	4.305	1.15	34	15	7	5	61
			28	20	7	5	60
			22	25	7	5	59

Source: Study Team

8) Economical Considerations

Comparison of the results with the other highway projects indicates that the use of 5cm of A/C surface course and 7cm of A/C binder course is a common practice in Vietnam due to economical reasons.

The cost values shown in the table are the relative costs of the pavement structure considering the cost of asphalt concrete surface course as unity. The cost values are taken from the cost estimate report.

Table 2.5-20 Cost Comparison

Alternates	Thickness (cm)				Cost(VND/m^2)
	Sub-base	Base	AC binder	AC surface	
Alternate -1	34	15	7	5	638,416
Alternate -2	28	20	7	5	641,207
Alternate -3	22	25	7	5	643,951

Source: Study Team

The Study Team adopts Alternative 1 which excels in terms of economical efficiency from Table 2.5-20.

9) Selected Pavement Structure

After the above calculation, the following pavement structure is selected:

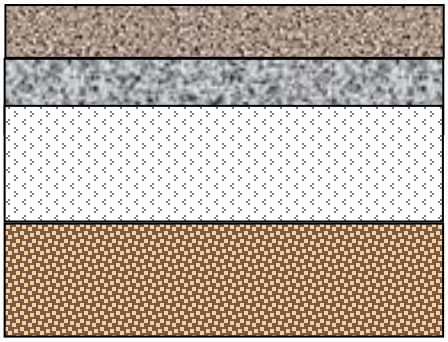


Figure 2.5-9 Pavement Structure Thickness

2.5.5. Bridge Design

(1) Design Standard and Design Criteria

Applied design standards and criteria for the bridge design are shown in Appendix-3 "Standards and Criteria for Bridge Design".

Basically, the bridges and structures in this Project shall be designed with the Vietnamese Design Standard (22 TCN 272-05) and AASHTO-LRFD (Load and Resistance Factor Design, 3rd Edition 2004) except for some items which should be considered in accordance with the other international standards.

The summary of applied design standards and specifications is shown in Table 2.5-21.

Table 2.5-21 Adopted Items for this Project

Item	Specifications	Standards
Design Method	Limit State Design	Vietnamese
Design Life	100 years	Vietnamese
Design Lane Width	3,600 mm or 3,750 mm	Vietnamese
Load Combination		Vietnamese
Live Load	HL-93	Vietnamese
Dynamic Load Allowance, IM	0.25 for main part of bridge	Vietnamese
Wind Load	Depend on the site	Vietnamese
Vessel Collision Force	Depend on the site	Vietnamese
Earthquake	Depend on the site	Vietnamese
Seismic Earth Pressure	Depend on the site	Japanese
Stress Loss in Tendons		Japanese
Creep & Shrinkage		Japanese / CEB-FIP
Pile Foundation Analysis	Displacement Method	Japanese

Source: Study Team

The items for which these standards cannot be appropriately applied shall be determined by referring to AASHTO (Allowable Stress Design Method, 17th Edition 2002) or Japanese Standard for Highway Bridge (JSHB-96).

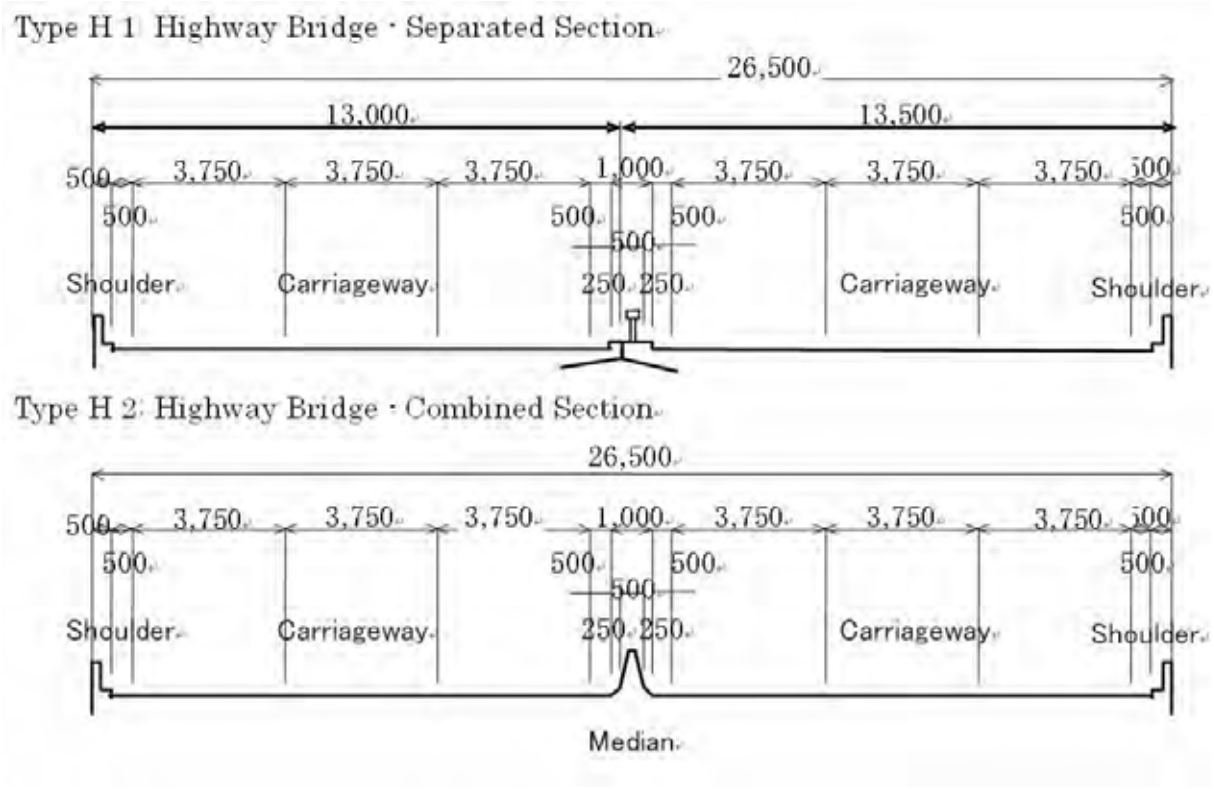
(2) Typical Cross Sections in Bridge Section

Typical cross sections of bridge section were updated during the discussion between JICA and MOT. The updated results are summarized in Appendix-10.

The typical cross sections of bridge are as shown in Figure. 2.5-10

Table 2.5-22 Typical Cross Section of Bridge Section

Type	Cross Section	Remarks
H1	Separated Section	Applicable for Stage Construction
H2	Combined Section	



Source: Study Team

Figure 2.5-10 Typical Cross Sections of Bridge Section

(3) Crossing Facilities

The bridge shall be constructed crossing over the following utilities:

1) Design Water Level for River/ Canal Crossing

Design water level is calculated as follows:

WL = 2.45m (High tide water level at 5% probability) + 1.41m (Effect of wave)

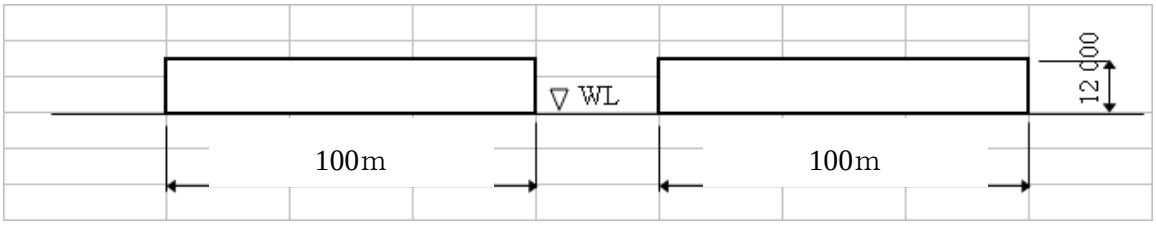
= 3.86m

Table 2.5-23 Design Water Level

Design Water Level = 3.86 m

2) Navigation Channel

The navigation channel for large vessels will be shifted to the northern side of deep sea port. The bridge shall have navigation for vessels of 1,000 DWT. The navigation clearance at Nam Trieu Channel is as follows:

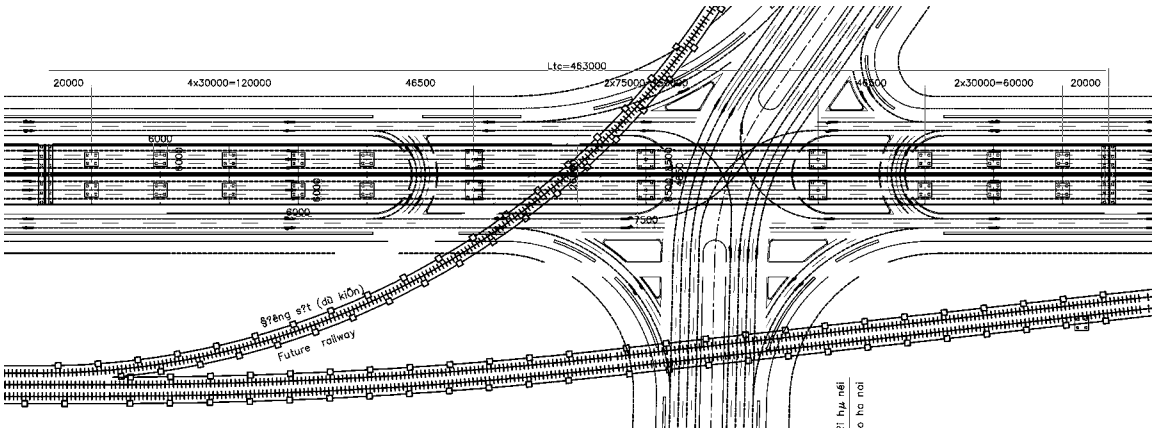


Source: Vinamarine Letter No. 192/TB-BGTVT dated 17 May 2009.

Figure 2.5-11 Required Navigation Channel

3) Flyover at No. 2 Intersection

No. 2 intersection is crossing the Dinh Vu Ring Road at Km 5+149.11. The Project road shall pass over the ring road through a flyover structure (refer to Section 2.5.3 above).

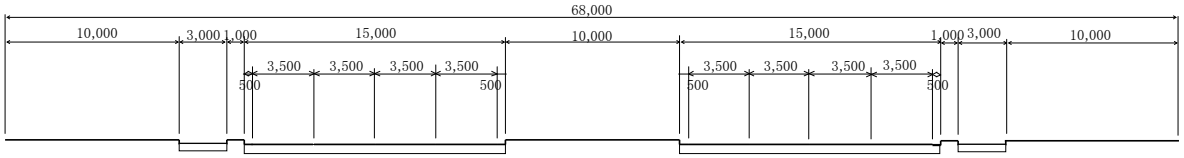


Source: Study Team

Figure 2.5-12 Flyover at No.2 Intersection

4) Ring Road in Dinh Vu Industrial Zone

Dinh Vu Ring Road is the most important arterial road in the industrial zone. It crosses the Project road at three (3) locations. Refer to Section 2.5.3 above.



Source: Hai Phong City Master Plan

Figure 2.5-13 Typical Cross Section of Ring Road in Dinh Vu IZ

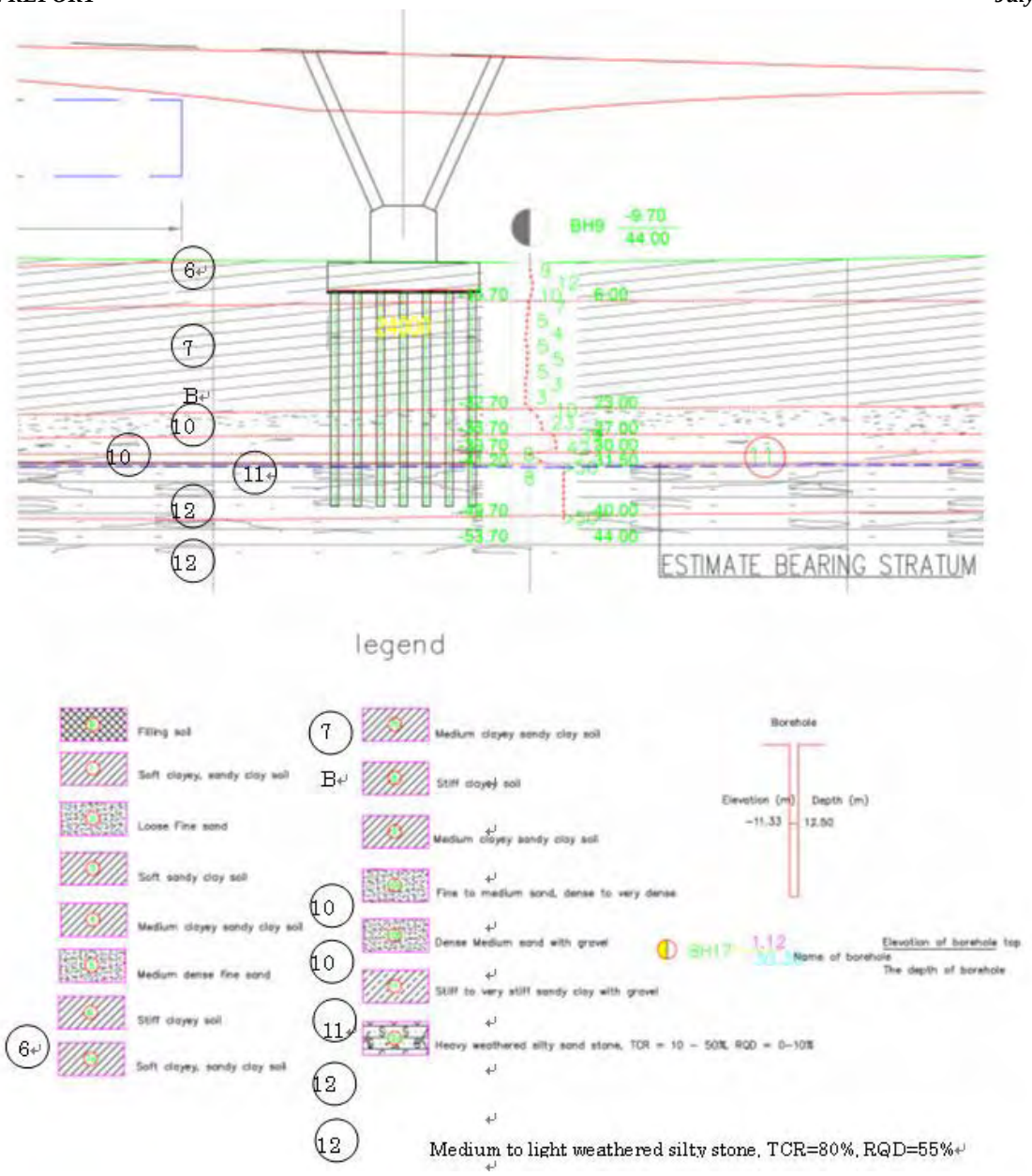
(4) Geotechnical Conditions

In the F/S, the geotechnical investigation was carried out as follows:

- The rock layer exists at about EL –41 m, which shows that N-value larger than 50 is assumed as bearing stratum.

- The skin friction forces for the calculation of bearing capacity of pile can be calculated from N-value obtained from the boring log charts.

The longitudinal geological profile of soil layers, assumed bearing stratum, and piles for the design are as shown in Figure 2.5-14.



Source: F/S Report (July 2009)

Figure 2.5-14 Longitudinal Geological Profile of Soil Layers, and Bearing Stratum

2.5.6. Cross Structure Design

(1) Drainage Box Culverts

Data from the F/S on drainage box culverts crossing the Project road are updated as follows:

Table 2.5-24 List of Drainage Box Culvert

Order No.	Existing drainage culvert: Station Km.. + ...	Direction of water	Type of Culvert	Side (m): Number of Culvert	Side (m): F (B)	Side (m): H	F (Km^2)	Q_{tk} (m^3/s)	Water level: H_d (m)	Water level: $\square_{Bottom}$ (m)	Water level: $H_{tk\%}$ (m)	Remark
1	Km0+950	L-R	Box		3.00	3.00	0.20	13.30	3.85	-1.00	2.85	Drainage catchment
2	Km1+700	L-R	Box	8	4.00	4.00	8.20	172.1	4.87	-1.98	2.89	Drainage catchment
3	Km2+390	L-R	Circular		2.00		0.10	6.65			2.92	Drainage catchment
4	Km4+100	L-R	Box	3	4.00	4.00	1.00	66.50	2.22	0.80	3.02	Drainage catchment
5	Km10+058.30	R-L	Circular		1.25				1.40	1.30	2.70	Drainage of gutter
6	Km10+400	R-L	Circular		1.25					1.10	2.68	Drainage of gutter
7	Km10+659	R-L	Circular		1.25				1.68	1.00	2.68	Drainage of gutter
8	Km10+818	R-L	Box	2	4.00	3.00	0.50	33.30	2.57	0.10	2.67	Drainage catchment
9	Km13+980	R-L	Circular		1.25						2.59	Drainage of gutter
10	Km14+669	L-R	Box		1.50	3.00					2.57	Drainage on dyke
11	Km14+926	L-R	Box		3.00	3.00			3.27	-0.70	2.57	Drainage catchment
12	Km15+150	R-L	Box	3	4.00	4.00	3.50	66.50	4.34	-1.80	2.54	Drainage catchment
13	Km15+521.5	L-R	Circular		1.25				2.24	0.30	2.54	Drainage catchment
14	Km15+688	R-L	Circular		1.25				1.74	0.80	2.54	Drainage of gutter

Source: Study Team

(2) Underpass Box Culverts

Data from the F/S on underpass box culverts crossing the Project road are updated as follows. Two underpasses are planned in Cat Hai Island.

Table 2.5-25 List of Underpass Box Culvert

Station	Type of Culvert	Width	Height	Length
Km10+128.1	Box	4.00m	3.20m	29.5m
Km13+600	Box	4.00m	320m	29.5m

Source: Study Team

2.5.7. Soft Ground Treatment

In this Study, soft ground sections were not updated. In the F/S, it is reported that soft ground is laid for the whole stretch of the Tan Vu – Lach Huyen Highway

(1) Soft Ground Section where Countermeasure NOT Required

Table 2.5-24 shows the soft ground sections where countermeasure is not required during the F/S.

Table 2.5-26 Location of Soft Ground (where Countermeasure is not Required) in F/S

	Station	Distance (m)	Condition of calculation		Without treatment			
			Thickness. of soft soil layers (m)	Height of EM (m)	Factor of safety (Fs)	Con. Sett. Sc (m)	Total. Sett. S (m)	Sett. Within 15 years after pavement (m)
1	Tan Vu Interchange		32.0	10.0	0.562	2.12	2.54	0.96
2	Km00+258.00-Km01+634.00	1376.0	32.0	3.3	1.219	1.02	1.22	0.56
3	Km01+765.00-Km02+542.00	777.0	32.0	3.6	1.194	1.09	1.31	0.65
4	Km03+130.00-Km04+738.00	1608.0	28.0	4.0	1.096	1.11	1.33	0.51
5	Km05+430.00-Km07+250.00	1820.0	25.0	4.8	0.936	1.24	1.49	0.32
6	Km10+100.00-Km10+450.00	350.0	25.0	1.7	1.843	0.32	0.38	0.08
7	Km10+920.00-Km13+300.00	2380.0	15.0	3.6	1.133	0.69	0.83	0.06
8	Km13+300.00-Km13+950.00	650.0	14.0	2.8				
9	Km13+950.00-Km15+320.00	1370.0	22.0	4.5	1.032	0.82	0.98	0.44
10	Km10+450.00-Km10+920.00	470.0	6.0	2.2	1.841	0.26	0.31	0.23
11	Km15+320.00-Km15+874.00	554.0	17.0	2.7	1.841	0.26	0.31	0.23

Source: F/S Report (July 2009)

Section No. 5 in the above table is included in the approach bridge section.

(2) Soft Ground Section where Countermeasure Required

In the F/S, there are nine countermeasures proposed for soft ground treatment. Those should be further investigated and studied in the detailed design stage.

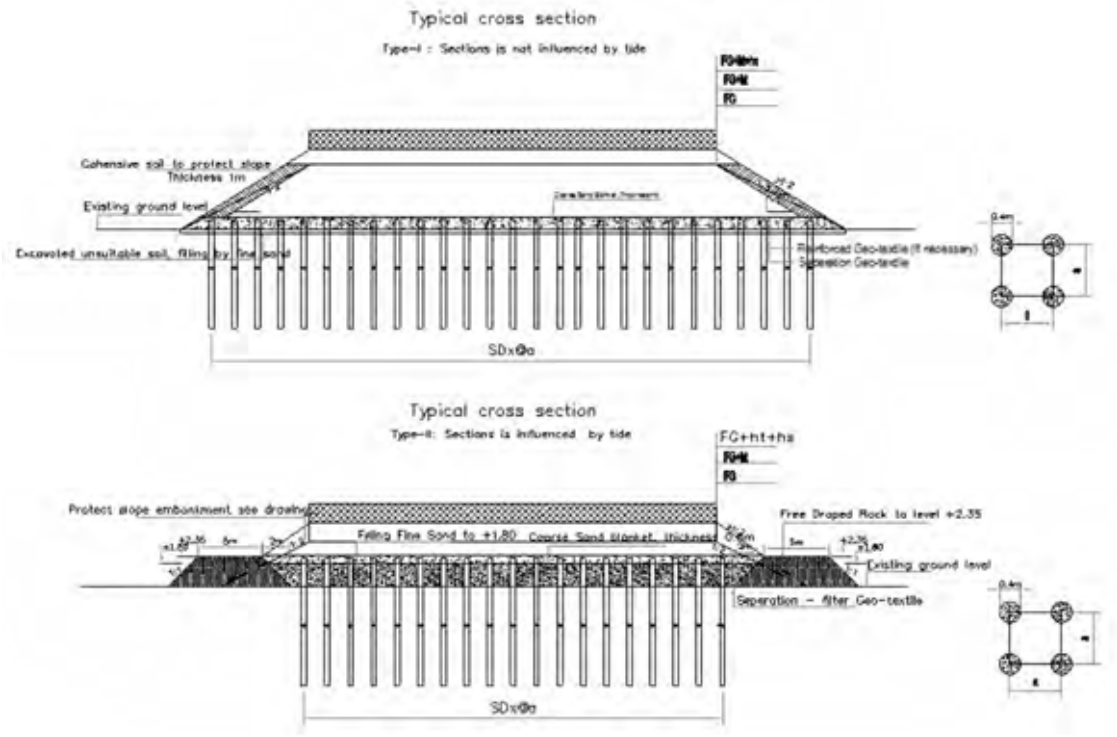
Table 2.5-27 List of Soft Ground Countermeasures in F/S

No	Soft soil treatment content																		Results of treatment			
	Treatment by SD or Replacement			Height of surchar. (m)	Thick. Of sand blanket (m)	Filling									Total of construc. Time (days)	Berm		Reinfor. Geotex. 200kN/m (layer)	Factor of safety affter complete Fs	U (%)	Resi. Sett. (cm)	Rate of Sett. (cm/year)
						Stage 1			Stage 2			Stage 3+4										
	SD	Spacing (m)	Depth (m)			H1 (m)	Rate of filling (cm/day)	Waiting time (day)	H2 (m)	Rate of filling (cm/day)	Waiting time (day)	H3 (m)	Rate of filling (cm/day)	Waiting time (days)		B (m)	H (m)					
1	SD	1.5x1.5	26		2.5	5.00	10	60	2.50	10	60	5.0	10	150	425	65	3.5	2	1.401	92	17.5	1.84
2	SD	1.8x1.8	16.0		1.2	4.50	10	150							225				1.432	76	24.2	2.04
3	SD	1.8x1.8	18.0		1.3	3.50	10	60	1.40	10	90				229				1.430	83	18.9	4.74
4	SD	1.8x1.8	15.0		1.3	4.00	10	75	1.30	10	90				248				1.459	76	26.8	2.34
5	SD	1.5x1.5	20.0		1.5	4.00	10	500	1.30	10	500	1	10	500	1863				1.404	86	17	0.53
6	Replacement		1.5																		28	
7	SD	2.0x2.0	13.0		0.8	4.4	10	180							254			1	1.424	85	10.4	3.39
8	Replacement		2.0																			
9	SD	1.5x1.5	20.0		1	4	10	60	1.5	10.00	90				235			1	1.447	95	4	3.28
10	Normal filling																					
11	Normal filling																					

Source: F/S Report (July 2009)

(3) Typical Cross Section of Soft Ground Treatment

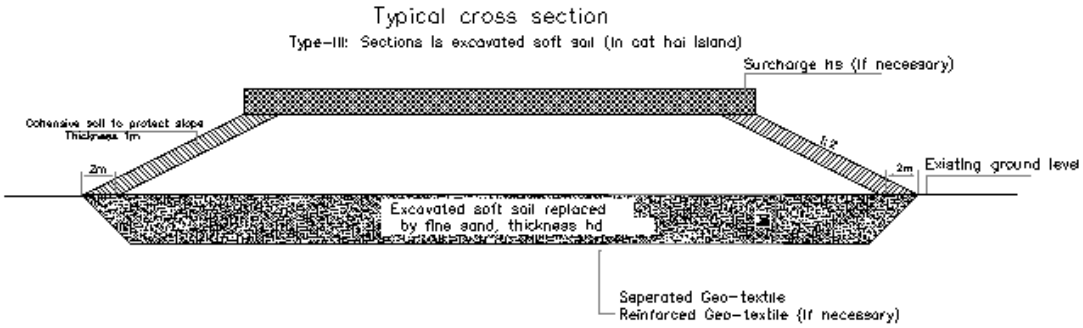
1) Sand Drain



Source: F/S Report (July 2009)

Figure 2.5-15 Typical Cross Section of Soft Ground Treatment (Sand Drain)

2) Replacement



Source: F/S Report (July 2009)

Figure 2.5-16 Typical Cross Section of Soft Ground Treatment (Replacement)

2.5.8. Major Work Quantities

Major work quantities are summarized in Tables 2.5-27~35.

Table 2.5-28 Quantities for Temporary Work

	Item	UNIT	Quantites	note
TEMP Facility	Yard and Temporary Facility	LS	1.0	
	Temporary Road	m^3	266,768.0	
	Temporary Jetty	m2	27,879.0	

Source: Study Team

Table 2.5-29 Quantities for Tan Vu Interchange

Work Item			unit	Quantites	notes
TAN VU INTERCHANGE	EMBANKMENT	Excavetion of organic soil	m^3	38,797.7	
		Embankment of sand, K=0.95	m^3	216,423.0	include K=0.98
		Embankment of Clay (Slope Protection)	m^3	42,784.5	
		Sodding (Slope Protection)	m^3	42,784.5	
	SOFT SOIL TREATMENT	Geotextile Filter Fabric (non-woven 12kN/m)	m^2	190,356.2	
		Sand Blancket (medium sand)	m^3	145,959.0	
		Sand Drain (D400)	m	758,248.4	
		Embankment of sand for compensation	m^3	209,678.0	
		Removal of surcharge	m^3	76,882.3	
	PAVEMENT	Pavement areas	m^2	42,935.7	
		Geotextile Filter Fabric (non-woven, 25kn/m)	m^2	45,776.1	
	TRAFFIC SAFETY	Guide Posts	each	220.0	
		Area Reflection Pavement Marking	each	2,293.3	
		Guardrail	m	946.9	
		Reflectorized Pavement Stud	each	524.0	
		Concrete curb	m	1,700.3	
		Planting	each	611.0	
		Lighting Pole-Single Arms	pole	69.0	

Source: Study Team

Table 2.5-30 Quantities for Road Work at Hai An Side

Work Item			unit	Quantites	notes
HAI AN side ROAD WORK	EMBANK MENT	Excavetion of organic soil	m^3	90,781.0	include nomal soil
		Embankment of sand, K=0.95	m^3	420,923.0	include K=0.98
		Embankment of Clay (Slope Protection)	m^3	46,708.3	
		Sodding (Slope Protection)	m^3	46,708.3	
	APPROACH ROAD (Soft Soil Treatment)	Geotextile Filter Fabric (non-woven)	m^2	352,569.0	include woven
		Sand Blancket (medium sand)	m^3	266,363.9	
		Sand Drain (D400)	m	1,798,841.4	
		Embankment of sand for compensation	m^3	431,280.0	
		Removal of surcharge	m^3	179,569.8	
	PAVE MENT	Fine Asphalt Concrete -5cm and 7cm	m^2	72,421.8	
		Aggregate Base and Subbase	m^3	58,585.0	
		Geotextile Filter Fabric (non-woven, 25kn/m)	m^2	105,021.1	
	TRAFFIC SAFETY	Guide Posts	each	823.0	
		Area Reflection Pavement Marking	each	5,738.4	
		Guardrail	m	748.8	
		Reflectorized Pavement Stud	each	1,099.0	
		Concrete curb	m	8,208.1	
		Planting	each	1,369.0	
		Lighting Pole-Single Arms	pole	216.0	
	Culver t	RC Pipe Culvert-D2.0m	m	43.0	
		RC Box Culvert-3m*3m(Km0+9)	m	46.6	
		RC Box Culvert-3m*4m*4m(Km0+9)	m	29.1	
	Cam Box Culvert	Concrete of box culvert, wall 28MPa	m^3	1,912.0	
		Reinforcement of box culvert, wall	ton	315.8	
		Lean Concrete	m^3	144.0	
	Cam Box Culvert	Billing Stone	m^3	119.0	
		Masonry	m^3	44.0	
		Concrete of approach slab, 28MPa	m^3	38.0	
		Reinforcement of approach slab	ton	4.7	
		Pavement(Fine,asphalt concrete-7cm)	m^2	1,360.0	
		Water proofing layer	m^2	1,360.0	
		Embankment of drainage material	m^3	2,120.0	
		Excavation of soil for foundation pit	m^3	1,770.0	
		Drive test pile 35*35cm (2piles)	m	80.0	
		Drive test pile 35*35cm	m	6,400.0	

Source: Study Team

Table 2.5-31 Quantities for Approach Road and Retaining Wall at Hai An Side

Work Item			unit	Quantites	notes
APPROACH ROAD & RETAINING WALL HAI AN SIDE	EMBANK MENT	Embankment of sand, K=0.95	m^3	58,320.0	include K=0.98
		Geotextile Fillter Fabric (non-woven, 25kN/m)	m^2	12,970.0	
		Pavement	m^2	12,592.0	
		Sodding (Slope Protection)	m^2	950.0	
	RETAINING WALL	Concrete of Retainingwall, 28MPa	m^3	22,012.0	
		Reinforcement of retaining wall	ton	1,761.0	
		Lean Concrete	m^3	1,269.0	
		RC Piles 35*35cm	m	81,198.0	
		Metal Railing	m	950.0	
		Cast iron drain pipe D150	m	633.0	

Source: Study Team

Table 2.5-32 Quantities for Road Work for Approach Bridge

Item			unit	Quantites	Amount (VND)
Hai An Side APPROACH BRIDGE	SUPER STRUCTURE	Box girder 45MPa for Box Girder bridge	m^3	36,331.0	Segment Method
		High Strength cable, transverse	ton	194.0	
		Concrete of deck, curb 28MPa	m^3	2,863.0	C40
		Reinforcement of deck, curb	ton	286.0	SD490
		Asphalt concrete of bridge deck	m^2	49,772.0	
		Metal Railing	m	7,963.0	
		Bearing	each	248.0	
		Water proofing layer	m^2	49,772.0	
		Bridge name sign	each	1.0	
		Expansion Joint	m	95.0	
		Lighting Pole -Single Arms	each	199.0	
		Cast iron drain pipe D150	set	995.0	
	SUBSTRUCTURE	Concrete of Abutment, pier, 28MPa (Under W)	m^3	17,819.0	C40
		Reinforcement of abutment, pier	ton	1,604.0	SD490
		Steel Pipe Pile	ton	7,523.0	
		Foundation Excavation	m^3	21,424.0	
		Embankment of drainage material	m^3	9,456.0	
		Sheet Pile	ton	6,801.0	
		Driving and Pulling steel sheet pile	m	64,763.0	
		timpering(manifacturing,Installation,Removal)	ton	1,360.0	

Source: Study Team

Table 2.5-33 Quantities for Main Bridge

Work Item			unit	Quantites	notes
MAIN BRIDGE	SUPER STRUCTURE	Box girder 45MPa for Box Girder bridge	m^3	9,714.0	C40
		High Strength cable, transverse	ton	55.0	
		Concrete of deck, curb 28MPa	m^3	678.0	
		Reinforcement of deck, curb	ton	67.0	SD490
		Asphalt concrete of bridge deck	m^2	11,775.0	
		Metal Railing	m	1,884.0	
		Bearing 9000kN	each	4.0	
		Bearing 5000kN	each	24.0	
		Water proofing layer	m^2	11,775.0	
		Expansion Joint	m	42.0	
		Lighting Pole -Single Arms	each	47.0	
		Naigation light	set	1.0	
		Cast iron drain pipe D150	set	237.0	
	SUBSTRUCTURE	Concrete of Abutment, pier, 28MPa (Under W)	m^3	12,447.0	C40
		Reinforcement of abutment, pier	ton	1,120.0	SD490
		Steel Pipe Sheet Pile(Exteria)	ton	4,725.7	SKY400
		Steel Pipe Sheet Pile(Bulk Head)	ton	1,575.0	SKY400
		Steel Pipe Pile(End Pier)	ton	1,328.0	SKK400
		Reinforcing Bar Stud SM490A-SD	ton	7.8	
		Bottom slab concrete	m^3	2,592.0	Tremie concrete
		PDA test on 1.2m Dia. Steel Pipe Sheet Pile	Nos.	3.0	
		Mortar Filling to Steel Pipe Joint	ton	68.0	
		Foundation Excavation	m^3	3,513.0	
		Embankment of drainage material	m^3	2,851.0	
		Structurel Excavation Inside Piles and joint pi	m^3	10,368.0	
		Sheet Pile(End Pier)	ton	908.0	End Pier
		Driving and Pulling steel sheet pile	m	8,640.0	
		timpering (manifacturing, Installation,Removal)	ton	182.0	

Source: Study Team

Table 2.5-34 Quantities for Approach Bridge at Cat Hai Side

Work Item			unit	Quantites	notes
Cat Hai Side APPROACH BRIDGE	SUPER STRUCTURE	Box girder 45MPa for Box Girder bridge	m^3	4,731.0	Segment Method
		High Strength cable, transverse	ton	25.0	
		Concrete of deck, curb 28MPa	m^3	373.0	
		Reinforcement of deck, curb	ton	37.0	SD40
		Asphalt concrete of bridge deck	m^2	6,490.0	
		Metal Railing	m	1,038.0	
		Bearing	each	32.0	
		Water proofing layer	m^2	6,490.0	
		Bridge name sign	each	1.0	
		Expansion Joint	m	14.0	
		Lighting Pole -Single Arms	each	26.0	
		Cast iron drain pipe D150	set	130.0	
	SUBSTRUCTURE	Concrete of Abutment, pier, 28MPa (Under W)	m^3	2,713.0	C40
		Reinforcement of abutment, pier	ton	244.0	SD40
		Steel Pipe Pile	ton	1,197.0	
		Foundation Excavation	m^3	3,161.0	
		Embankment of drainage material	m^3	1,374.0	
		Sheet Pile	ton	903.0	
		Driving and Pulling steel sheet pile	m	8,603.0	
		Timpering(manifacturing,Installation,Removal)	ton	181.0	

Source: Study Team

Table 2.5-35 Quantities for Approach Road and Retaining Wall at Cat Hai Side

Work Item			unit	Quantites	notes
APPROACH ROAD & RETAINING WALL CAT HAI SIDE	EMBANK MENT	Embankment of sand, K=0.95	m^3	17,617.0	
		Geotextile Fillter Fabric (non-woven, 25kN/m)	m^2	5,149.0	
		Pavement	m^2	4,999.0	
		Sodding (Slope Protection)	m^2	377.0	
	RETAINING WALL	Concrete of Retainingwall, 28MPa	m^3	8,492.0	
		Reinforcement of retaining wall	ton	679.3	
		Lean Concrete	m^3	504.0	
		RC Piles 35*35cm	m	32,234.0	
		Metal Railing	m	377.0	
		Cast iron drain pipe D150	m	251.0	

Source: Study Team

Table 2.5-36 Quantities for Road Work at Cat Hai Side

Work Item			unit	Quantites	notes
CAT HAI side RORD WORK	EMBANK MENT	Excavetion of organic soil	m^3	136,972.0	Include normal soil
		Embankment of sand, K=0.95	m^3	604,139.0	Include K=0.98
		Embankment of Clay (Slope Protection)	m^3	82,125.5	
		Sodding (Slope Protection)	m^3	82,125.5	
	APPROACH ROAD (SOFT SOIL TREATMENT)	Excavation of unsuitable soil	m^3	107,107.7	
		Embankment of sand, K=0.95	m^3	107,107.7	
		Geotextile Filter Fabric (non-woven)	m^2	599,400.0	Include woven type
		Sand Blancket (medium sand)	m^3	188,786.2	
		Sand Drain (D400)	m	1,313,630.9	
		Embankment of sand for compensation	m^3	344,704.0	
		Removal of surcharge	m^3	171,021.8	
	PAVE MENT	Fine Asphalt Concrete -5cm and 7cm	m^2	135,847.3	
		Aggregate Base and Subbase	m^3	109,893.0	
		Geotextile Filter Fabric (non-woven, 25kn/m)	m^2	196,206.0	
	TRAFFIC SAFETY	Guide Posts	each	1,380.0	
		Area Reflection Pavement Marking	each	8,598.6	
		Guardrail	m	480.0	
		Reflectorized Pavement Stud	each	1,842.0	
		Concrete curb	m	13,779.7	
		Planting	each	2,298.0	
		Lighting Pole-Single Arms	pole	361.0	
	CULVERT	RC Pipe Culvert-D1.25m	m	258.0	
		RC Box Culvert-2m*4m*3m(Km10+818)	m	31.5	
		RC Box Culvert-1.5*3m(Km14+669)	m	31.6	
		RC Box Culvert-3m*3m(Km 14+926)	m	31.8	
		RC Box Culvert-3m*4m*4m (Km 15+150)	m	31.9	

Source: Study Team

2.6. Preliminary Construction Planning

Construction period was changed to 32 months based on discussions between JICA and MOT. Updated construction plan is presented in Appendix-10.

In this section, the result of the Study concerning the construction period of 30 months required in the TOR of the Study, is presented.

2.6.1. Review of the F/S

In the F/S, the construction period is estimated as 36 months. In order to meet the scheduled opening of the road in 2014, shortening to 30 months as required in the TOR of this Study, following items in the construction plan, must be reconsidered:

- Shorten the construction period to open the port in time.
- Ensure construction safety during typhoon season.

Based on the above-mentioned points of view, and the result of the survey on construction method, it can be said that the following innovative methods and technologies are needed.

(1) Shorten the Construction Period

In this project, the road on the Hai An side is about 4.5 km long, the bridge is about 5.4 km long, and the road on the Cat Hai side is about 5.9 km long. Among these, the critical item to determine the construction period of the project is the construction of the bridge.

In order to shorten the construction period of the bridge to be within 30 months, the following solutions are recommended:

1) Selection of Construction Method for Less Construction Period considering Safety

For Approach Bridge

Adopt **Steel Pile Method.** The construction method for sheet pile is simple and takes much lesser time than that of cast-in-place pile method. This method is less risky in terms of driving in mud, collapse of borehole, rebar cage installation and mixture of impurities to the concrete. Hence, delayed project progress would be unlikely. It is noted that this construction method causes significant noise impacts. However, since the construction site is offshore and far from the residential zone, such impact is not a problem.

For Main Bridge

At the foundation of the main bridge, due to the deep level of water, large scale construction of temporary cofferdam is necessary. Thus, t**he steel pipe well foundation** is combined with temporary cofferdam. Because it is not necessary to construct the temporary cofferdam separately, it will take much less time to execute said works. Moreover, the steel pipe well foundation method is not only much faster but also safer for offshore construction (See Section below for construction safety).

2) Superstructure Construction

The super-T girder type superstructure selected in the F/S is supposed to be constructed through the precast method. With reference to other projects that adopt super-T girder types, such method does not seem to guarantee highly productive construction progress.

Especially for the above structure in this project, large scale construction for the bridge span installation is involved. Thus, this requires systemized construction in order to realize cost reduction and time savings.

(2) Construction Safety of the Project

The depth of sea water below the bridge is over 10 m, and it significantly varies due to tidal effects. In addition, during the typhoon season, height of waves could be nearly 10 m. Hence, in order to build the foundation of bridge, it is necessary to construct temporary cofferdam.

In the F/S, except the point near the mainland, all pier locations are planned to be installed with temporary single steel sheet pile cofferdam. There would be no problem at shallow sea water area, however, it is strongly recommended to change the construction method at deep water section.

Especially from piers P109 to P116 section, surrounding water depth is exceeding 10 m. In such condition, standard construction method is not applicable and special attention shall be paid for considering construction safety.

At such depth, temporary cofferdam shall be constructed by the double steel sheet pile method (temporary) or a steel pipe sheet pile method (permanent) in order to ensure construction safety. It is proposed to apply the **steel pipe well foundation method** as the temporary cofferdam for piers P109 to P116, section as shown in Figure 2.6-1.

In particular, for the foundation of the main bridge, steel pile well with temporary cofferdam method is preferable from the view point of construction safety and shortening of construction period.

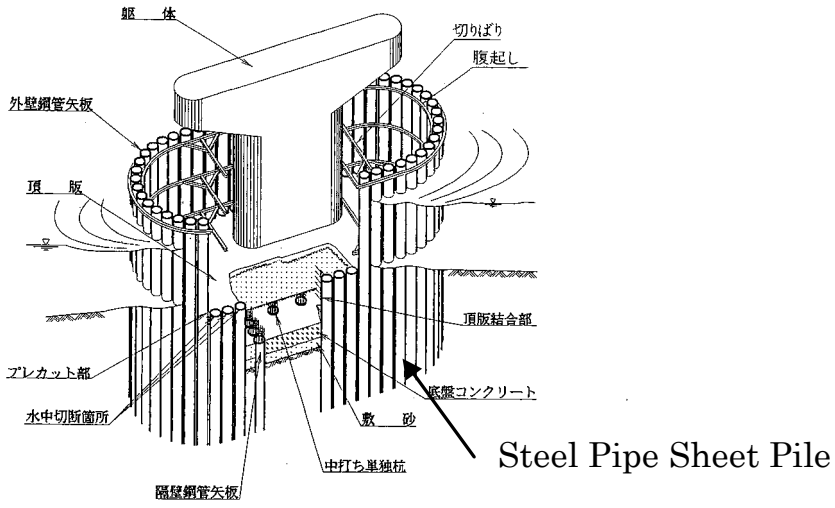


Figure 2.6-1 Schematic View of Steel Pipe Well Foundation

In case the steel pipe well foundation is not adopted, temporary cofferdam by double sheet pile method would be applied as shown in Figure 2.6-2. This temporary method is not recommended from technical viewpoint of construction safety. In addition, this method surely involves significantly longer construction period than the above.

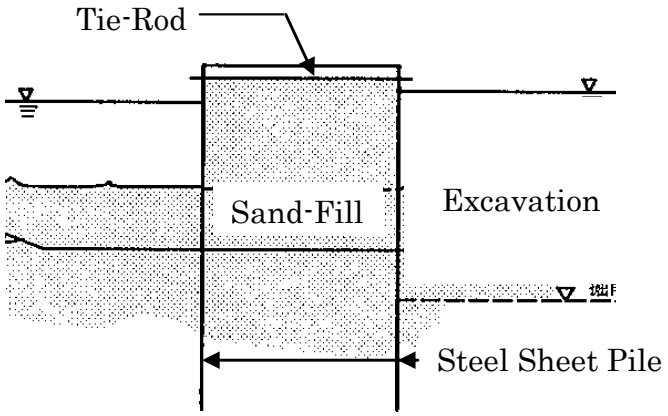


Figure 2.6-2Cofferdam with double steel sheet Pile

(3) Conclusion of the Review of the F/S Construction Plan

In order to meet the 30 months construction period as required in the Study TOR, it is necessary to shorten the construction time, while ensuring the construction safety of the project. Hence, in consideration of the application of STEP scheme, it is proposed to apply the following modifications related to the bridge works:

- Change the construction method for the bridge superstructure from super-T girder to PC segmental box girder to further ensure durability as the structure is subject to salt water damage.
- Adopt the SBS Method for the erection of the superstructure of the approach bridge to shorten the construction period.
- Use steel pile foundation for the approach bridge to shorten the construction period.
- Use steel pipe well with temporary cofferdam foundation for the main Bridge to improve construction safety and for reducing construction period.

2.6.2. Major Work Item

Quantities of the bridge works were calculated for the bridges with four lanes of 3.0 m width each. Meanwhile, updated quantities based on the 4-lane, 3.5 m width bridge scheme are indicated in Appendix-10.

(1) Outline of Construction Works

The project is roughly composed by the following work items

- Temporary works
- Hai An side

- Road works including three intersections.
- Tan Vu Intersection
- Approach Bridge
- Flyover Bridge

➢ Main Bridge
➢ Cat Hai side
- Approach Bridge
- Road works including the connecting section to the port works

1) Temporary works

Temporary works consist of the following items:

➢ Temporary yards (including engineers' office, contractors and labor office, etc.)
➢ Temporary construction roads and jetty
➢ Temporary staging and cofferdam

Especially, the precast segment construction method proposed for the approach bridge needs about 60,000 m^2 of area for manufacturing and storage. Furthermore, according to the current calculation, the weight of one segment is about 60 tons, and hence, it is necessary to design a temporary bridge and staging which can sustain such weight.

2) Road and Intersection

The construction items for the road and intersections are the same as those in the F/S report such as earthworks, pavement and soft ground treatment planning. Regarding the soft ground treatment, there was no further study as shown in Section 2.5.7. Several construction methods, which were proposed in the F/S, were selected, and construction costs were updated.

3) Main Bridge

The main bridge consists of a PC-box continuous girder bridge supported on V-shaped pier. The length of the bridge is as shown below. The erection method adopted is the balanced-cantilever method with the use of a traveling form. The construction method drawings are presented in Sheet No.C-04 in Appendix-1 "Drawings".

In addition, for the foundation of the main bridge, with the aim of ensuring construction safety and shortening the construction period, steel pipe well foundation is selected. The construction method drawings are presented in Sheet No.C-03 in Appendix-1 "Drawings".

4) Approach Bridge

The approach bridge has a total length of about five km, which is divided into six sections.

Table 2.6-1 Sections of Approach Bridge

Approach Bridge (1)	548.2m = 46.6m + 7×65.0m + 46.6m
Flyover Bridge (1)	226.0m (= 68.75m+83.5m+68.75m)
Approach Bridge (2)	2,133.5m = 53.5m +10×65.0m + 11×65m + 11×65.0m
Flyover Bridge (2)	226.0m (= 68.75m+83.5m+68.75m)
Approach Bridge (3)	1,300.0m = 10×65.0m + 10×65.0m
Approach Bridge (4)	519.2m = 7×65.0m + 64.2m (Main Bridge – Cat Hai island)

Regarding the erection method, the SBS method is selected considering the length of the bridge, shape of the girder section, and the geological formation.

The erection girder cannot be procured in Vietnam, and hence, must be transported from Japan. Meanwhile, installation of 800 mm diameter steel pipe requires the use of hydraulic hammer. The construction method drawings are presented in Sheet No.C-04 in Appendix-1: Drawings.

The flyover bridge consists of continuous PC-box girder supported by double V-shaped pier. The length of the bridge is shown below. The erection method to be adopted is the balanced-cantilever method utilizing traveling form. The construction method drawings are illustrated in Sheet No.C-04 in Appendix-1: Drawings.

For the foundation of the flyover bridge, the steel pile method is selected to shorten the construction period. During the construction of the foundation, piles located at the sea will be installed using pile driving hammer equipment placed on a deck barge. Meanwhile, those located onshore and near the wharf will be driven on the land using the same equipment.

(2) Major Work Item and Approximate Quantities

The preliminary estimated quantities for each work item are shown in Section 2.5.8.

In the quantity taken-off, updated typical cross section for the bridge based on discussions between JICA and MOT was considered. This updated data is summarized in Appendix-10.

2.6.3. Procurement Plan

(1) Labor

The labors for the project are divided into three categories:

- Japanese skilled workers
- Vietnamese skilled workers
- Common labor

Japanese skilled workers

In the project, there are some work items which are rarely carried out in Vietnam, such as cofferdams combined with steel pipe sheet pile, steel pipe foundation, sand drain work and PC box girder erection by SBS method. Therefore, it is required to designate Japanese personnel in-charge who had extensive experience on such works.

Vietnamese skilled workers

It is necessary to procure special operator, such as those for large cranes, from not only near the site, but also from within Vietnam.

Common Labor

The common labor for the work will be basically procured from Hai An District and Cat Hai District.

(2) Material

Major materials to be used in this project and their potential locations are shown in the table below:

Table 2.6-2 Main Materials

Major materials	Procurement location		
	Vietnam	Japanese companies in Vietnam	Japan
Embankment sand	○		
Aggregate Base, Sub Base	○		
Sand for Sand-drain	○		
Geo-textile Filter Fabric	○		
RC square pile	○		
Asphalt	○		
Guardrail, Lighting pole, etc.	○		
Cast iron drain pipe	○		
Cement		○	
Aggregate for concrete	○		
Sand for concrete	○		
Reinforcing Bar		○	
High strength cable		○	
Steel pipe pile		(○)	○
Steel pipe sheet pile			○
Bearing		○	
Expansion joint		○	

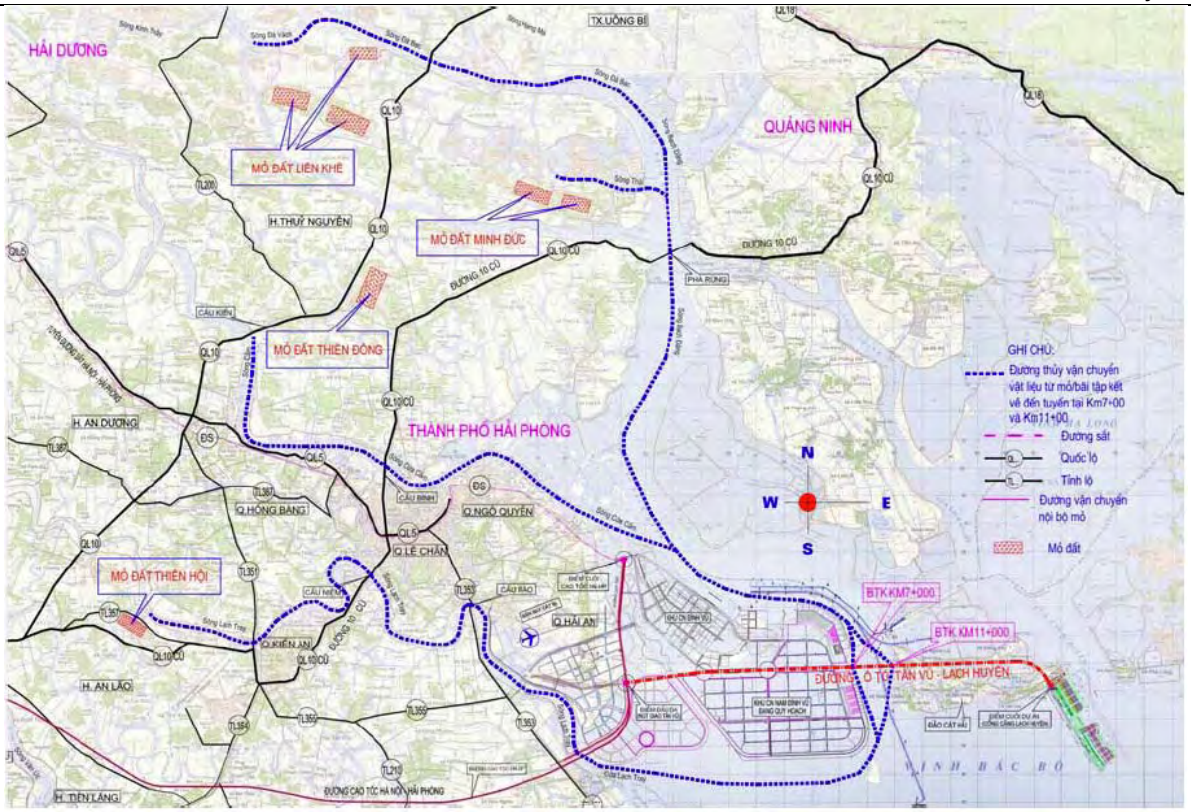
Source: Study Team

In the above table, the steel pipe sheet pile is produced only in Japan, therefore, it is assumed to be imported from Japan. Regarding the steel pile, said material could either be procured in Vietnam or imported from Japan.

(3) Embankment Materials

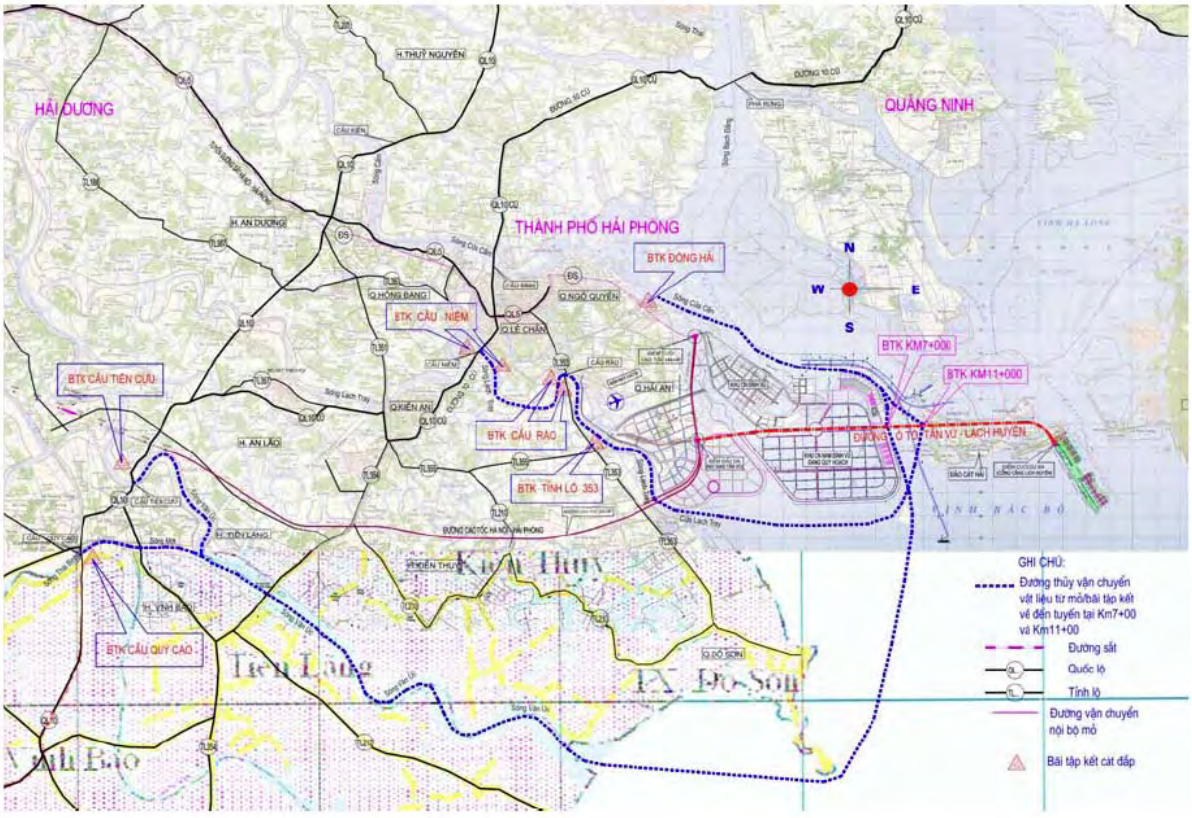
Embankment materials, borrow pits for soil and sand, and stone quarries, which have a huge volume, are estimated with reference to that of the F/S report.

Figures 2.6-3 to 2.6-5 show the locations of the borrow pits while Figures 2.6-6 and 2.6-7 show the potential borrow pits for each material. Tables-1 to 3 present the source and transport distance of borrow materials.



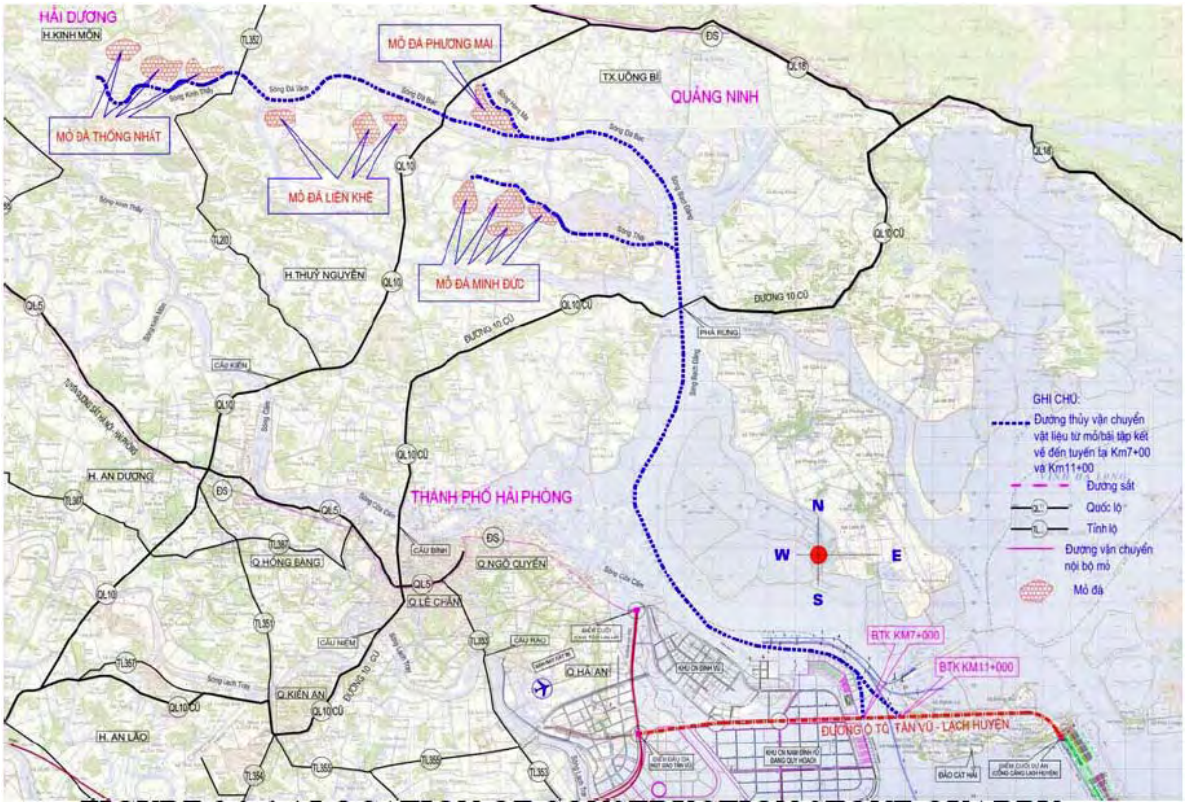
Source: F/S Report (July 2009)

Figure 2.6-3 Location of Borrow Pits (Sand)



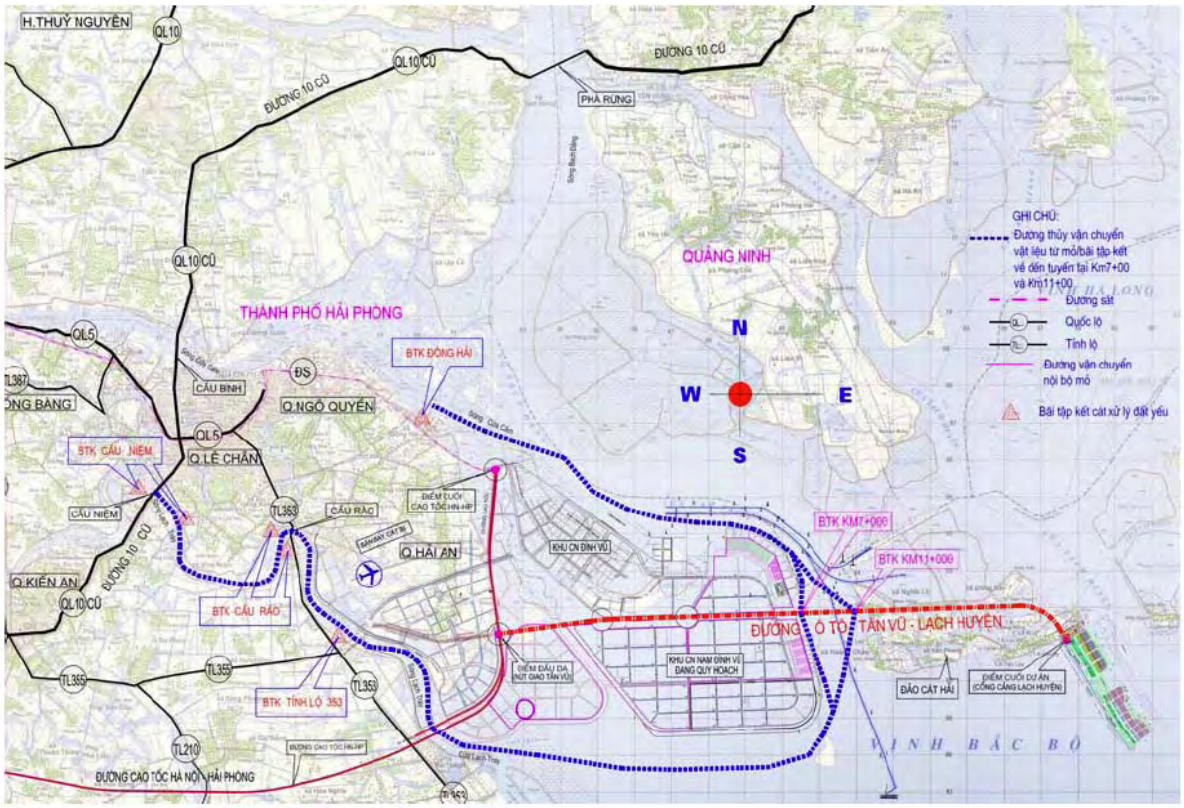
Source: F/S Report (July 2009)

Figure 2.6-4 Location of Borrow Pits (Sand)



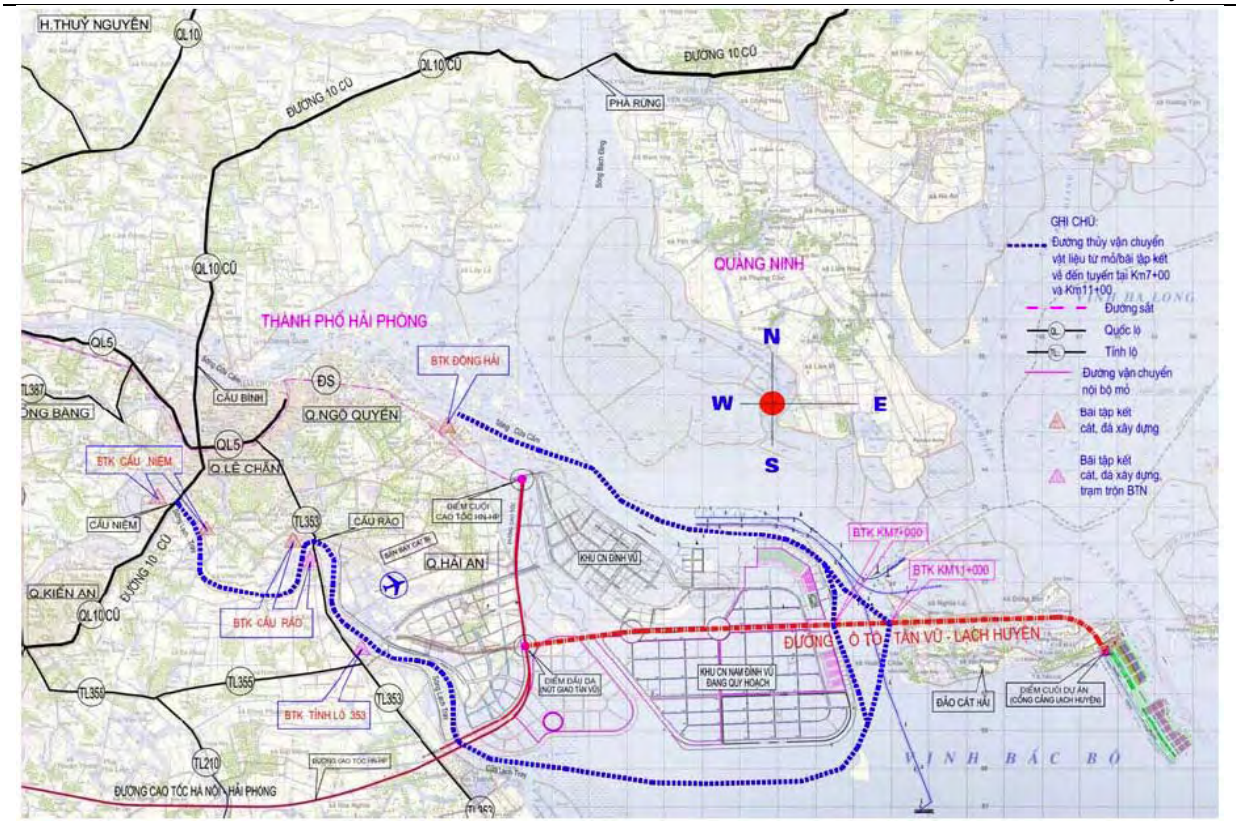
Source: F/S Report (July 2009)

Figure 2.6-5 Location of Stone Quarries



Source: F/S Report (July 2009)

Figure 2.6-6 Location of Borrow Pits (Sand for Soft Ground Treatment)



Source: F/S Report (July 2009)

Figure 2.6-7 Sand and Construction Stone Yards

Table 2.6-3 Means and Transport Distance of the Borrow Materials

Items	Material Pits / Yards								
	Location of Pits / Yards	Material Sources	Capacity (m3)	Capability Supply	Route from Pits/Yards to Location of the Project		Transport distance		
							Road(km)	Waterway (km)	Total (km)
Fine sand for embanking foundation	Yards along Provincial Road No.353	Sand on Thai Binh River and Kinh Thay River		4000 m3/day			0	20.2	20.2
	Yards near Rao Bridge		Capacity of fine sand on Kinh Thay river, Van Uc river and Thai Binh river are very huge	2000 m3/day			0	22.4	22.4
	Yards near Niem Bridge			1500 m3/day	From material Yards to points to declare on route , station Km7+00 and Km 11+00		0	28.7	28.7
	Dong Hai Yard			1000 m3/day			0	13.7	13.7
	Yards near Tien Cuu Bridge	Sand on Kinh Thay River		3000 m3/day			0	56.2	56.2
	Yards near Quy Cao Bridge	Sand on Van Uc River		2000 m3/day			0	54.8	54.8
Embankment soil K98	Lien Khe Soil Pit		500,000	2000 m3/day			1.0 (Soil road)	38.8	39.8
	Minh Duc soil pit		800,000	3000 m3/day	From material Yards to points to declare on route , station Km7+00 and Km 11+00		1.5 (Soil road)	27.6	29.1
	Thien Hoi soil pit		50,000	1000 m3/day			1.5 (Soil road)	40.8	42.3
Embankment soil K95 to protect sloop	Thien Dong soil pit		400,000	2000 m3/day	From material Yards to points to declare on route , station Km7+00 and Km 11+00		4.5 (Asphalt road)	3.8	35.3
Items	Material Pits / Yards								
	Location of Pits / Yards	Location of Pits / Yards	Location of Pits / Yards	Location of Pits / Yards	Location of Pits / Yards	Location of Pits / Yards	Transport distance		
							Road (km)	Road (km)	Road (km)
Bedding sand and sand pile for soft embank-ment	Yards along Provincial Road No.353	Sand sources Lo River, Viet Tri - Phu Tho		1500 m3/day		From material Yards to points to declare on route , station Km7+00 and Km 11+00	0	20.2	20.2
	Yards near Rao Bridge			2000 m3/day			0	22.4	22.4
	Yards near Niem Bridge			500 M3/day			0	28.7	28.7
	Dong Hai Yard			500 m3/day			0	13.7	13.7
	Sand sources on Lo River, in Viet Tri - Phu Tho						0	272	272

Source: F/S Report (July 2009)

Table 2.6-4 Means for Transporting Materials and Transport Distance

Item	Material pits / Yards							
	Location of material pit/Yard	Material source	Available Volume (m3)	Available Capacity	Road conditions from pits / Yards to the site	Transport distance		
						Road (km)	Waterway (km)	Total (km)
Fine aggregate (stone 0x5mm) and coarse aggregate for AC concrete, coarse aggregate for CC, Base, and Sub-base	Thong Nhat Stone Quarry	Limestone	Very huge	6,000 m3/day	From Yards to start point, station Km7+00 and Km11+00	1.5 (Soil road)	47.0	48.5
	Phuong Mai Stone Quarry		Very huge	1,000 m3/day		0.5 (Soil road)	34.0	34.5
	Minh Duc Stone Quarry		Very huge	2,000 m3/day		0.5 (Soil road)	29.4	29.9
	Lien Khe Stone Quarry		Very huge	1,500 m3/day		0.5 (Soil road)	36.4	36.9
Fine aggregate for AC and for CC (coarse sand)	Yard on provincial road 353	Sand pit Lo river, Viet Tri - Phu Tho		500 m3/day	From pits/Yards to start point, station Km7+00 and Km11+00	0	20.2	20.2
	Yard near Rao bridge			700 m3/day		0	22.4	22.4
	Yard near Niem bridge			300 m3/day		0	28.7	28.7
	Yard near Dong Hai bridge			300 m3/day		0	13.7	13.7
	Sand pit Lo river, Viet Tri - Phu Tho			1,000,000 m3/year		0	272	272

Source: F/S Report (July 2009)

Table 2.6-5 Location and Transport Distance from Material Pits/Yards to Project Site

(Establishing Yards toward Hai Nam at station Km7+00 and toward Cat Hai at station Km11+00)

Pit / Yard	Unit	Road	Waterway		Total
1. Thong Nhat Stone Quarry Phu Thu Town - Kinh Mon - Hai Duong	km	*1.5* Soil road	*47.0* Kinh Thay River Da Vach River Da Bac River Bach Dang River Nam Trieu River Mouth	3.3 4.9 11.6 17.2 10.0	48.5
2. Phuong Mai Stone Quarry Phuong Nam Commune - Uong Bi - Quang Ninh	km	*0.5* Soil road	*34.0* Hang Ma River Da Bac River Bach Dang River Nam Trieu River Mouth	3.2 3.6 17.2 10.0	34.5
3. Lien Khe Stone Quarry Lien Khe Commune - Thuy Nguyen – Hai Phong	km	*0.5* Soil road	*36.4* Da Bac River Bach Dang River Nam Trieu River Mouth	9.2 17.2 10.0	36.9
4. Minh Duc Stone Quarry Minh Duc Town - Thuy Nguyen - Hai Phong	km	*0.5* Soil road	*29.4* Thai River Bach Dang River Nam Trieu River Mouth	6.0 13.4 10.0	29.9
5. Soil Pit Lien Khe Lien Khe Commune - Thuy Nguyen - Hai Phong	km	*1.0* Soil road	*38.8* Da Bac River Bach Dang River Nam Trieu River Mouth	11.6 17.2 10.0	39.8
6. Minh Duc Soil Pit Minh Duc Town - Thuy Nguyen - Hai Phong	km	*1.5* Soil road	*27.6* River Th¸i Bach Dang River Nam Trieu River Mouth	4.2 13.4 10.0	29.1
7. Thien Dong Soil Pit Dong Son Commune - Thuy Nguyen - Hai Phong	km	*4.5* Asphalt road (NH10 before)	*30.8* River Cam Cam River Mouth Nam Trieu River Mouth	3.9 16.9 10.0	35.3
8. Thien Hoi Soil Pit An Tien Commune - An Lao -Hai Phong	km	*1.5* Soil road	*40.8* Lach Tray River Lach Tray River Mouth Sea	25.9 3.3 11.6	42.3
9. Yard near Quy Cao Bridge Giang Bien Commune - Vinh Bao - Hai Phong	km	*0.0*	*54.8* Thai Binh River Van Uc River Sea	6.0 22.7 26.1	54.8
Pit / Yard	Unit	Road	Waterway		Total
10. Yard near Tien Cuu Bridge Quang Trung Commune - An Lao - Hai Phong	km	*0.0*	*56.2* Van Uc River Sea	30.1 26.1	56.2
11. Yard near Niem Bridge Vinh Niem Ward - Le Chan and Quan Tru Ward - Kien An - Hai Phong	km	*0.0*	*28.7* Lach Tray River Lach Tray River Mouth Sea	13.8 3.3 11.6	28.7
12. Yard near Rao Bridge Dang Giang Ward - Ngo Quyen and Anh Dung Ward - Duong Kinh - Hai Phong	km	*0.0*	*22.4* Lach Tray River Lach Tray River Mouth Sea	7.5 3.3 11.6	22.4
13. Yard in provincial road No. 353 Anh Dung Ward - Duong Kinh - Hai Phong	km	*0.0*	*20.2* Lach Tray River Lach Tray River Mouth Sea	5.3 3.3 11.6	20.2
14. Dong Hai Yard Dong Hai Ward - Hai An - Hai Phong	km	*0.0*	*13.7* Cua Cam River Nam Trieu River Mouth	3.7 10.0	13.7
15. Asphalt Mixing plant - Yard in provincial road No. 353 Anh Dung Ward - Duong Kinh - Hai Phong	Km	*11.3* Asphalt road 9.9 km Soil road 1.4 km			11.3 (transport to Km0)
16. Asphalt Mixing plant - Yard near Rao Bridge Anh Dung Ward - Duong Kinh - Hai Phong	Km	*13.5* Asphalt road 12.1 km Soil road 1.4 km			13.5 (transport to Km0)

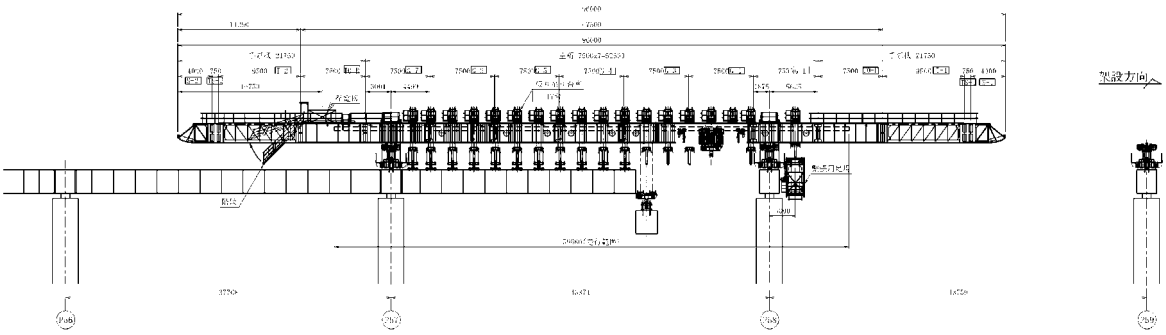
Source: F/S Report (July 2009)

(4) Construction Equipment

The construction equipment is shown on Appendix-4 "List of Construction Equipment". While most of them can be procured in Vietnam, some items which could not be procured locally will be imported from Japan.

1) Erection Girder for the Construction of the Approach Bridge

SBS erection method is applied for construction of the approach bridge. The erection girder for this method is shown in the figure below. The movable hanging equipment is not available in Vietnam, and hence, is planned to be procured from Japan.



Source: Study Team

Figure 2.6-8 Erection Girder

2) Pile-Driven Hammer

In Vietnam, procurement of pile-driven hammer for foundation with steel pipe sheet pipe (D=1200) and steel pile (D=800) is impossible. Therefore, the 15-ton hydraulic hammer will be procured from Japan while the base machine, barge (400 ton) and tugboat will be procured in Vietnam.

2.6.4. Construction Method

(1) General

Generally, the construction method proposed in the F/S is acceptable. Some updated comments are introduced below:

(2) Road Works

Soft ground treatment by sand pile with preloading method is adopted in the F/S. It is basically accepted but other options will be further studied in the detailed design stage i.e. vacuum consolidation method.

(3) Substructure of Approach Bridge

In order to ensure the 30 months construction period, steel pile foundation method is deemed reliable to save time.

(4) Superstructure of Approach Bridge

In order to reduce the construction period, and ensure bridge durability and easy maintenance in the future, PC-box girder is proposed in this Study. Consequently, either the SBS erection

(4) Construction Equipment

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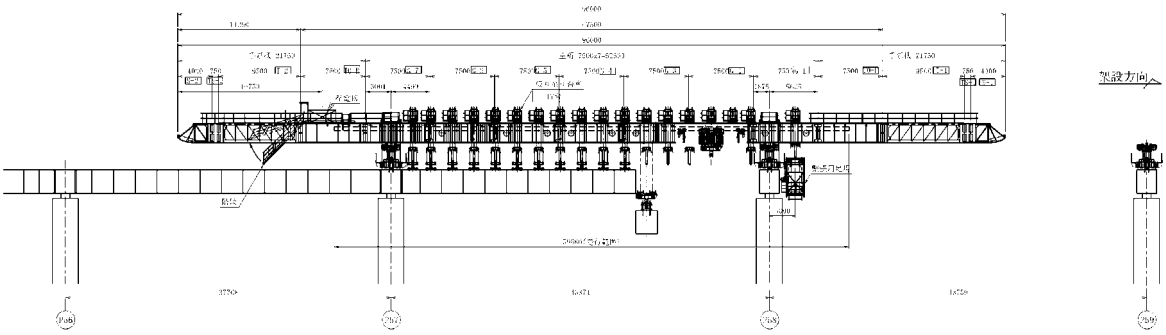

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(4) Superstructure of Approach Bridge

In order to reduce the construction period, and ensure bridge durability and easy maintenance in the future, PC-box girder is proposed in this Study. Consequently, either the SBS erection

method or movable scaffolding system (MSS) erection method may be adopted as discussed below.

(5) Substructure of the Main Bridge

The water depth at the main bridge foundation site is exceeding 10 m. In such depth, the temporary cofferdam structure should be constructed with double sheet pile cofferdam method or a steel pipe well foundation. Considering construction safety, it is proposed to adopt the steel pipe well foundation method for the main piers' foundations.

(6) Superstructure of the Main Bridge

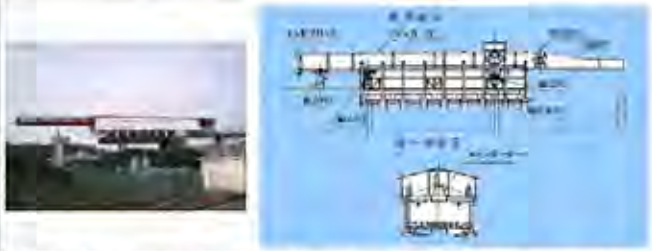
Adoption of balanced-cantilever erection method for the superstructure, as also mentioned in the F/S, is reasonable and desirable.

(7) Comparison of Erection Method for the Approach Bridge

The table showing comparison between SBS Method and MSS Method is shown below. Results of comparison reveal that the SBS method is more preferable for the following reasons.

- Segment preserved at the factory can have well-managed quality.
- Based on actual performance in Japan, the MSS method is limited to 50-m spans. On the other hand, the project requirement is 60 m.
- Construction period is the shortest.

Table 2.6-6 Comparison between SBS and MSS

Item	1 : Span by span erection method	2 : Movable scalfolding erection method
Image drawing		
Outline	- Segment produced in Yard will be transported to the bridge construction site. Then using erection girder to erect span one by one. - After erect segment on the pier, installing the Erection girder assembler, lifting segment one by one by hanging equipment, place, set it on fixed location - Carrying out the tension after hanging segment of 1 span. - After 1 span erection, moving Erection girder forward, and repeating the same erection	- From the structure on main girder, hanging Scalfolding, no need to use the falsework from the ground, erecting span one by one. - Erecting block on pier by fixed falsework erection. - Assembling main girder, set up supporting members. - From falsework suspended by Main girder, erecting span one by one. - Demolishing hanging scalfolding, moving Main girder forward, and repeating the same erection.
Applicable span and girder span-height length	40m～50m (Max span length:66.3m) 1/17～1/20	30m～45m (Max span length:50.0m) 1/17～1/20
Standard schedule	Install & demolish erec.equip. 60 days Main girder erection 15 days ※Span length is estimated as 60m	Install & demolish erec.equip. 60 days Main girder erection 25 days/1span ※Span length is estimated as 60m
Advantageous	- Since Segment can parallel process at site and at the Yard, it can significantly reduce construction period. - After manufacturing, the Segment can be kept in Yard. Shrinkage and Creep Effects is small so prestress efficient is high. - Segment is preserved at the factory can have well-managed quality	- At Erection time, it can be secure in the space under girder, so there are unconstrained of girder height. - In Japan, it is covered with shed, so it does not depend on weather - The same work is repeated, so it is good for training worker.
Disadvantageous and attension	- It is not suitable cost if it is not large-scale construction. - Since there are no continuous reinforcing at segment joint. The careful design of the joint is required (limitation of stress). - It needs to check during transporting/lifting - Segment (or cast-in-situ) at pier must be erected in advance - Equipment with specified performance may required according to segment weight.	- Same with method in the left, cost for assembling/demolishing equipment is high, so it is only appropriate for large bridges (5000m2 or more) - It must be almost the same length of the spans - Block at pier must be erected in advance - Scalfolding/Supporting with vacant box need to assemble separately. - Japan has many projects with hollow slab bridge and and girder bridge by using this method, but a little of box girder.

Source: Study Team

(8) Drawings of Construction Methods

The construction outline drawings of the abutment, substructure, and superstructure of the approach bridge are shown in Sheets C-01 to C-05. Meanwhile, drawings of the substructure and superstructure of the main bridge are shown in Sheets C-06 and C-07 in Appendix-1 "Drawings".

2.6.5. Temporary Facility Plan

(1) Construction Yard

Temporary facilities are needed at the site that will be utilized while managing the construction activities, and as manufacture yard, stock yard and locations for concrete batching plants.

The necessary yard area based on similar construction and empirical area for SBS construction method is approximately 150,000 m^2 in total. The items included are as follows:

Table 2.6-7 Necessary Yard Areas for Span-By-Span (SBS) Method

Main Office, Motor Pool, Concrete Batching Plant,	18,000 m^2
Fabrication Yard for PC-Segment for SBS method	60,000 m^2
Steel Pipe Sheet Pile and Steel Pipe Pile Stock Yard	20,000 m^2
Rebar Fabrication and Stock yard, Formwork/Scaffolding Fabrication and Stock Yard	45,000 m^2
Wharf, Temporary Slope for Deck Barge	7,000 m^2
Total	150,000 m^2

Source: Study Team

(2) Temporary Construction Road and Temporary Bridge/Staging

From Tan Vu intersection to the location planned to be filled in the future, cofferdam and temporary road by embankment method is necessary for the substructure's construction. Based on these structures, the temporary works for superstructure and substructure for the wharf and pier at the sea side are carried out.

2.6.6. Construction Period of 30 months

Construction schedule is updated to 32 months based on discussions between JICA and MOT. Updated construction schedule is shown in Appendix-10.

The following are construction schedules for 30 months duration studied before the JICA Follow-up Mission.

As shown in tables below, construction commences from July 2012 and ends in December 2014, covering a total of 30 months. This period is six months shorter than that in the F/S report.

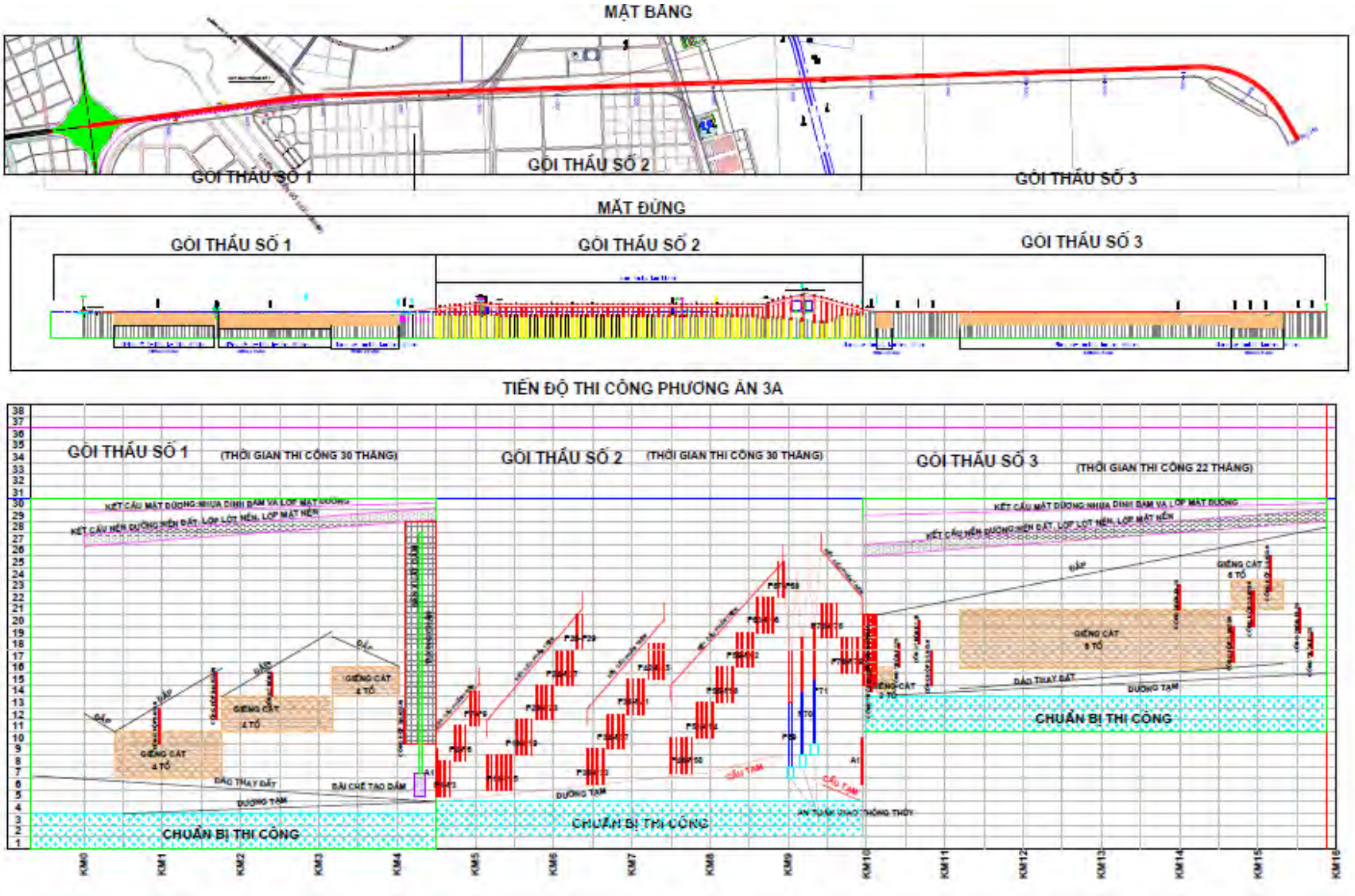
The main reason leading to a shorter construction time is the selection of the steel pile foundation method, steel pipe well foundation method and the SBS erection method for the approach bridges.

Table 2.6-8 Construction Schedule (Road Section)

This table is updated after discussion between JICA and MOT as presented in Appendix-10.

Table 2.6-9 Construction Schedule (Bridge Section, 32 months)

This table is updated after discussion between JICA and MOT as presented in Appendix-10.



Source: Study Team

Figure 2.6-9 Construction Schedule (30 Months)

2.7. Preliminary Project Cost Estimate

2.7.1. Review of the F/S

(1) Review of the F/S

The estimated Project cost in the F/S was reviewed in this Study, and was confirmed to fully meet the requirements in accordance with Vietnamese laws and regulations at that time. In this Study, the Project cost was updated based on current Vietnamese laws, regulations and standard unit costs. Facility design was also updated as well as the Project implementation program.

Main contents of the Project cost updates in this Study are summarized below:

- Update related laws and regulations based on the current versions;
- Update cost structure to meet the requirements of JICA;
- Divide the Project cost into loan eligible and non-eligible portions;
- Update general unit cost (GUC) at the time of cost estimate;
- Estimate cost of the foundation and the superstructure of approach bridge which replaced the structure types proposed in the F/S;
- Classify the Project cost to foreign currency (F/C) and local currency (L/C).

(2) Related Law and Regulations

Project cost estimate applied in the F/S were updated in this Study based on current versions of related laws and regulations.

Main laws and regulations related to the Project cost estimate applied in the F/S and in this Study are shown in Table 2.7-1.

Table 2.7-1 Main Laws and Regulations Related to the Project Cost Estimate

Law and Regulations	F/S	This Study
Guiding the formulation and management of work construction investment expenditures	Circular No 05/2007/TT-BXD (Dated on July 25, 2007) (Issued by Ministry of Construction)	Circular No 05/2007/TT-BXD (Dated on July 25, 2007) (Issued by Ministry of Construction)
Norm of construction cost estimate	Decision No 24/2005/QD-BXD (Dated on July 29, 2005) (Issued by Ministry of Construction)	Decision No.957/QĐ-BXD (Dated on September 29, 2009) (Issued by Ministry of Construction)
Labor cost	Standard cost designated by local authority is applied	Standard cost designated by local authority is applied
Material price in Hai Phong city (Market price)	Announcement No.62/2008/SXD-CBG (Dated on June 30, 2008) (Issued by Hai Phong CPC)	Announcement No.17/2010/SXD-CBG (Dated on March 8, 2010) (Issued by Hai Phong CPC)
Lease cost of construction equipment	Decision No.2157/2006/QD-UBND (Dated on September 29, 2006) (Issued by Hai Phong PPC)	Decision No.2157/2006/QD-UBND (Dated on September 29, 2006) (Issued by Hai Phong PPC)
Guidelines for calculating freight of transportation by cars	Decision No 89/2000/QD-BVGCP (Dated on November 13, 2000) (Issued by Government Pricing Committee)	Decision 57/2004/QD-BTC (Dated on June 28, 2004) (Issued by Ministry of Finance)

2.7.2. Funding Plan

Financing for the Project was assumed to be funded through the JICA STEP Loan scheme for 100% of the eligible portion. As for the non-eligible portion, it was assumed to allocate the state budget of the Government of Vietnam (GOVN).

2.7.3. Methodology

(1) Cost Structure

Cost structure was presented in Annex I of the minutes of discussions (M/D) between JICA and GOVN dated March 19, 2010. This form is slightly different from the current Vietnamese standard (Circular No 05/2007/TT-BXD). However, all required cost items in the standard are covered.

The cost structure applied in this Study is shown in Table 2.7-2.

Table 2.7-2 Cost Structure

Cost Items		Remarks
Total Project Cost		I+II
I	JICA Loan Eligible Portion (STEP Scheme)	1+2+3+4+5+6
1	Construction Cost	See 2.7.3(2)
2	Price Contingency	1*Rate
3	Physical Contingency	[1+2]*Rate
4	Consulting Services	Construction Supervision
5	Interest during Construction	[1+2+3]*Rate (Construction)+4*Rate (Consulting Services)
6	Commitment Charge	[1+2+3+4]*Rate
II	State Budget Portion	7+8+9+10
7	Environmental Management and Monitoring Cost	Including Land Acquisition and Compensation Cost
8	Administration Cost	[1+2+3+4+5]*Rate
9	Value Added Tax (VAT)	[1+2+3+4]*Rate
10	Import Tax	Import Goods*Rate

(Source: Minutes of Discussion dated March 19, 2010)

(2) Construction Cost

1) Construction Cost Structure

Construction cost structure was based on the current Vietnamese standard, Circular No 05/2007/TT-BXD dated July 25, 2007 and issued by the Ministry of Construction (MOC).

The construction cost structure is shown in Table 2.7-3.

Table 2.7-3 Construction Cost Structure

Cost Items	Equation
1 Construction Cost	1)+2)+3)
1) Direct Construction Cost	a)+b)+c)+d)
a) Material Cost	
b) Labor Cost	
c) Construction Equipment Cost	
d) Other Direct Construction Cost	[a)+b)+c)]*1.5%
2) Indirect Construction Cost	e)+f)+g)
e) Management Cost	1)*5.3%
f) Overhead and Profit Margin	[1)+e)]*6.0%
3) All Risk Insurance Premium	[(1)+(2)]*1.0%

2) General Unit Cost

The GUC of each construction item was approximated considering cost-based estimate, which consists of the unit cost of each component (material, labor and construction equipment) to complete the construction work. Said cost was marked-up to consider other direct cost, indirect cost and all risk insurance premium as defined in Table 2.7-3.

Productivity Rate

Productivity rate (norm) was based on the current standard, Decision No.957/QĐ-BXD dated September 29, 2009 issued by MOC. However, the productivity rate for steel pipe foundation and steel pipe well foundation works are not listed in the above decision. Therefore, productivity rates for these works were based on Japanese standards issued by MLIT-Japan.

Material, Labor and Construction Equipment Cost

Unit cost for labor, material and construction equipment was taken from the official rates published by People's Committee of Hai Phong City (the first quarter, 2010). As for the imported goods, the unit cost including shipping cost was estimated by quotation method.

Hauling Cost

Domestic hauling cost was estimated in accordance with Decision 57/2004/QD-BTC dated June 28, 2004 issued by the Ministry of Finance (MOF).

All Risk Insurance Premium

Section B.1.6 in the main text of Circular No 05/2007/TT-BXD dated on July 25, 2007 issued by MOC states that construction insurance premium shall be included in the item, Other Cost (part of administration cost in the cost structure of this Study). However, since FIDIC is applied to the general conditions of contract for JICA Loan Project, the Contractor shall be responsible for the overall construction insurance. Therefore, all risk insurance premium was added into the construction cost in this Study. This was assumed to be 1.0% of the sum of direct construction cost and indirect construction cost referring to other projects in Vietnam.

(1) Consulting Services

Detailed engineering design is expected to be implemented under JICA Grant-aid scheme. Therefore, the cost for detailed engineering design was excluded from the Project cost. Meanwhile, the cost of construction supervision was based on Annex I of M/D between JICA and GOVN dated March 19, 2010.

(2) Environmental Management and Monitoring Cost

Environmental management and monitoring cost including land acquisition and compensation cost are shown in Section 3.3.3, "Recommendation on Socio-environmental Considerations"

(3) Quantity Take-off

Quantity taken-off for each construction work item was carried out as shown in Section 2.5.7, "Major Work Quantities".

(4) Project Cost Estimate

Project cost was estimated based on the GUC and quantity discussed above.

2.7.4. Conditions of Cost Estimate

(1) Time of Cost Estimate

Time of cost estimate in this Study was March 2010 as instructed by JICA.

(2) Currency

In accordance with the funding plan in Section 2.7.2, Japanese Yen (JPY) was used as F/C while Vietnamese Dong (VND) was used as L/C in this Study.

(3) Exchange Rate

The following exchange rates were applied in this Study as instructed by JICA.

- VND 1 = JPY 0.00532
- USD 1 = JPY 90.5 = VND 17,002

(4) Classification Conditions of Currency and Tax

Classification conditions of currency and tax applied in this Study are shown in Table 2.7-4.

Table 2.7-4 Classification Conditions of Currency and Tax

Cost Items	Classification Condition of Currency and Tax
I JICA Loan Eligible Portion	
1 Construction Cost	Assuming to receive an order as a single or JV of foreign companies
1) Direct Construction Cost	The currency was determined based on labor's nationality, procurement place of material and equipment
a) Material Cost	Cost for material distributed domestically was in L/C without considering a country of origin
	Cost for material requiring individual import procedure was in F/C
b) Labor Cost	Cost for skilled labor with foreign nationality was in F/S and Vietnamese labor was in L/C
c) Construction Equipment Cost	Cost for equipment distributed domestically was in L/C without considering a country of origin
	Cost for equipment requiring individual import procedure was in F/C
	Cost for operator with foreign nationality was in F/C and Vietnamese operator was in L/C
d) Other Direct Construction Cost	Shipping cost for equipment requiring individual import procedure was in F/C, and others were in L/C
2) Indirect Construction Cost	Cost required at the site was in L/C, and others were in F/C
e) Management Cost	Travel expense for engineer and skilled labor with foreign nationality was in F/C, and others were in L/C
f) Overhead and Profit Margin	The cost was in F/C since it was expense of contractor's headquarter
3) All Risk Insurance Premium	The cost was in F/C assuming insurance at home country of contractor
2 Price Contingency	The cost was classified by the ratio of F/C and L/C of the cost requiring contingency
3 Physical Contingency	The cost was classified by the ratio of F/C and L/C of the cost requiring contingency
4 Consulting Services	Followed Annex I of minutes of discussions (M/D) between JICA and GOVN dated on March 19, 2010
II State Budget Portion	
5 Environmental Management and Monitoring Cost	The cost was in L/C since it was expense in Vietnam
6 Administration Cost	(Since this was the expense of public organization, it was exempt from VAT)
7 Value Added Tax (VAT)	VAT was imposed on the total amount of items in JICA loan eligible portion
8 Import Tax	The cost was in L/C since it was paid in Vietnam

(5) Price Contingency Rate

As instructed by JICA, the following price contingency rates were applied in this Study:

- F/C : 1.8 % per annum
- L/C : 10.3 % per annum

(6) Physical Contingency Rate

As instructed by JICA, 5% of the physical contingency rate was applied in this Study. Clause B.2.6 of the Circular No 05/2007/TT-BXD dated on July 25, 2007 issued by MOC also states that 5.0% of the project cost shall be allocated for physical contingency for projects with implementation period exceeding two (2) years. Therefore, this rate satisfies the Vietnamese regulations.

(7) Interest during Construction

As instructed by JICA, the following rates for interest during construction were applied in this Study:

- Construction Cost : 0.2 % per annum of disbursed amount
- Consulting Services : 0.01 % per annum of disbursed amount

(8) Commitment Charge

Based on the M/D between JICA and GOVN dated March 19, 2010 concerning Lach Huyen Port Infrastructure Construction Project, the commitment charge amount is derived as follows:

- Loan amount × number of years of disbursement period × 0.1%

(9) Administration Cost

Administration cost is equal to the project management cost and other costs defined in Circular No 05/2007/TT-BXD dated on July 25, 2007 issued by MOC. Rate of administration cost was based on Annex I of M/D between JICA and GOVN dated on March 19, 2010. This was determined as 5% of the sum of construction cost, price contingency, physical contingency, consulting services and environmental management and monitoring cost.

(10) Value Added Tax

In accordance with Circular No 32/2007/TT-BTC, 10% of the amount of JICA loan eligible portion was estimated as value added tax (VAT) in this Study.

(11) Import Tax

R Rates of import tax vary according to item. In this Study, import tax rate for goods which require import procedure was assumed to be 10% as the average.

(12) Value of Estimated Cost

The project cost was estimated considering future price fluctuation in order to allocate an exact budget required for the project. However, the present price was used for economic analyses without considering the future price fluctuation.

2.7.5. Preliminary Cost Estimate

(1) Summary of Estimated Project Cost

Summary of estimated Project cost is shown in Table 2.7-5.

This table is updated after the discussion between JICA and MOT took place, as presented in Appendix-10.

Table 2.7-5 Summary of Estimated Project Cost

Cost Items		Project Cost (by Currency)		Project Cost (Currency Exchange)	
		F/C (Mil.JPY)	L/C (Mil.VND)	F/C (Mil.JPY)	L/C (Mil.VND)
Total Project Cost		7,200	6,882,409	43,814	8,235,803
I	JICA Loan Eligible Portion (STEP Scheme)	7,200	5,447,357	36,180	6,800,751
1	Construction Cost	5,320	3,796,649	25,518	4,796,562
2	Price Contingency	293	1,307,946	7,251	1,362,981
3	Physical Contingency	281	255,230	1,638	307,977
4	Consulting Services	779	87,532	1,245	233,961
5	Interest during Construction	277	0	277	51,995
6	Commitment Charge	251	0	251	47,274
II	State Budget Portion	0	1,435,052	7,634	1,435,052
7	Environmental Management and Monitoring Cost	0	314,132	1,671	314,132
8	Administration Cost	0	350,781	1,866	350,781
9	Value Added Tax (VAT)	0	670,148	3,565	670,148
10	Import Tax	0	99,991	532	99,991

Source: Study Team

(2) Breakdown of Estimated Construction Cost

Breakdown of estimated construction cost is shown in Table 2.7-6.

This table is updated after the discussion between JICA and MOT took place, as presented in Appendix-10.

Table 2.7-6 Breakdown of Estimated Construction Cost

Cost Items		Project Cost (by Currency)		Project Cost (Currency Exchange)	
		F/C (Mil.JPY)	L/C (Mil.VND)	F/C (Mil.JPY)	L/C (Mil.VND)
1	Construction Cost	5,320	3,796,649	25,518	4,796,562
1)	Temporary Facilities	63	490,810	2,674	502,560
2)	Tan Vu Interchange	27	239,179	1,299	244,199
3)	Approach Road (Hai An Side)	83	736,997	4,003	752,512
4)	Approach Bridge (Hai An Side)	2,862	1,235,973	9,437	1,773,917
5)	Main Bridge	1,816	258,681	3,192	600,076
6)	Approach Bridge (Cat Hai Side)	394	147,077	1,177	221,221
7)	Approach Road (Cat Hai Side)	75	687,932	3,735	702,078

Source: Study Team

(3) Annual Fund Requirement

Annual fund requirement for the project was estimated in relation with the Project implementation program as shown in Section 2.9 "Implementation Structure and Program"

Estimated annual fund requirement is shown in Appendix-5 "Annual Fund requirement".

(4) Economic Cost

Economic cost for the project were estimated in relation with the Project implementation program as shown in Section 2.9 "Implementation Structure and Program"

Amount of estimated economic cost are shown in Table 2.7-7, while annual base of estimated economic and financial cost are shown in Section 3.2 "Economic Analysis".

This table is updated after the discussion between JICA and MOT took place, as presented in Appendix-10.

Table 2.7-7 Amount of Estimated Economic Cost

Cost Items	Amount (by Currency)		Amount (Currency Exchange)	
	F/C (Mil.JPY)	L/C (Mil.VND)	F/C (Mil.JPY)	L/C (Mil.VND)
1 Economic Cost	6,328	3,960,642	27,398	5,150,025

Source: Study Team

(5) Comparison with the F/S

Construction Cost

The cost estimated in the F/S and this study is compared as follows,

- F/S : 5,789,844 Million VND,
- This Study: 4,797,562 Million VND.

The major differences which have impact on the construction cost are summarized in the table below.

Table 10 Comparison between F/S and This Study on Construction Cost

	F/S	This Study
Construction Cost	5,789,844 Million VND	4,797,562 Million VND
Major Differences		
Scope of Work	Full Scale (6 lanes)	Stage Construction (4 lanes)
Type of Foundation	Cast-in-place pile foundation	Steel pipe well foundation (Main Bridge) Steel pipe foundation (Approach Bridges)
Type of Superstructure of Approach Bridges	Super-T Girder	PC Box Girder
Toll Gate	Included	not considered
VAT	VAT is Included in Construction Cost	VAT is not included in construction cost but counted in the state budget portion

Source: Study Team

Note: The effects of stage construction, type of foundation and type of structure of Bridges are discussed in Sections 2.4.3 and 2.4.6, respectively.

Total Project Cost

The cost estimated in the F/S and this study (Preparatory Study) is compared as follows,

- F/S : 8,729,452 Million VND,
- This Study: 8,235,803 Million VND.

The major differences which have impact on the construction cost are as shown in the table below.

Table 11 Comparison between F/S and This Study on Total Project Cost

	F/S	This Study
Total Project Cost	8,729,452 Million VND	8,235,803 Million VND
Major Differences		
Consultant services	Detailed design, tender assistance and construction supervision	Construction supervision and tender assistance (partial)
Price Contingency	overall rate of 15% for construction, consultant services and other costs	Compounded interest with annual rate
Physical Contingency	5%of construction cost, consultant services and other costs	5% of for construction cost
Environmental Management and Monitoring Cost	Only the cost for land acquisition and resettlement	Land acquisition and resettlement, livelihood restoration plan, HIV prevention program, environmental management program, environmental monitoring program, and so on.
Annual Rate for Loan Interest	13%	0.2% for construction cost 0.01% for consulting service
Import Tax	Not counted	Counted for state budget portion

Source: Study Team

Note: The environmental management and monitoring are discussed in detail in Section 3.4.3

2.7.6. Goods and Services Expected to be Procured from Japan

This Project is expected to apply STEP scheme. Therefore, the procurement ratio, and goods and services expected to be procured from Japan were calculated in this Study

(1) Methodology

Goods and services to be provided by Japanese firms were calculated in accordance with the procurement plan in Section 2.6, “Preliminary Construction Planning”.

The calculation result of Project cost estimate was used to determine the procurement ratio of goods and services from Japan. Therefore, the calculation method was the same as that for the Project cost estimate.

(2) Conditions of Calculation

1) Japanese Firm

The term ‘Japanese firm’ is defined in Table 2.7-8 below.

Table 2.7-8 Definition of Japanese Firms

Classifications	Definition
Japanese Firm	- Firm registered in Japan as corporation - Firm in which Japanese and Japanese firms are the holder of major interest - Firm in which Japanese are the major directors
Japanese Firm in Vietnam	- Firm registered in Vietnam as corporation - Firm which stock share of Japanese firms should be more than 10 % and investment from firms in the third country should not exceed the investment from Japanese firms
Japanese Firm In the Third Country	- Firm registered as corporation in the country where it is stationed other than Japan or Vietnam - Firm which registered country or region is on the list of DAC - Firm which stock share of Japanese firms should be more than a third and investment from countries other than Japan and the registered country should not exceed the total investment from Japanese firms

2) Contractor

Prime contractors are tied to Japanese firms. Joint ventures (JV) with Vietnamese firms are also admitted subject to some conditions.

Procurement conditions for contractors are shown in Table 2.7-9.

In this Study, JV with only Japanese firms or a single Japanese firm was assumed in the calculation of the procurement ratio from Japan.

Table 2.7-9 Procurement Conditions of Japanese Firm

Formation	Procurement Condition of Contractor
Single	- Japanese firm
Joint Venture	- Joint venture of only Japanese firms - Joint venture of Japanese firm(s) and firm in the recipient country (Vietnam) (Japanese firm shall be a leading partner, and its contract portion shall be the largest) (Total amount of contract with Japanese firm > Total amount of contract with the recipient country)

Note: Japanese firm in Vietnam and in the third country can be a supplier of goods but cannot be counted as a Japanese Contractor

2) Denominator and Numerator

The denominator and numerator of the procurement ratio of goods and services from Japan, applied in this Study, are shown in Table 2.7-10.

Table 2.7-10 Denominator and Numerator of Procurement Ratio of Goods and Service from Japan

Item	Contents
Denominator	- Contract amount (1 Construction cost in Table 2.7-6)
Numerator	- Cost of goods from Japan and services provided by Japanese firm

4) Goods and Services Procured from Japan

Definition of goods and services procured from Japan are shown in Table 2.7-11.

Table 2.7-11 Definition of Goods and Services Procured from Japan

Item	Definition
Goods	- Material and equipment procured from Japanese firm which processes and refinement are finalized in Japan - Material and equipment procured from Japanese firm stationed in Vietnam or the third country
Services	- Salary and travel expense of Japanese worker, engineer and skilled labor - Hauling cost and insurance to goods from Japan - Design cost of Japanese firm - Cost of sub-contract to Japanese firm (Only manufacturing cost is counted for sub-contract with Japanese firm in Vietnam or the third country)[1)] - Insurance and warranty paid to Japanese firm - Overhead and profit margin of Japanese firm

Note 1): manufacturing cost is classified into provision of goods

(3) Procurement Ration from Japan

Table 2.7-12 shows procurement ratio from Japan.

This table is updated after discussion between JICA and MOT as presented in Appendix-10.

Table 2.7-12 Procurement ratio from Japan

Unit: Yen

Construction Cost		25,517,712,043	
Goods procured from Japan			
1	Erection Girder	600,341,372	2.4%
2	Steel Pipe Pile	2,218,259,116	8.7%
3	Steel Pipe Sheet Pile	1,662,957,215	6.5%
4	PC Strand	615,340,457	2.4%
5	Reinforcement Steel	1,058,781,441	4.1%
6	Cement	333,830,312	1.3%
7	Steel Sheet Pile for Cofferdam	1,556,430,217	6.1%
8	H-shaped Steel for Jetty	429,413,302	1.7%
9	Japanese Engineer	315,061,980	1.2%
10	Japanese Skilled Labor	187,174,300	0.7%
11	Administration Overhead	1,709,359,059	6.7%
Total		10,686,948,772	41.9%

Source: Study Team

Updated project cost is presented in Appendix-10

(4) Goods Expected to be Procured from Japan

The contents and cost of major goods expected to be procured from Japan are shown in the Table 2.7-13.

This table is updated after the discussions between JICA and MOT as presented in Appendix-10.

Table 2.7-13 Goods expected to be Procured from Japan

Supplier	Item	Unit	Qty	Unit Price (JPY)	Amount(JPY)
Japanese Firm	Erection Girder	m^3	41,062	14,620	600,341,372
	Steel Pipe Pile	ton	10,200	224,452	2,218,259,116
	Steel pipe Sheet Pile	ton	6,309	263,606	1,662,957,215
	PC Strand	ton	2,461	250,032	615,340,457
Japanese Firm in Vietnam	Reinforcement Bar	ton	13,877	76,251	1,058,781,441
	Cement	ton	60,982	5,474	333,830,312
	Steel Sheet Pile	ton	10,335	131,929	1,363,483,674
	Equipment for Steel Sheet Pile	m	82,006	2,353	192,946,543
	H-shaped Steel	ton	3,367	99,102	333,711,630
	Equipment for Driving/Extracting H-shaped Steel	m	52,273	1,831	95,701,672

Source: Study Team

Updated project cost is presented in Appendix-10.

2.8. Operation and Maintenance Plan

2.8.1. Review of the F/S

In the F/S, operation and maintenance (O&M) plan was examined. However, despite the specific designs and features of the proposed road and bridge, the descriptions seem more like an O&M manual rather than O&M plan that requires overall framework in terms of institutional, technical and financial aspects.

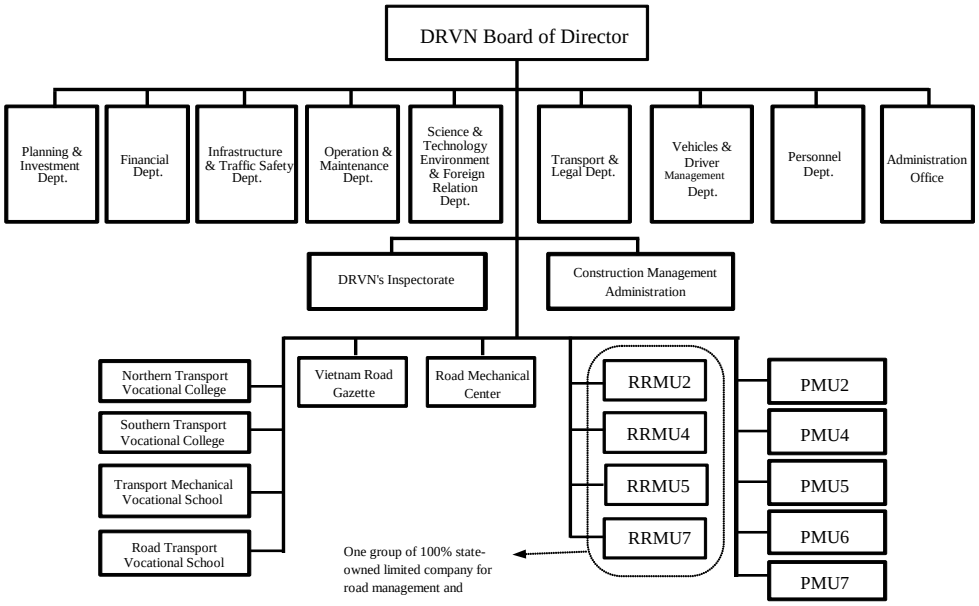
In this Study, in order to propose development of O&M framework for Tan Vu – Lach Huyen Highway, present conditions associated with O&M works in Vietnam are reviewed. Furthermore, the existing institutions in-charge of O&M, standards, and work systems are investigated.

2.8.2. Institutional Structure and Capacity for O&M

(1) Overview of the Present Condition of O&M Structure

The O&M organizations under MOT, include the Directorate of Roads for Vietnam[2] (DRVN) and Vietnam Expressway Corporation (VEC), which was established in accordance with development of expressway project. The O&M organizations for national highway and expressway in Vietnam confirmed in this Study are as discussed below.

National highways in Vietnam are under the control of DRVN, of which four Regional Road Management Units (RRMU Nos. 2, 4, 5 and 7) are in-charge of the road operation of national highways in each region. Figure 2.8-1 shows the organization chart of DRVN.



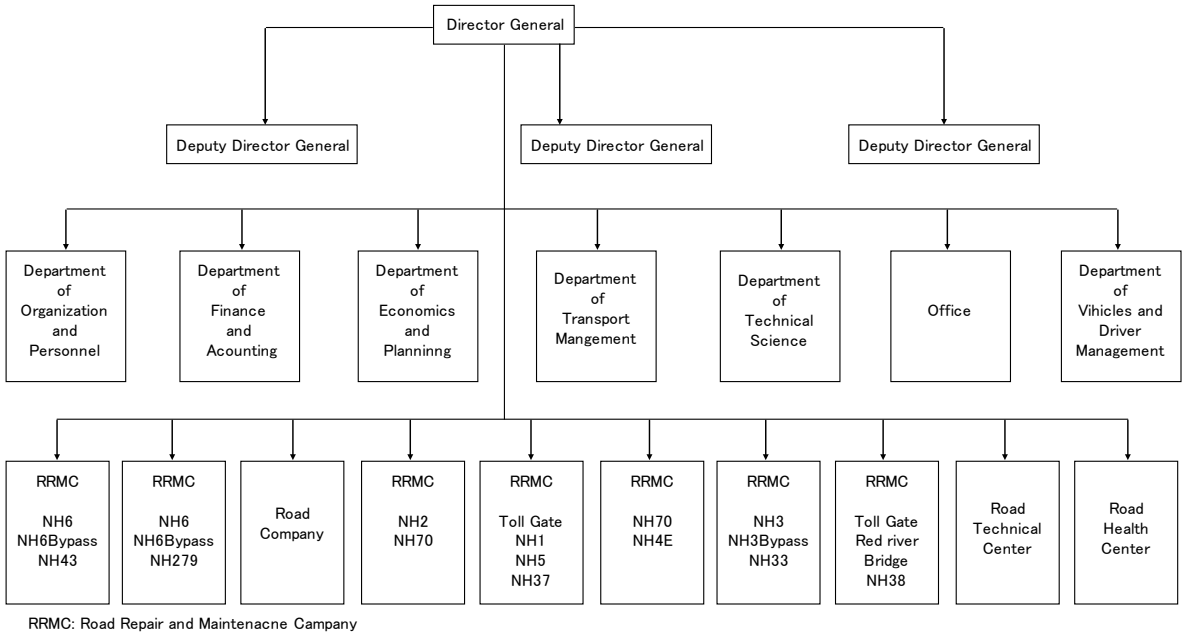
Source: Prepared based on Prime Minister Decision No: 107/2009/QĐ-TTg,
and Minutes of Discussions on Lach Huyen Port Infrastructure Construction Project between JICA and GOV on June 18, 2010.

Figure 2.8-1 Organization Chart of DRVN

[2] Vietnam Road Administration (VRA) was reformed to Directorate of Roads for Vietnam (DRVN) in May 2010.

RRMU2 (Regional Road management Unit No.2) is in charge of the O&M of the project road. Figure 2.8-2 shows organization chart of RRMU2.

Each RRMU, under its jurisdiction, has 9 to 14 Road Repair and Management Companies (RRMC), each of which has three to seven divisions to undertake actual road maintenance works.

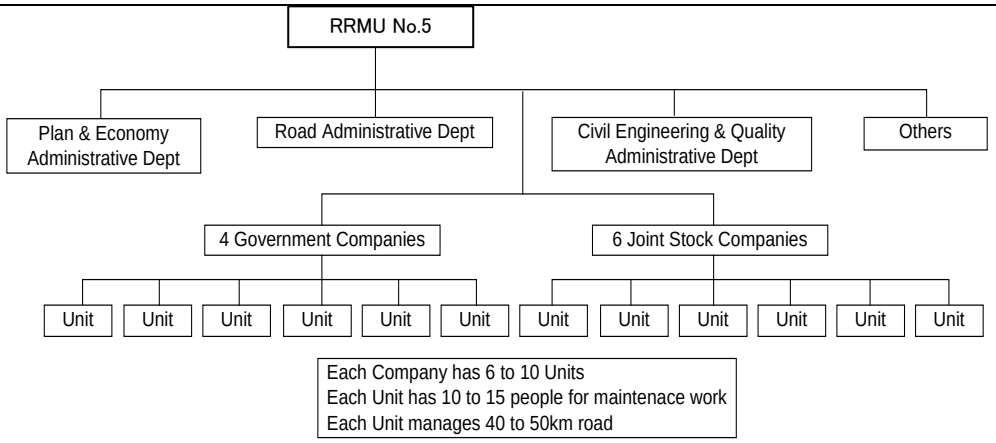


Source: JICA

Figure 2.8-2 Organization Chart of RRMU2

(2) Preceding Example of Highway O&M work in Vietnam

As an actual previous example of highway O&M, practices undertaken by RRMU No. 5 are worth being reviewed. Under RRMU No. 5, as shown in the organizational chart in Figure 2.8-3, are ten O&M companies consisting of four government companies, and six joint stock companies. Hai Van Tunnel Management and Development Company (HAMADECO), which operates the Hai Van Tunnel located north of Da Nang is one of the government companies. Under each company are six to ten maintenance units, which implement road maintenance and repair works. Each unit consists of 10 to 15 workers, and operates approximately 40 to 50 km of national highway.



Source: Study on Da Nang-Quang Ngai Expressway Project, JETRO 2008.

Figure 2.8-3 Organization Chart of RRMU No.5

Table 2.8-1 shows an example of the O&M work system undertaken by each unit under RRMU No. 5.

Table 2.8-1 Example of O&M Work System in RRMU No. 5

Work Item		Implentation	Frequency	Work Method	Notes
Daily Inspection		Each Unit	Daily	Patrol by Motorcycle, and report	Especially side-slope and bridges
Maintenance Work	Road Surface Clearing	Each Unit	Properly	All by hand	Only urban area uses vehicles
	Water Way Clearing	Each Unit	Properly	All by hand	
Repair Work	Road Surface Repair (small)	Each Unit	Properly	Potholes: By asphalt material	
				Cracks: By sealing	
	Road Surface Repair (major)	Cooperation with Several Units	-	Utilizing Geo-textile	Each company has an asphalt plant
	Side Slope Repair (small)	Unit	-	Simple repair such as soil removing	
	Side Slope Repair (major)	Construction Team	-	Slope protection, or Retaining wall	Implements after rainy season

Source: Study on Da Nang-Quang Ngai Expressway Project, JETRO 2008.

(3) Present Standards of O&M work in Vietnam

Regarding O&M in Vietnam, there are some works or technical standards adopted for national highways. O&M work on national highways by RRMU is implemented according to two types of standards, namely the "Technical Standards for Road Routine Maintenance", and "Road Maintenance Routine Standards". The former defines items of road inspections, procedures of pavement repair, and quantitative technical standards such as International Roughness Index (IRI). The latter provides frequency of road patrol and inspections on different types of roads, frequency of road or waterway cleaning, and quantitative standards of road repair. Tables 2.8-2 and 2.8-3 present the items in these two standards.

Also, during maintenance works, some traffic regulations such as lane regulation are implemented. The standards of such regulations are provided by the "Regulations of Road Signals".

Table 2.8-2 Items in Technical Standards for Road Routine Maintenance

Chapter	Title	Contents of Chapter 2 and 3	
1	General Regulation	2.1	File Document Work
2	Management Work	2.2	Road Safety Corridor Management
3	Routine Maintenance	2.3	Inspect, Monitor Technical Condition of the Facilities
4	Commissioning and Result Evaluation	2.4	Classify, Assess Technical Condition of the Facilities
5	Traffic Safety Guarantee in Road Routine Maintenance	2.5	Traffic Count
6	Work Safety	2.6	On-Duty for Traffic Safety
7	Environment Protection	2.7	Bridge Guard
Appendix	Title	2.8	Bridge and Road Registration
1	Equipment of Patrol	2.9	Statistics for Monitoring, Analysing the Causes of Traffic Accidents
2	Permissible Roughness of Road Pavement	3.1	Road Pavement
3	Classification Standard of Road and Bridge to make Repair Plan	3.2	Road Side
4	Vehicle Classification and Traffic Count Report Sample	3.3	Road Side Waterway / Ditch
5	Road Accident Report Sample	3.4	Road Surface
6	Amount of Required and Emulsified Asphalt for 2 layers	3.5	Retaining Wall
7	Standard Check-up for Routine Maintenance	3.6	Spillway and Subway / Duct
8	Check-up Report Sample for Road Routine Maintenance	3.7	Tunnel
9	Sample Report of Remaining Issues for Routine Maintenance	3.8	Road to Ferry
		3.9	Emergency Road
		3.10	Drainage Pipe / Culvert
		3.11	Bridge
		3.12	Facilities for Road Management Work
		3.13	Road Signals
		3.14	Routine Management of Trees

Source: Technical Standards for Road Routine Maintenance, VRA

Table 2.8-3 Items in Road Maintenance Routine Standards

Chapter	Title
1	Routine Management, Maintenance of Asphalt Concrete Road Surface
2	Routine Management, Maintenance of Cement Concrete Road Surface
3	Routine Management, Maintenance of Asphalt Crush Rock
4	Routine Management, Maintenance of Crush Rock Aggregate
5	Routine Management, Maintenance of Soil Road
6	Routine Management, Maintenance of Class I and Class II Road with 4 Motorized Traffic Lanes
7	Routine Management, Maintenance of Roads and Bridges with Length 25m ≤ L ≤ 300m

Source: Road Maintenance Routine Standards, VRA

In terms of the work system in RRMU, small and medium works are implemented by each unit, while major works are initiated through the cooperation of some units under the same company. Each company has one asphalt plant and utilizes it for major pavement repairs. Moreover, each company has a construction team that works on major disaster repairs. Materials for construction are obtained basically within the territory of each unit.

(4) State Funding Procedures for O&M of National Highway

Article 48 of the new Road Law No.23/2008/QH12 stipulates that road maintenance fund should be obtained from the: (i) state budget; (ii) road use's incomes (iii) and other regulated incomes.

In general, income sources related to road use could be diversified into toll collection, additional collection on vehicle verification, issuance of driving license, over-sized and over-

loaded permission, roadside advertisement, and public sale of registration number by vehicle owners. The international donor community has recommended on establishing a fund to secure a sufficient budget source for road system maintenance. However, fund mobilization from other sources has not been promoted, resulting in heavy reliance on the state budget.

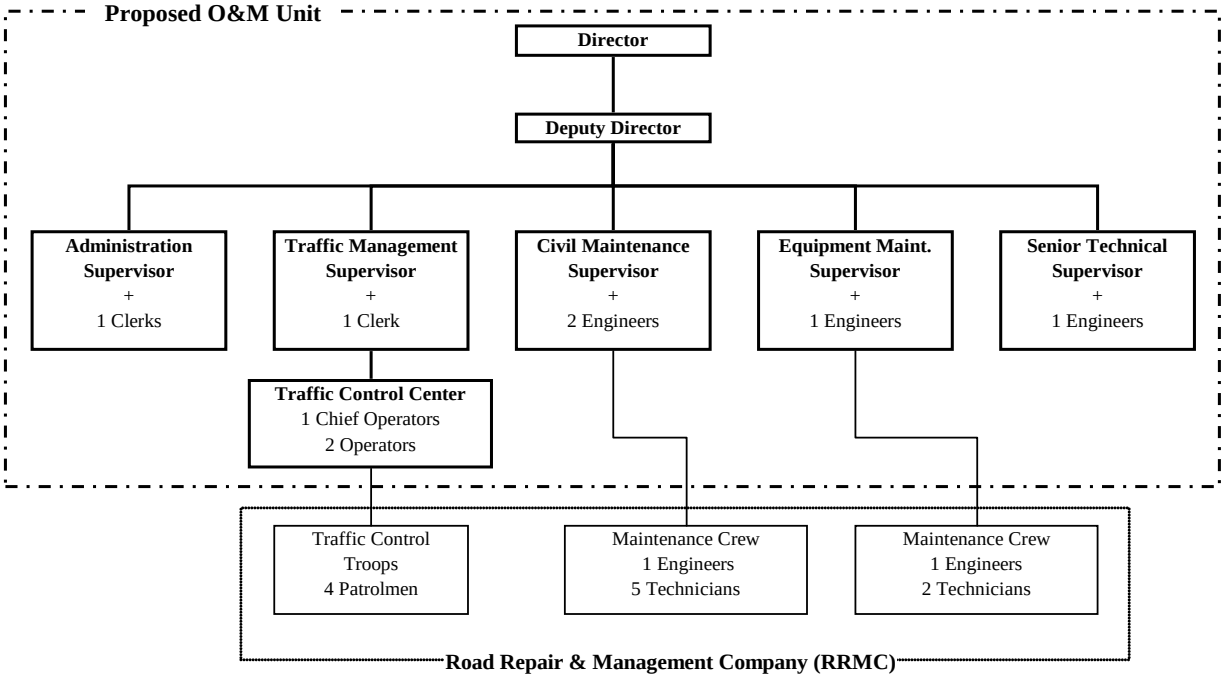
Annually, MOT prepares an expense program and coordinates with MOF for fund allocation for national highway maintenance. Subsequently, MOT hands over the approved expenditure program (agreed between both ministries) to VRA (currently DRVN). VRA allocates the funds to RRMUs and authorizes these to localities of national highway management. RRMU and the local Department of Transport (DOT) then organize bidding and allocate bidding packages of road maintenance to bidding winners. Road maintenance companies would obtain their expenditures from VRA's branches or local treasury branches. A previous study (New National Highway No.3 and Regional Road Network Construction Project) indicated that the average maintenance costs spent by RRMU 2 on the existing National Highway No.3 range from VND 10 – 20 million per km for regular works and VND 200 – 300 million per km for periodic works. However, such amounts are minimal and requirements are at least three times more. Recent reports of MOT and VRA stated that the allocated budget only satisfied 50% of the total required amount for road management and maintenance.

2.8.3. Operation and Maintenance Plan

(1) O&M Plan

As overviewed for the O&M practices of RRMU No.5, for the Tan Vu-Lach Huyen Highway, which will extend to some 16 km, one unit of O&M should be dedicated from the existing unit. Alternatively, a new company should be established under RRMU No. 2, which will be responsible for carrying out O&M of the new highway. As RRMC under the RRMU No. 2 undertakes the maintenance works for National Highway No. 3, the dedicated O&M unit under RRMU No.2 should play the major role in the O&M activities. Such organization/unit should have suitable locations, structures, and number of staff considering conditions for O&M such as road and bridge structure, and traffic characteristics. With the establishment of O&M organization/unit, appropriate facilities and equipments such as office building, vehicles, systems, and materials and equipments for maintenance works are indispensable.

It is proposed to assign an O&M unit from RRMU No.2 as indicated in the following organization structure.



Source: Study Team

Figure 2.8-4 Proposed Structure of O&M Unit

The proposed O&M unit will be duly responsible for the following O&M activities.

Traffic management: Traffic surveillance and control inclusive of patrols, emergency site management and breakdown assistance services, vehicle regulation, and disaster management.

Routine maintenance: Inspection, cleaning, traffic accident recovery works, and traffic regulation.

Repair works: Pavement renovation, and repair of bridges and structures.

Rehabilitation: Pavement rehabilitation, reinforcement / improvement of bridges and structures, restoration of embankment settlement, slope protection, and rehabilitation of traffic safety and control facilities.

According to the required activities, DRVN shall need to divert or recruit not only five supervisors, four engineers and two clerks, but also 13 staff comprising of four patrolmen, two engineers and seven technicians from RRMC to be mobilized for O&M works.

(2) Cost Estimate for O&M Activities

The previous study on New National Highway No.3 and Regional Road Network Construction Project indicates that the unit costs for the routine maintenance, repair works and rehabilitation of the highway in Vietnam can be assumed at 40% of those in Japan. Thus, the annual cost requirement for O&M activities are estimated as annual recurrent expenditures for VRA as presented below.

Table 2.8-4 Annual Operating Cost for O&M Unit

Subgroup	Cost Item	Position	Unit Cost (Mil.VND/annum)	Qty.	Total (Mil.VND/annum)
O&M Unit	Personnel	Director	180	1	180
		Deputy Director	160	1	160
		Supervisor	125	5	625
		Clerk	70	2	140
		Engineer	100	4	400
	Supply, Utility, Housing, Machinery, etc.		12	LS	12
Traffic Control Center	Personnel	Chief Operator	80	1	80
		Operator	45	2	90
		Patrolman	47	4	188
	Supply, Utility, Housing, Machinery, etc.		6	LS	6
	Miscelaneous (communication, fuels, sundries etc.) (10% of Personnel Cost)				186
Maintenance Crew	Personnel	Engineer	95	2	190
		Technician	51	7	357
				Total	2,614

Source: JICA Study 2010 (unit cost is adapted from New National Highway No.3 and Regional Road Network Construction Project)

Table 2.8-5 Annual Cost for Routine / Repair Works

Item	Unit Cost (Mil.VND/km/annum	Length (km)	Total (Mil.VND/annum)
Cleaning	233	10.44	2,433
Earthwork Maintenance	536	10.44	5,596
Bridge Maintenance	453	5.44	2,464
Lighting	190	15.88	3,017
		Subtotal	13,510
	Indirect Cost (10% of the above)		1,351
		Total	14,861

Source: JICA Study 2010 (unit cost is adapted and adjusted from New National Highway No.3 and Regional Road Network Construction Project, which initially applied JH empirical data.)

The total recurrent costs associated with O&M works are thus estimated at some VND 17,500 million per annum, which is approximately half of the estimate in the F/S (VND 35,000 million per annum at 2010 price). In addition to the above, indicative costs for major maintenance work that will be required for every 5-10 years are estimated as follows.

Table 2.8-6 Cost Estimate for Major Rehabilitation

Item	Qty.	Total (Mil.VND)
Replacement of expansion joints	LS	9,702
Replacement of asphalt pavement	LS	18,934
Replacement of waterproofing work	LS	36,111
	Total	64,747

Source: JICA Study 2010

As part of major rehabilitation works according to the design specifications of the road and bridge sections, the expansion joints on the bridge part should be replaced every 5-10 years after its opening. Similarly, asphalt pavement and associated structures for waterproofing should be replaced every 5-10 years periodically. The estimated costs are VND 64,747 million in total, which is slightly more than half of those in the F/S (VND 115,500 million at 2010 price including large area road resurfacing and major road maintenance).

(3) Further Study and Recommendation

Framework of O&M works for Tan Vu-Lach Huyen Highway has been proposed under the study. Necessary recurrent expenditures and budget requirement for major rehabilitation works are preliminarily estimated as well. However, initial investment cost for facilities, procurement of equipment and materials are not considered in this Study.

Given the situation that O&M budget for national roads usually satisfies only 50% of those requiring O&M, obtaining sufficient budget for such activities would be a challenging role for DRVN/RRMU. In addition, since the highway will open as a toll-free road, O&M budget cannot be supported by toll revenues but through advertising and other tax revenues. Therefore, O&M works should be conducted in a cost-efficient and streamlined manner.

Since the project facilities are totally additional road and bridge under the jurisdiction of RRMU No. 2, its existing resources that should be allocated for O&M activities could be an additional budgetary burden. As a responsible organization, RRMU No. 2 could either divert its existing resources such as human resources, equipment and materials into O&M activities of Tan Vu-Lach Huyen Highway, or establish an independent management unit as proposed in this section, partly utilizing the existing resources. Based on this perception, the following arrangements are recommended:

1) RRMU should scrutinize its own resources to assess what are necessary and what are not in consultation with DRVN and MOT.

2) Based on the above assessment, it will be necessary to assess the required procurement items and its associated costs including building, office facilities, vehicles, equipment for routine/repair works, spare parts and traffic control and safety during the detailed design stage.

3) In the detailed design stage, annual recurrent costs for O&M activities and organizational framework should be updated and finalized based on the final specifications for the road and bridge structures.

2.9. Implementation Structure and Program

Implementation structure and program was updated during the discussion between JICA and MOT. Updated implementation structure and program is presented in Appendix-10.

The following are study results before the discussion between JICA and MOT took place.

2.9.1. Review of F/S

(1) Implementation Structure

In the F/S report, the implementation structure is described based on the scheme of BOT. VIDIFI is then introduced as the executing agency.

According to the instruction of Prime Minister in the letter No.8677/VPCP-KTN dated 22 December 2009, the project owner has been transferred from VIDIFI to MOT. In addition, MOT has assigned Project Management Unit No. 2 (PMU 2) under the notice no. 73/TB-BGTVT dated 03 March, 2010.

The updated implementation structure is introduced in the following sections.

(2) Implementation Program

In the F/S report, the following time schedule is assumed as a BOT project,

- Detailed Design and Preparation of Tender Documents : 12 months
- Procurement Process of Contractors : 6 months
- Construction : 36 months

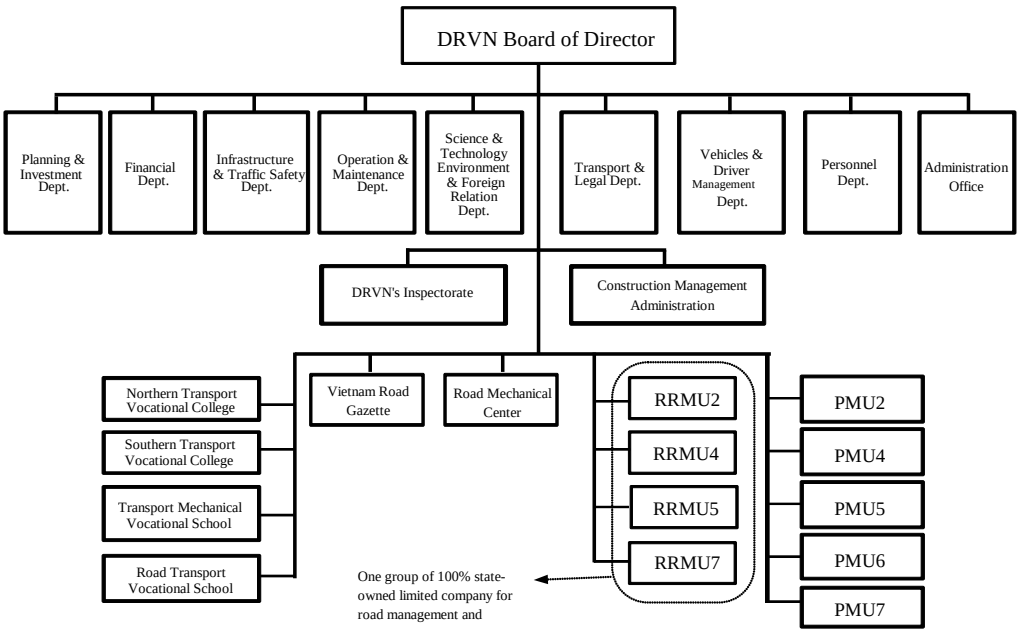
The schedule for Detailed Design and Preparation of Tender Documents will be conducted using Japanese Grant. The schedule for procurement process of contractors will also be conducted using Japanese Grant.

The construction period is also subjected for updates based on Section 2.6.2

2.9.2. Project Owner and Implementating Agency for Road and Bridge Portion

(1) Project Owner

It was confirmed that the Project Owner is Directorate of Roads for Viet Nam (DRVN).



Source: Prepared based on Prime Minister Decision No: 107/2009/QĐ-TTg,
and Minutes of Discussions on Lach Huyen Port Infrastructure Construction Project between JICA and GOV on June 18, 2010.

Figure 2.9-1 Organization Chart of DRVN

(2) Implementating Agency

PMU 2, under DRVN, is responsible for all project works as shown below. Its organization chart is shown in Figure 2.9-2.

- Pre-construction works comprising engineering design, land acquisition, relocation/resettlement and tendering
- Construction supervision
- O&M civil works and equipment
- Traffic safety facilities
- Capacity building by Project Management System

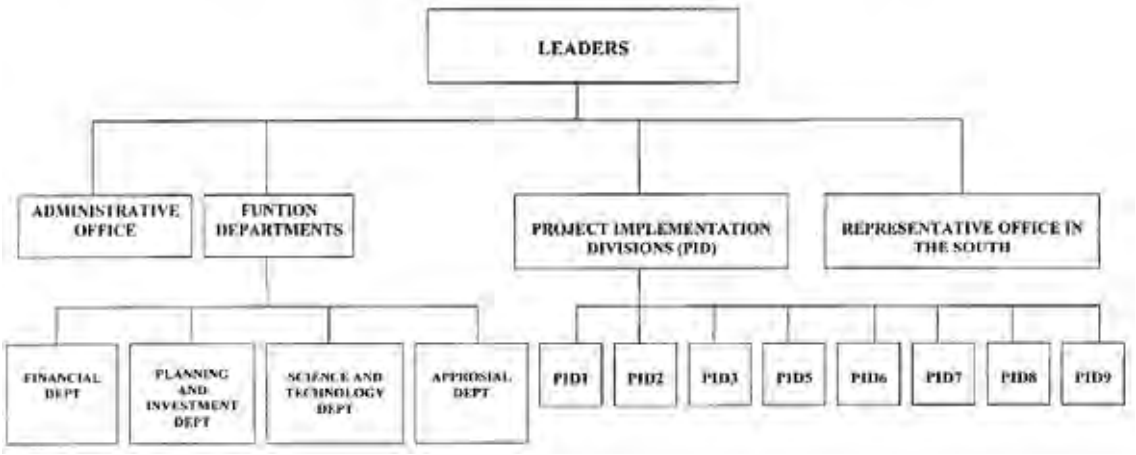


Figure 2.9-2 Organizational Chart of PMU2

Among the Project Implementation Divisions in PMU 2, PID5 is responsible for the project on the road and bridge portion of Lach Huyen Port Construction. It shall be in charge of the

following items as Executing Agency:

- Preparation of Investment,
- Detailed Design,
- Bidding, and
- Construction Supervision.

The relationships among PID5 and the related divisions in PMU2, and among responsible personnel of PID5 concerning above items related to implementation of the access bridge and road, are shown in Figures 2.9-3 and 2.9-4.

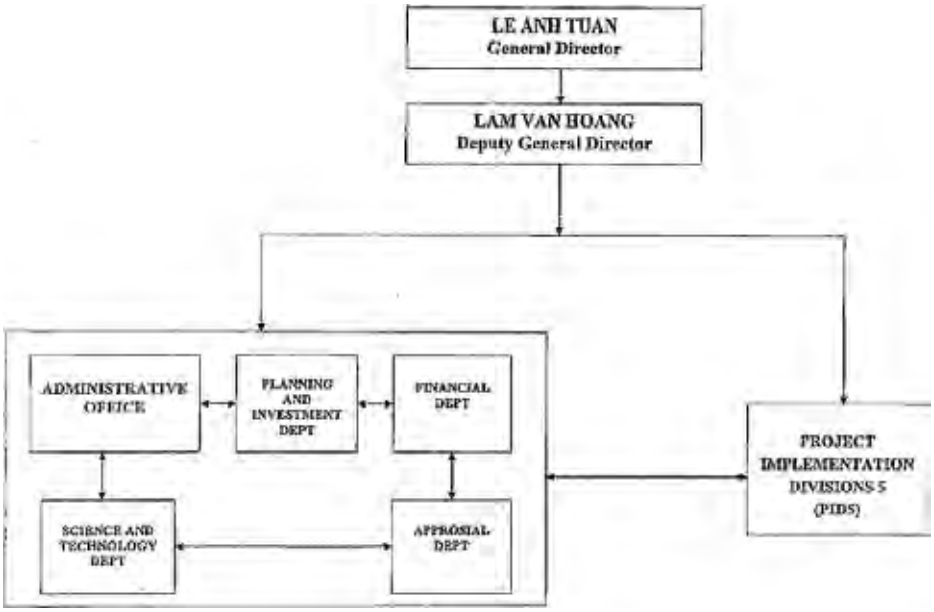


Figure 2.9-3 Relationships among PID5 and Related Divisions in PMU2

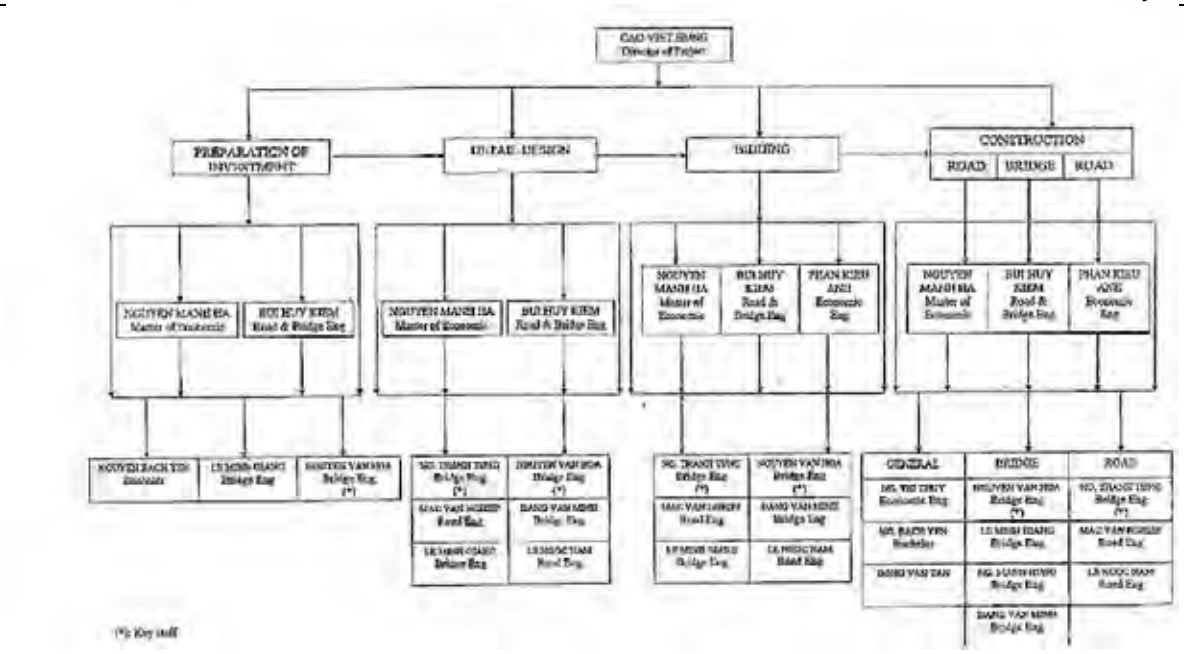


Figure 2.9-4 Organizational Chart of PID5

2.9.3. Implementation Structure

(1) Related Organizations

According to MOT's letter, No 2678/BGTVT-KHDT dated 27 April 2010, the organizations related to project implementation including the port portion are as follows,

1) Funding Agency: JICA

2) Borrower: Ministry of Finance (for both portions)

3) Line Agency: MOT (for both portions)

4) Project Owner
   a) Road and Bridge Portion: DRVN
   b) Port Portion:
      i) Public Sector: Vietnam Maritime Administration, VINAMARINE
      ii) Private Sector: VINALINES

5) Implementing Agency
   a) Road and Bridge Portion: PMU 2
   b) Port Portion: Maritime Project Management Unit No.2 (MPMU2)

5) Land Acquisition, Resettlement Action Plan and Land Clearance:
   Hai Phong People's Committee (for both portions)

As for the private sector in the port portion, the Special Purpose Company (SPC) will be established as a 100% daughter of the JV of VINALINES and private investors.

(2) Joint Coordination Committee (JCC)

A JCC has been organized in order to secure the smooth implementation and consistency between the two portions. The Vice Minister of MOT would chair the JCC while representatives of relevant stakeholders, such as VINAMARINE, DRVN, MPMU 2, PMU 2, VINALINES, MPI and MOF would serve as members of the JCC. They would hold JCC meetings periodically. JICA will also take part in the JCC meetings.

The implementation structure is shown in Figure 2.9-5.

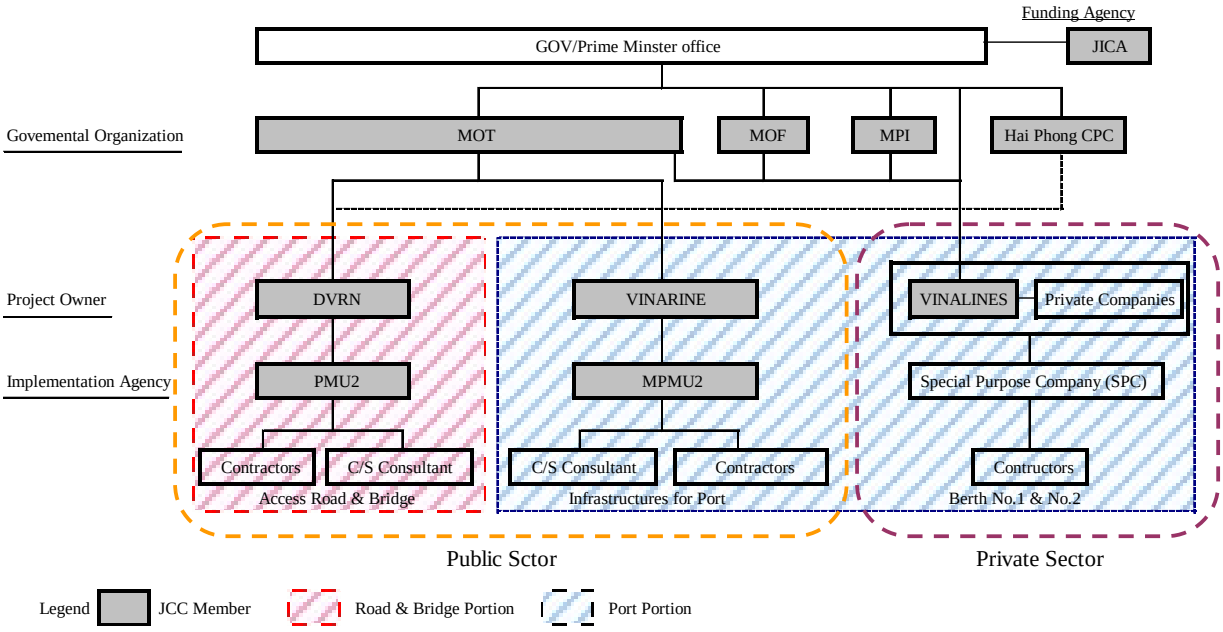


Figure 2.9-5 Organization Structure for Project Implantation

2.9.4. Implementation Program

(1) Procurement of Construction Works

The procurement of contractors should be in accordance with the guidelines for procurement under Japanese ODA Loans. Because the implementation of this project will be funded by the Japanese Government with an ODA Loan, STEP scheme based on the M/D on Lach Huyen Port Infrastructure Construction Project between JICA and GOVN dated March 19, 2010, prime contractors must be Japanese firms. JVs with the firms incorporated and registered in recipient countries are also allowed to be a prime contractor under the condition that a Japanese firm will be the lead partner. Subcontractors, on the other hand, may be from any country.

(2) Procurement of Consulting Service

Consulting services for the detailed design and tender assistance would be provided by JICA on the condition that STEP is applied for the project

1) Detailed Design and Tender Assistance

Based on M/D, technical assistance for the detailed design and tender assistance would be provided by JICA on the condition that STEP is applied. Procurement of a consultant for the

detailed design and tender assistance would be conducted under a Japanese grant soon after the timing of the pledge by Japanese Government to GOVN. This shall be in accordance with the Procurement Guidelines of the Japanese Grant Aid for General Projects, for Fisheries and for Cultural Cooperation (Type I-G).

2) Construction Supervision

Procurement of a consultant for construction supervision will be conducted in accordance with the Guidelines for the Employment of Consultants under Japanese ODA loans. In case that STEP is applied as mentioned in the M/D, the prime consultant must be a Japanese firm, or a Japanese-led JV with firms incorporated and registered in Vietnam.

(3) Implementation Program (I/P)

The implementation program in this Study is established based on following assumptions:

- STEP scheme of Japanese ODA Loan is applied,
- Consulting services for the detailed design and tender assistance are supported by Japanese grant,
- Loan agreement is signed in September 2010, and,
- Construction period is 30 months*.**(The period is updated after discussion between JICA and MOT as presented in Appendix-10)**

The implementation program is as follows and shown in Table 2.9-1, assuming that common practice is applied.

Table 2.9-1 Implementation Milestones

Event/ Milestone	Time/ Period
Preparatory Study	: April 2010 to July 2010
JICA Follow-up Mission	: June 2010
Pledge by Japanese Government	: July 2010
Exchange Note & Loan Agreement	: September 2010
Procurement of D/D consultant	: July 2010 to August 2010
Detail Design	: September 2010 to May 2010
Procurement of T/A Consultant	: December 2010 to January 2011
Bidding Time	: February 2011 to April 2012
Procurement of C/S consultant	: October 2010 to June 2011
Land Acquisition	: January 2011 to December 2012
Resettlement	: January 2011 to December 2012
Construction	: June 2012 to December 2014
Defect Liability Period	: January 2015 to December 2016

This table is updated after discussion between JICA and MOT as presented in Appendix-10.

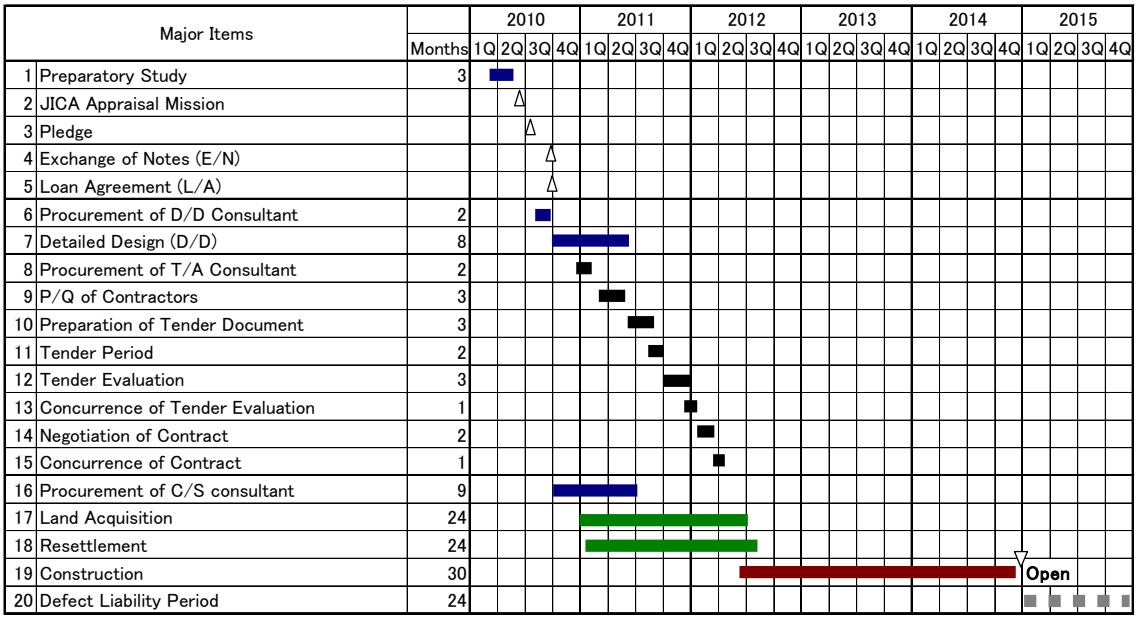


Figure 2.9-6 Proposed Implementation Program

This figure is updated after discussion between JICA and MOT as presented in Appendix-10.

(4) Risks on Delay of Implementation Schedule

Risks which may lead to delay in project implementation are itemized as follows:

- Delay in design works
- Delay in land acquisition
- Delay in procurement
- Delay in construction works.
- Delay in environmental mitigation actions.
- Delay in development of the Hanoi-Hai Phong Expressway.
- Delay in establishment of O&M organization.
- Delay in contractual arrangement between MOT and the private sector

The proposed measures for these risks on delay are summarized in the table below.

Table 2.9-2 Anticipated Measures for Risks on Delay

No.	Risk on Delay	Anticipated Measures
1	Design Works	• Select competent consultant, • Coordinate well with relevant stakeholders.
2	Land Acquisition	• Monitor the progress of the land acquisition progress and review the progress periodically.
3	Procurements	• Procure timely the supervision consultant. • Procure timely the contractors.
4	Construction Works	• Select competent contractor(s) • Monitor and control the construction progress strictly
5	Environmental Mitigation Actions	• Prepare good environmental management program (EMP) during the detailed design phase. • Monitor and control the contractor's EMP execution strictly
6	Development of Hanoi-Hai Phong Expressway	• Monitor the construction progress. • Prepare a contingency plan for delay of Hanoi-Hai Phong Expressway.
7	Establishment of O&M Organization	• Coordinate with GRA/RRMU2 for selection of O&M organization. • Prepare effective O&M plan.
8	Contractual Arrangement between MOT and Private Sector	• Establish Lach Huyen Port PPP conference for smooth coordination.

2.10. Procurement Plan

2.10.1. Review of F/S

The construction packages recommended in the F/S are as follows:

Package 1: Tan Vu IC and Dinh Vu area

Package 2: Approach and Main Bridges

Package 3: Section in Cat Hai Island

Advantages and disadvantages of implementing said packages, as discussed in the F/S, are summarized as follows:

Advantages:

a) The type of construction works for each package can be simply defined. Contractors who specialize in the type of construction works could be qualified.

Disadvantages:

a) Package No.1: There is a risk that no contractors would participate in the bidding due to a relatively low contract amount. They may also avoid facing troubles on earth works for making embankment on soft soil ground near the sea. In addition, interference with the construction works of Package No. 2 is expected in case that a common jetty is used for both packages.

b) Package No.2: The length of the bridge, 5.44 km, is longer than any Japanese contractors have accomplished. The specifications for pre-qualification should be decided after discussion with MOT and JICA. In addition, interference with the construction works of Package No. 1 is expected in case that a common jetty is used for both packages.

c) Package No.3: There is a risk that no contractors would participate in the bidding due to a relatively low contract amount. It is also possible that contractors will avoid risks of delays due to possible delay in land acquisition.

d) It is difficult to control the overall construction schedule as the completion of each package varies.

2.10.2. Alternative Study on Procurement of Construction Works

In order to avoid such risk where no contractors would intend to participate in the bidding, alternatives shown in the figure below are studied and discussed in the following sections.

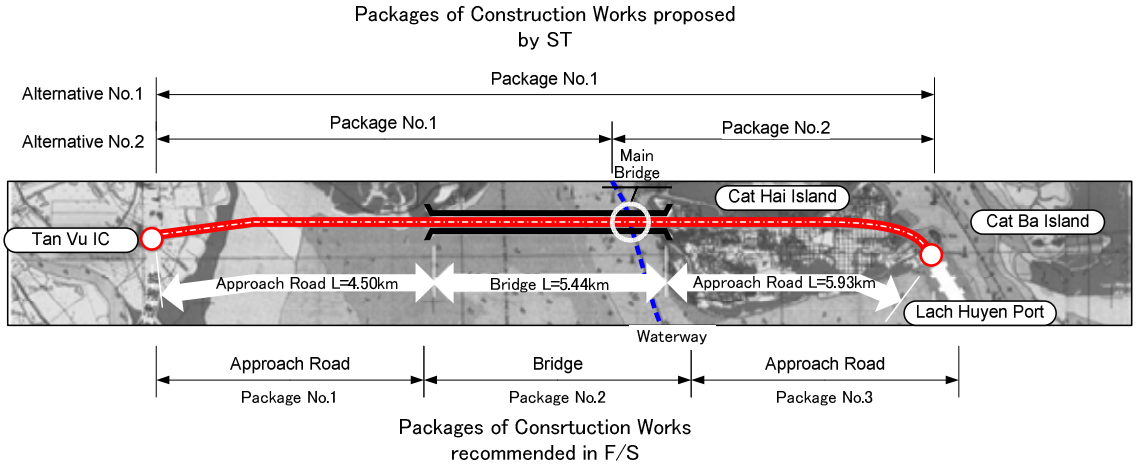


Figure 2.10-1 Alternatives in Procurement Plan

Table 2.10-1 Alternatives in Procurement Plan and Construction Cost

		Alternative No.1	Alternative No.2	
		Package No.1	Package No.1	Package No.2
Location		All Section	Tan Vu IC, Din Vu area and West Approach Bridges	Main Bridge, East Approach Bridges and Cat Hai Island
Construction Cost*	mil. VND	5,789,844	4,032,807	1,757,037
	mil. Yen**	30,570	21,293	9,277

		Packages recommended in F/S		
		Package No.1	Package No.2	Package No.3
Location		Tan Vu IC and Din Vu area	Main Bridge and Approach Bridges	Cat Hai Island
Construction Cost*	mil. VND	870,395	4,344,322	575,126
	mil. Yen**	4,596	22,938	3,037

* Based on Alternative 3A in the F/S report and to be updated

**converted by using an exchange rate:1VND=0.00528Yen

(1) Alternative No.1: One Package

Another proposed alternative is to incorporate all construction works into one package.

Advantages:

a) Construction schedule can be managed comprehensively, which is good in terms of overall project implementation.

b) The problems concerning interference can be solved as part of the scope of one contractor.

Disadvantages:

a) The contract amount is bigger and the length of the bridge is longer than any Japanese contractors have accomplished. The specifications for pre-qualification should be decided after discussion with MOT and JICA.

(2) Alternative No.2: Two Packages

Another proposed alternative of construction contract packaging are as follows:

Package 1: Tan Vu IC, Dinh Vu area and West Approach Bridge

Package 2: Main Bridge, East Approach Bridges and Approach Road in Cat Hai Island

Advantages:

a) Both packages have reasonable contract amount in terms of road and bridge works

b) The boundary of the packages is the west end of the Main Bridge, and hence, no interference of construction works is anticipated.

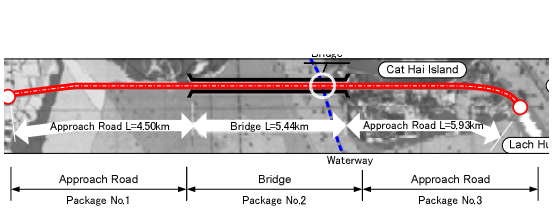
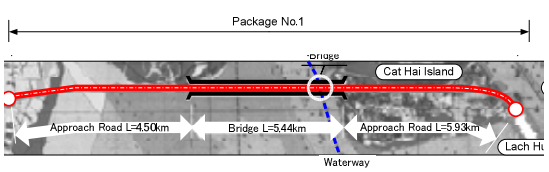
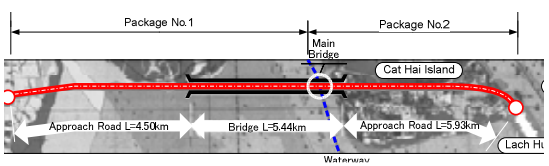
Disadvantages:

a) It is difficult to control the overall construction schedule as the completion of each package varies.

(3) Recommendation

As shown in the comparison table on the next page, Alternative No. 1 with one package or Alternative No. 2 with two packages is recommended rather than the three packages in the F/S.

Table 2.10-2 Comparison among Procurement Plan Alternatives

Evaluation Item	F/S		Alternative No.1		Alternative No.2	
Schematic Plan View						
No of Packages	Three (3)		One (1)		Two (2)	
Manageability	It is difficult to control the overall construction schedule as the completion of each package be varies.	△	Construction schedule can be managed comprehensively, which is good for overall project implementation.	○	It is difficult to control the overall construction schedule as the completion of each package varies.	△
Interference between packages	Interference of construction works for package no.1 and 2 is expected in case a common jetty is used	△	The problems concerning interference can be solved as part of the scope of one contractor.	○	The boundary of the packages is the west end of Main Bridge, and hence, there is no interference of construction works.	○
Qualification of Contractors	The contractor specializing in the type of construction works could be qualified. Regarding Package No.2, the length of the bridge, 5.44 km, is longer than any Japanese contractors have accomplished. The specifications for pre-qualification should be decided after discussion with MOT and JICA.	△	The contract amount is bigger and the length of the bridge is longer than most Japanese contractors have accomplished. The specification for pre-qualification should be decided after discussion with MOT and JICA.	△	Regarding Package No.1, the length of the bridge, 4.5 km, is still longer than the one that any Japanese contractors have accomplished.	△
Attractiveness of packages	Package no.1 and 3 are not attractive for contractors to bid because of relatively small contract amount. They will also avoid high risks due to soft ground or resettlement issues.	△	Attractive only for big general contractors because of large contract amount.	○	Both packages have reasonable contract amount in terms of road and bridge works	○
Evaluation	Not Recommended	△	Most Recommended	◎	Recommended	○

Source: Study Team

3. PROJECT EFFECTS

3.1. General

The project effects are assessed in terms of economic and financial feasibilities as usual practice in the transport sector. Financial analysis is principally based on the collection of toll fees from road and bridge users. In this particular project, assessment is focused only on economic feasibility since MOT and JICA agreed that the project road is "toll free" in May 2010. Therefore, economic analysis will be conducted in the following sub-section to assess the project feasibility in terms of Vietnam's economy as a whole.

3.2. Economic Analysis

3.2.1. Review of the F/S

Some key features of the F/S were reviewed for the economic evaluation and then compared with those in this Study as presented in Table 3.2-1.

Table 3.2-1 Comparison of the F/S and this Study in Economic Evaluation

Item	F/S Study	This Study
Traffic demand forecast	Based on 2008 result Forecast period: 2015-2032	Updated to 2010 Forecast period: 2015-2035
Project life for analysis	2008-2048	2010-2035
Project benefits	- VOC saving - TTC saving - Road accident cost saving	- VOC saving - TTC saving - Container transport cost saving
VOC unit value	Unknown previous study in 2005	Adjusted unit rates from SAPROF study for Southern Vietnam Expressway Construction Project (2007)
TTC unit value	The single rates for all types of vehicles are applied and projected for: 2014: at VND28,980/hr 2022: at VND54,000/hr 2032: at VND78,960/hr	-ditto-
Container transport	Not accounted as the project benefit	Accounted as the project benefit

Source: Based on reviews of the F/S.

In the F/S, EIRRs were presented. However, toll, VAT, and advertisement revenues were included in the benefit stream for calculation of EIRR. It is not a common practice to mix financial revenues and savings from VOC and TTC in the economic analysis. Therefore, the computed EIRR ranging from 6.6-15.4% has no validity in economic sense.

3.2.2. Estimation of Benefits

(1) Basic Concept

For "With Project Case", it is assumed that the Tan Vu-Lach Huyen Highway will open in 2015 and connect directly Lach Huyen Port and Tan Vu Interchange on the Hanoi-Hai Phong Expressway. In this case, all traffic will go through the road and bridge constructed by the project, catering container transportation in and out of the Lach Huyen port. Based on the

traffic demand forecasts in this study, total annual VOC and TTC were estimated for the period of 2015-2035. However, for "Without Project Case", it is necessary to consider alternative routes for passenger traffic and containers to be handled at the Lach Huyen port, since there is no access road and bridge between the Cat Hai Island and Dinh Vu area.

The required number of trips for ferry transportation, carrying all traffic volume including containers, are roughly estimated at more than 500 trips/day in 2020, and more than 1,700 trips/day in 2030 between Dinh Vu and Ninh Tiep ferry ports. This scenario is physically infeasible. Therefore, the existing ferry route for passenger traffic and barge transportation for containers between the Lach Huyen and the Hai Phong ports could be a basis for "Without Project Case".

(2) Items for Quantification of Benefits

Vehicle Operation Cost (VOC) Saving Benefit and Travel Time Cost (TTC) Saving Benefit are two quantifiable benefits brought about by the road and bridge project in general. The project net benefit is the value of differences of VOC and TTC between "With" and "Without" Project Cases.

These benefits are estimated as the balance of both VOC and TTC in "With" and "Without" Project Cases. "Without Project Case" means the traffic flow of the present road network or the presently available means of transportation, whilst "With Project Case" means the traffic flow of the new network to be realized by the completion of the Project. VOC and TTC savings are defined as follows:

$$\text{VOC Savings} = (\Sigma\ \Sigma\ \text{woQs} \times D \times \text{woVOCs}) - (\Sigma\ \Sigma\ \text{wQs} \times D \times \text{wVOCs})$$

$$\text{TTC Savings} = (\Sigma\ \Sigma\ \text{woQs} \times D/s.wo \times TTC) - (\Sigma\ \Sigma\ \text{wQs} \times D/s.w \times TTC)$$

Where,

woQs	: Traffic volume at speed(s) in "Without Project Case"
D	: Distance of road sections
woVOCs	: VOC value at speed(s) in "Without Project Case"
wQs	: Traffic volume at speed(s) in "With Project Case"
wVOCs	: VOC value at speed(s) in "With Project Case"
D/s.wo	: Travel time at speed(s) in "Without Project Case"
D/s.w	: Travel time at speed(s) in "With Project Case"
TTC	: Travel time cost

In addition to the above items, a more important item for the project benefit would be the cost saving of container transportation in and out of the proposed Lach Huyen port. Since the project nature is very much emphasized in industrial road and bridge development, numerous benefits are expected from transportation of containers with the Tan Vu-Lach Huyen highway as compared with those of "Without Project Case" which would require alternative means of transportation such as maritime transportation including barge and ferry. The project benefit

from container transportation can be defined as the difference of economic costs of container transportation between "With Project Case" and "Without Project Case".

(3) Vehicle Operating Costs

The basic data of VOC were obtained from the SAPROF Study for Southern Vietnam Expressway Construction Project (2007). The data were converted from 2007 into 2010 price level by applying consumer price index (means of transport and communication sector; 128.8 when based on 2007 = 100). The adjusted unit VOC data and obtained parameters, formula are shown in Table 3.2-2.

Table 3.2-2 Calculation of Unit VOC in 2010 Prices

Consumer Price Index

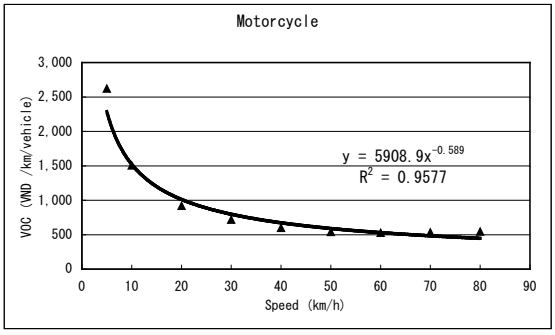
No.	Item	CPI 2010
(1)	CPI (all goods) (2007=100)	142.7
(2)	Housing and construction materials (2007=100)	144.7
(3)	Means of transport and communication (2007=100)	128.8
(4)	Means of transport and communication (2002=100)	157.6

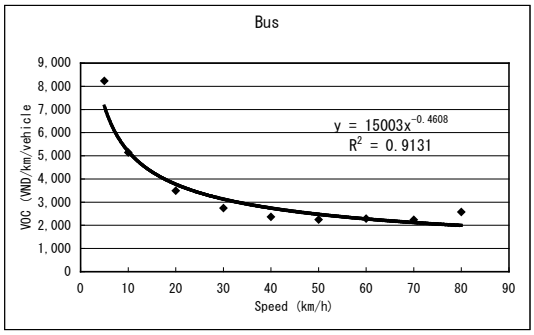
Source: Calculated from Statistical Handbook, Various Issues, GSO Vietnam.

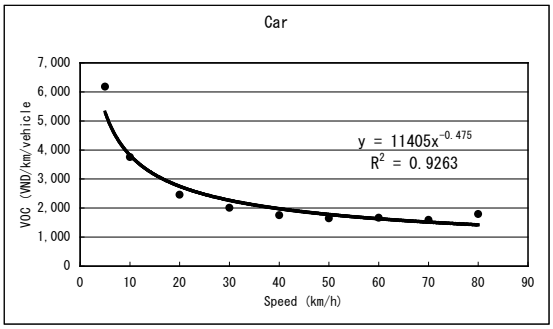
Calculation of Unit Vehicle Operation Cost (VOC)

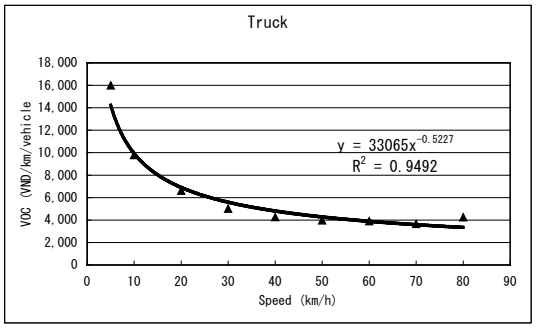
Speed (km/hour)	US$/vehicle/1000km in 2007 Constant Price				US$/vehicle/1000km in 2010 Constant Price				VND/Vehicle/km in 2010 Constant Price			
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)
	*Motorcycle (2002)	**Car	**Bus	**Truck	Motorcycle	Car	Bus	Truck	Motorcycle	Car	Bus	Truck
5	97.8	282.2	376.0	730.0	154.1	363.4	484.2	940.1	2,620	6,179	8,232	15,983
10	56.2	171.4	235.1	446.9	88.6	220.7	302.7	575.5	1,506	3,753	5,147	9,785
20	34.3	112.2	159.5	301.6	54.0	144.5	205.4	388.4	919	2,457	3,492	6,603
30	26.8	91.8	125.3	228.6	42.2	118.2	161.4	294.4	718	2,010	2,743	5,005
40	22.3	80.0	107.9	194.4	35.1	103.0	138.9	250.3	597	1,752	2,362	4,256
50	20.1	75.2	102.8	181.0	31.7	96.8	132.4	233.1	538	1,646	2,251	3,963
60	19.7	76.0	104.5	177.9	31.0	97.9	134.6	229.1	528	1,664	2,288	3,895
70	19.9	72.6	102.4	166.6	31.4	93.5	131.9	214.5	533	1,590	2,242	3,648
80	20.3	81.9	117.5	193.3	32.0	105.5	151.3	248.9	544	1,793	2,573	4,232

*The Study on Urban Transport Master Plan and Feasibility Study in Ho Chi Minh Metropolitan Area (HOUTRANS), June 2004, JICA
**SAPROF Study for Southern Vietnam Expressway Construciton Project, Final Report, 2007, JBIC
US$1.00 = 17,002 VND
Ex.) Motorcycle Unit VOC (e) = (a) x (4), Car Unit VOC (f) = (b) x (3)









Obtained Parameters and Formula for VOC Calculation

VOC	Coefficient	exp	Formula
Motorcycle	5,909	-0.589	VOC = 5909 x Speed (km/hr)$^{-0.589}$
Car	11,405	-0.475	VOC = 11405 x Speed (km/hr)$^{-0.475}$
Bus	15,003	-0.4608	VOC = 15003 x Speed (km/hr)$^{-0.4608}$
Truck	33,065	-0.5227	VOC = 33065 x Speed (km/hr)$^{-0.5227}$

Source: Study Team

(4) Travel Time Cost

The savings in TTC is another important component of road and bridge user benefit. Travel time values are considered as opportunity cost of labor. Hence, income growth rate or GDP growth rate can be applied to reflect the changes in travel time value since 2007 which was used in the study of the Southern Vietnam Expressway Construction Project. Thus, the unit rates of time value per person have been adjusted by the GDP growth rates for the period of 2007-2010 as shown in Table 3.2-3 below.

Table 3.2-3 Travel Time Cost (2010 prices)

Type of Vehicle	Travel Time Values (2007)*		Travel Time Values (2010)			
	US$ / hour / person	VND / hour / person	US$ / hour / person	VND / hour / person	Average Occupancy	Time Value/hour/vehicle (VND)
Bicycle	0.66	11,221	0.86	14,600	1	14,600
Motorcycle	0.66	11,221	0.86	14,600	1	14,600
Car	0.78	13,262	1.02	17,300	4	69,200
Trucks of 2 axles	0.66	11,221	0.86	14,600	2	29,200
Trucks of more than 3 axles	0.66	11,221	0.86	14,600	2	29,200
Mini bus with less than 25 seats	0.66	11,221	0.86	14,600	10	146,000
Large bus	0.66	11,221	0.86	14,600	27	394,200
Trailer and bus with trailer	0.66	11,221	0.86	14,600	2	29,200

*Source: SAPROF Study for Southern Vietnam Expressway Construciton Project, Final Report, 2007, JBIC

Ex.) : Motorcycle TTC 2010 in VND : 14,600 = 17,002 x 0.86

(5) Ferry Transportation for Passenger Traffic under "Without" Project Case

Traffic demand forecast indicates that the current shipping capacity of Dinh Vu-Ninh Tietp Ferry is required to increase by approximately 5.7 times in 2035 in order to carry the increased passenger traffic excluding container transportation demand. This implies that the current ferry service of one roundtrip every hour should be increased to at least five roundtrips every hour with extended operation hours.

(6) Container Transportation under "Without" Project Case

Based on the cargo volume forecast at the Lach Huyen port, more than 1,200 TEU of containers in 2015, and 19,000 TEU in 2030 have to be transported everyday in and out of the port. In order to meet such demand, barge transportation comprising of 15 trips in 2015 and 220 trips in 2030 would be required between the Lach Huyen and Hai Phong ports.

According to the Preparatory Survey on Lach Huyen Port Infrastructure Construction (Draft Final Report, JICA May 2010), without the access bridge, 36 units of barges (90 TEU) and 20 units of Ro Ro ships would be required to work 24-hours / 7-days-a-week for shuttle transportations of containers in 2020. This study estimates 91 units of barges and 55 units of Ro Ro ships would be necessary to meet the demand for container transportations in 2035. Furthermore, these containers have to be transshipped from freight vessels to barge and vice versa at both the Lach Huyen and Hai Phong ports. It is also a concern that the additional containers from the Lach Huyen port would soon exhaust the port capacity of Hai Phong port. However, a study on expansion of the Hai Phong port capacity is far beyond the scope of this study. Therefore the existing and future capacity of Hai Phong and adjacent ports are not taken into consideration in this "Without Project Case".

In this case, more than 140 vessels and 12 large ferries operated may bring about horrible congestion in the Nam Trieu channel. The transportation capacity of barge and ferry could adversely affect the cargo handling performance of the Lach Huyen port.

(7) Estimated Project Benefit

Assumed transportation routes and conditions as well as comparison with "With Project Case" are presented in Figure 3.2-1. The general conditions for benefit calculation are shown in Table 3.2-4.

Table 3.2-4 General Conditions for Benefit Calculation

General Conditions for Passengers Traffic - **Without Project Case**

Without Project	Tan Vu IC-Dinh Vu	Dinh Vu-Ninh Tiep (Ferry)	Ninh Tiep-Ben Got	Total
Distance (km)	15	--	7.7	22.7
Travel Time (min)	45	90	20	155.0
Ave. Speed (km/hr)	20.0	--	23.1	

General Conditions for All Traffic - **With Project Case**

With Project	Tan Vu IC-Dinh Vu	Dinh Vu - Ben Got	Total
Distance (km)	4.50	11.37	15.9
Travel Time at 50km/hr speed (min)	5.4	13.6	19.0
Travel Time at 80km/hr speed (min)	3.4	8.5	11.9

Source: Study Team

Based on the above conditions, travel times by type of vehicle for "With" and "Without" project cases were estimated in Table 3.2-5. Daily values for VOC and TTC per vehicle were also computed in Table 3.2-6 in which detailed calculations for each unit by road sections are noted under each table for explanation. For the "With Project Case", according to the road width of 3.0 m per lane, design speed of 50 km per hour is applied for VOC and TTC calculation.

Table 3.2-5 Travel Time by Type of Vehicles – With and Without Project Cases

Travel Time by Type of Vehicles and of Container Transportation - **With and Without Project Cases**

Route	**Without Project**	Tan Vu IC - Dinh Vu (15km)	Dinh Vu-Ninh Tiep (Ferry)	Ninh Tiep - Ben Got (7.7km)	Total
Route 2	Bicycle (min.)	90	90	40	220
	Motorcycle, Car, Bus (min.)	45	90	20	155

Route	**Without Project**	Port handling (transshipping)	Transport (Lach Huyen - Hai Phong)	Transport (Hai Phong - Tan Vu IC: 8km)	Total
Route 1	Container transport (Maritime)	24 hrs / 90TEU barge	120		1,560
	Container transport (Ground Transport by Trailers) at average 40km/hr speed			12	12

Route	**With Project**	Tan Vu IC - Dinh Vu (4.5km)	Dinh Vu - Ben Got (11.4km)	Tan Vu - Ben Got (15.9km)	Remarks
Route 3	Bicycle (min.)	27	68	95	Average 10km/hr speed
	Motorcycle, Car, Bus, Trailer* (min.	5	14	19	Design speed: 50km/hr
		3	9	12	Design speed: 80km/hr

*For benefit calculation, the design speed at 50 km / hr is adapted.

Source: Study Team

Table 3.2-6 Values of VOC and TTC per Vehicle per Day – With and Without Project Cases

Unit VOC for Passengers' Traffic (per vehicle per day) - **With and Without Project Cases** (Unit: 1000VND/vehicle/day)

Route	Condition	Motorcycle	Car	Mini Bus	Large Bus	Motorcycle	Car	Mini Bus	Large Bus	Motorcycle	Car	Mini Bus	Large Bus
Route 2	**Without Project***	Tan Vu IC - Dinh Vu (15km)				Ninh Tiep - Ben Got (7.7km)				Tan Vu IC - Ben Got			
		15.2	41.2	56.6	56.6	7.2	19.8	27.2	27.2	22.3	61.0	83.8	83.8
Route 3	**With Project****	Tan Vu IC - Dinh Vu (4.5km)				Dinh Vu - Ben Got (11.4km)				Tan Vu IC - Ben Got			
		2.7	8.0	11.1	11.1	6.7	20.2	28.1	28.1	9.4	28.2	39.3	39.3
									Unit VOC Saving =	13.0	32.8	44.5	44.5

*Ex.): Motorcycle VOC for Tan Vu IC - Dinh Vu Section under Without Project Case = 5909 x 20km/hr$^{-0.589}$ x 15km = 15,181 VND/vehicle/day
**Ex): Motorcycle VOC for Tan Vu IC - Dinh Vu Section under With Project Case = 5909 x 50km/hr-0.589 x 4.5km = 26,548 VND/vehicle/day

Unit TTC for Passengers' Traffic (per vehicle per day) - **With and Without Project Cases** (Unit: 1000VND/vehicle/day)

Route	Condition	Bicycle	Motorcycle	Car	Mini bus	Large bus	Bicycle	Motorcycle	Car	Mini bus	Large bus	Bicycle	Motorcycle	Car	Mini bus	Large bus
Route 2	**Without Project***	Tan Vu IC - Dinh Vu including 90 min. ferry (15km)					Ninh Tiep-Ben Got (7.7km)					Tan Vu IC - Ben Got				
		43.8	32.9	155.7	328.5	887.0	9.7	4.9	23.1	48.7	131.4	53.5	37.7	178.8	377.2	1,018.4
Route 3	**With Project****	Tan Vu IC - Dinh Vu (4.5km)					Dinh Vu - Ben Got (11.4km)					Tan Vu IC - Ben Got				
		6.6	1.3	6.2	13.1	35.5	16.5	3.3	15.7	33.1	89.4	23.1	4.6	21.9	46.2	124.8
											Unit TTC Saving =	30.4	33.1	156.9	330.9	893.5

*Ex.): Bicycle TTC for Tan Vu IC - Dinh Vu Section under Without Project Case = (90min. + 90min.)/60 x 14,600 = 43,800 VND/vehicle/day
Car TTC for Tan Vu IC - Dinh Vu Section under Without Project Case = (45min. + 90min.)/60 x 69,200 = 155,700 VND/vehicle/day
**Ex): Bicycle TTC for Tan Vu IC - Dinh Vu Section under With Project Case = 27min./60 x 14,600 = 6,570 VND/vehicle/day
Car TTC for Tan Vu IC - Dinh Vu Section under With Project Case = 5.4/60 x 69,200 = 6,228 VND/vehicle/day

Unit VOC and TTC for Container Transportation by Trailers - **With and Without Project Cases**

Route	Conditions	VOC (1000VND / vehicle / day)	TTC (1000VND / vehicle / day)	Remarks
Route 1	**Without Project***	38.5	5.8	Hai Phong-Tan Vu IC: 8km section only
Route 3	**With Project****	67.9	9.2	Tan Vu IC-Ben Got: 15.9km whole section
	Unit Saving =	-29.4	-3.4	

*Ex): VOC under Without Project Case = 33065 x 40km/hr$^{-0.5227}$ x 8km = 38,465 VND/vehicle/day
TTC under Withiout Project Case = 29,200 x 12min./60 = 5,840 VND/vehicle/day
**Ex): VOC under With Project Case = 33065 x 50km/hr$^{-0.5227}$ x 15.9km = 67,904 VND/vehicle/day
TTC under With Project Case = 29,200 x 19min./60 = 9,247 VND/vehicle/day
Note: VOC and TTC savings associated with container transport can not be simply compared due to difference in the travel distances between With and Without Project Cases.

Source: Study Team

The following table presents the traffic demand forecast used for VOC and TTC calculations. The traffic volumes of minibus, large buses and trailers are specified and adjusted for VOC and TTC calculations from the demand forecast presented in Section 2.3.

Table 3.2-7 Traffic Demand Forecast Used for Benefit Calculation

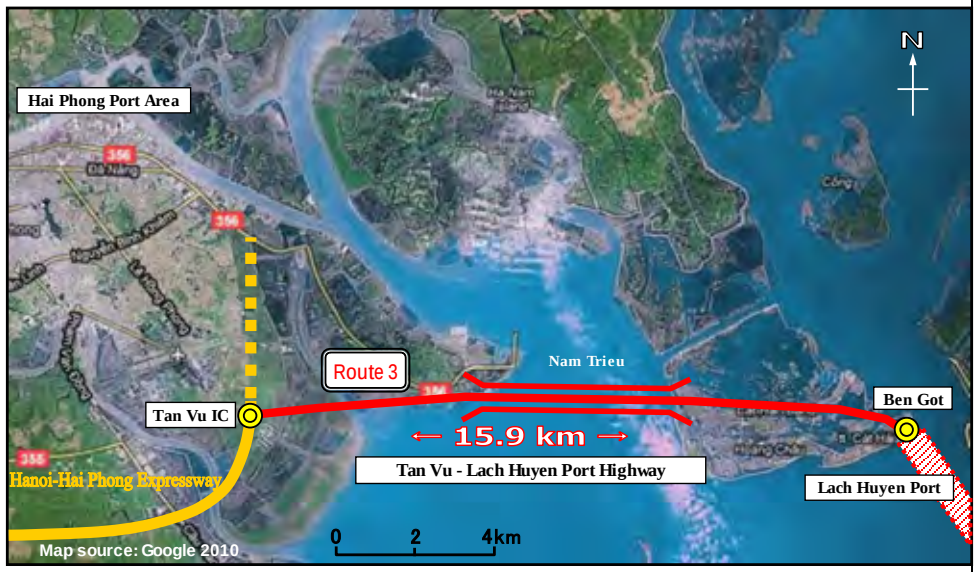
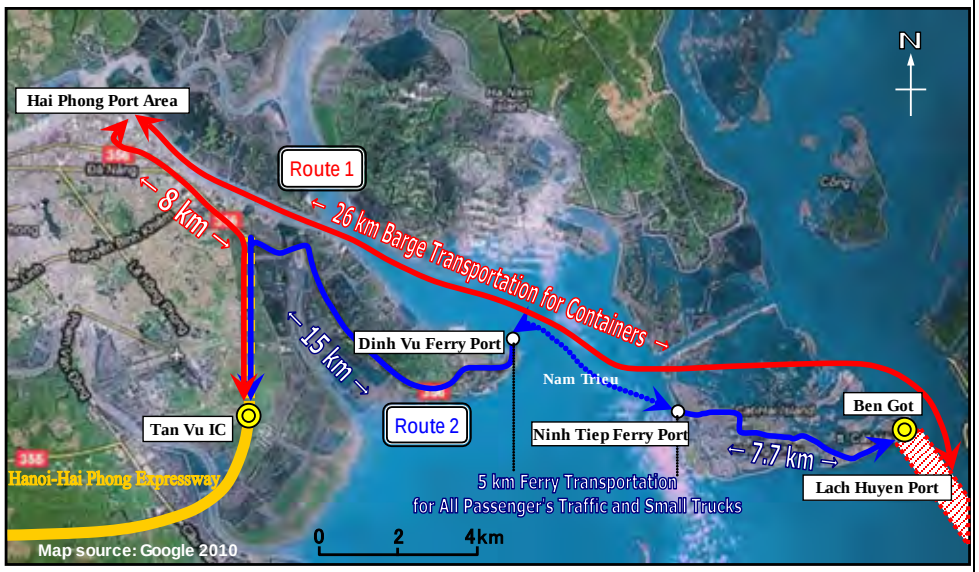
Daily Traffic Volume - Without Project Case (Unit: Vehicle/day)

Year	Tan Vu IC - Dinh Vu						Ninh Tiep - Ben Got					
	Bicycle	Motorcycle	Car	Minibus	Large Bus	Trailer	Bicycle	Motorcycle	Car	Minibus	Large Bus	Trailer
2010	165	640	22	119	9	0	645	673	291	111	10	0
2011	178	691	24	128	10	0	697	727	314	119	11	0
2012	192	746	26	138	11	0	753	785	339	129	12	0
2013	207	806	28	149	12	0	813	848	366	139	13	0
2014	224	870	30	161	13	0	878	916	395	150	14	0
2015	242	940	32	174	14	1,268	948	989	427	162	15	0
2016	261	1,015	35	188	15	2,263	1,024	1,068	461	175	16	0
2017	282	1,096	38	203	16	3,263	1,106	1,153	498	189	17	0
2018	305	1,184	41	219	17	4,271	1,194	1,245	538	204	18	0
2019	329	1,279	44	237	18	5,282	1,290	1,345	581	220	19	0
2020	355	1,381	48	256	19	6,299	1,393	1,453	627	238	21	0
2021	380	1,478	51	274	20	8,745	1,491	1,555	671	255	22	0
2022	407	1,581	55	293	21	10,414	1,595	1,664	718	273	24	0
2023	435	1,692	59	314	22	12,205	1,707	1,780	768	292	26	0
2024	465	1,810	63	336	24	14,126	1,826	1,905	822	312	28	0
2025	498	1,937	67	360	26	16,173	1,954	2,038	880	334	30	0
2026	533	2,073	72	385	28	12,841	2,091	2,181	942	357	32	0
2027	570	2,218	77	412	30	14,452	2,237	2,334	1,008	382	34	0
2028	610	2,373	82	441	32	16,151	2,394	2,497	1,079	409	36	0
2029	653	2,539	88	472	34	17,937	2,562	2,672	1,155	438	39	0
2030	699	2,717	94	505	36	19,822	2,741	2,859	1,236	469	42	0
2031	741	2,880	100	535	38	21,474	2,905	3,031	1,310	497	45	0
2032	785	3,053	106	567	40	23,219	3,079	3,213	1,389	527	48	0
2033	832	3,236	112	601	42	24,964	3,264	3,406	1,472	559	51	0
2034	882	3,430	119	637	45	26,707	3,460	3,610	1,560	593	54	0
2035	935	3,636	126	675	48	28,452	3,668	3,827	1,654	629	57	0

Daily Traffic Volume - With Project Case (Unit: Vehicle/day)

Year	Tan Vu IC - Dinh Vu						Dinh Vu - Ben Got					
	Bicycle	Motorcycle	Car	Minibus	Large bus	Trailer	Bicycle	Motorcycle	Car	Minibus	Large bus	Trailer
2015	42,400	65,800	3,960	534	234	1,791	26,900	41,533	2,500	338	148	1,135
2016	47,700	72,600	5,420	652	277	2,180	30,000	45,667	3,420	411	174	1,367
2017	52,600	78,667	7,120	784	319	2,586	32,900	49,333	4,460	490	201	1,624
2018	57,000	83,667	9,040	911	360	3,000	35,600	52,267	5,640	568	225	1,872
2019	61,100	88,067	11,180	1,058	402	3,459	38,100	54,867	6,960	662	251	2,160
2020	64,800	91,200	13,540	1,221	447	3,952	40,300	56,733	8,420	760	278	2,458
2021	67,600	97,733	16,120	1,458	538	4,829	39,300	56,733	9,340	849	312	2,803
2022	69,300	103,267	18,920	1,718	628	5,755	37,900	56,467	10,340	941	343	3,150
2023	69,800	107,600	21,780	2,002	722	6,800	36,300	55,933	11,320	1,039	375	3,531
2024	69,200	110,933	24,960	2,307	823	7,909	34,300	55,133	12,400	1,144	409	3,926
2025	67,400	113,200	28,340	2,632	924	9,122	32,200	54,067	13,540	1,260	441	4,362
2026	64,300	114,333	31,900	2,994	1,020	10,364	29,600	52,667	14,700	1,378	470	4,775
2027	60,100	114,400	35,660	3,380	1,119	11,750	26,900	51,133	15,940	1,512	500	5,251
2028	54,700	113,400	39,480	3,790	1,214	13,180	23,700	49,200	17,160	1,646	527	5,723
2029	48,200	111,267	43,640	4,231	1,313	14,686	20,400	47,067	18,480	1,788	555	6,210
2030	40,500	108,067	48,000	4,702	1,413	16,279	16,800	44,667	19,860	1,943	585	6,732
2031	38,600	112,333	52,800	5,379	1,490	17,888	15,300	44,600	20,960	2,135	591	7,100
2032	35,900	115,800	57,700	6,109	1,559	19,533	13,700	44,333	22,080	2,338	597	7,481
2033	32,300	118,600	62,740	6,891	1,619	21,213	12,000	43,933	23,260	2,556	600	7,862
2034	28,100	120,600	67,900	7,733	1,672	22,924	10,100	43,400	24,440	2,781	601	8,247
2035	22,900	122,000	73,200	8,645	1,736	24,634	8,000	42,733	25,640	3,026	608	8,627

Source: Study Team

With Project Case	Without Project Case
	
Conditions:	Conditions:
Route 3: Tan Vu-Lach Huyen Highway - All traffic goes through the Tan Vu-Lach Huyen Highway smoothly without disturbance and congestion. - Containers are smoothly transported by trucks or trailers from and to the Lach Huyen port, enhancing trading and marketing activities. - Port capacity and function will be fully utilized. - There is no congestion in maritime transportation and maritime safety, and fishing boats are more secured as well.	**Route 1: Container Transport** - Daily required no. of barges (90TEU): 5 vessels in 2015, 52 in 2025, 91 in 2035. - Daily required no. of RoRo ships: 3 vessels in 2015, 32 in 2025, 55 in 2035. - Daily required no. of trips between Lach Huyen and Hai Phong ports: 15 in 2015, 180 in 2030, 317 in 2035. - Cost of transports: VND 2.0 billion/day in 2015, VND 25.3 billion/day in 2025, VND 44.6 billion/day in 2035. **Route 2: Passenger Traffic** - Daily required nos. of trips between Dinh Vu and Ninh Tiep ferry ports: 18 trips in 2015, 36 trips in 2025, 70 trips in 2035 - Daily required no. of ferries: 3 in 2015, 6 in 2025, 12 in 2035. - Cost of transports: ferry fees are assumed to be financial cost. Therefore, it is assumed that ferry fees are not counted for cost of transportation in economic analysis. But TTC is accounted for economic cost.

Source: Study Team

Figure 3.2-1 Comparison of the "With" and "Without" Project Cases

The major project benefit from barge transportation cost under "Without" Project Case is calculated based on Table 3.2-8 below. These comprise of port handling charges, economic costs of ship hiring and fuel costs based on the container demand forecast at Lach Huyen Port.

Table 3.2-8 Benefit Calculation for Barge Transportation of Containers under "Without" Project Case

Port Handling Charge for Transshipment

	Port	US$/TEU	VND/TEU
(I)	Lach Huyen	40	680,080
(II)	Hai Phong	40	680,080

Source: Data from existing Hai Phong - Cai Lan maritime transportation

Economic Prices Estimate for Lach Huyen-Hai Phong Barge Transport

	Item	Value	Remarks
(a)	Ship hiring cost (RoRo ship)(VND/day/ship)	13,812,500	414 mil.VND per month hiring basis
(b)	Barge hiring cost (90TEU equivalent) (VND/day/ship)	9,668,800	290 mil.VND per month hiring basis
(c)	Diesel gasoline requirement* (liter/hr)	540	120 liter/hr x 90TEU/20TEU
(d)	Fuel cost (VND/ship/trip)	13,500,000	(c) x (g) x (i)
(e)	Distance (km) (Lach Huyen-Hai Phong)	26.0	
(f)	Speed at full container (km/hr)	14.8	8 knot x 1.852
(g)	Time required per trip (hr)	2.0	(e) / (g)
(h)	Marine Diesel Oil Price** ($US/MT)	587	
(i)	Liter equivalent of Marine Diesel Oil Price (VND/liter)	12,500	(h) / 1,000kg x 0.8 x VND17,002

*Based on the data of barge transportation Hai Phong-Cai Lan (48km) at 20 million VND/month for 20TEU barge, 120 liter/hr of diesel fuel requirement, 8 knot ave. speed.

**As of May 25 at Singapore MDO price (Source: http://www.bunkerworld.com/markets/prices/sg/sin/)

Cost Estimation for the Barge Transportation of Containers under "Without" Project Case

	(1)	(2)	(3)	(4)	(5)	(6)
Year	Container Demand TEU/day	No. Trips/day	No. Barge/day	No. RoRo Ship/day	Costs of Daily Transports* (Mil.VND/day)	Costs of Annual Transports** (Mil.VND/year)
2015	1,268	15	5	3	2,017	736,192
2016	2,263	26	8	5	3,575	1,305,041
2017	3,263	37	11	7	5,141	1,876,372
2018	4,271	48	14	9	6,717	2,451,675
2019	5,282	59	17	11	8,297	3,028,468
2020	6,299	70	20	12	9,872	3,603,197
2021	8,745	98	28	17	13,723	5,008,945
2022	10,414	116	34	21	16,350	5,967,570
2023	12,205	136	39	24	19,145	6,988,048
2024	14,126	157	45	27	22,141	8,081,521
2025	16,173	180	52	32	25,373	9,261,016
2026	12,841	143	41	25	20,138	7,350,387
2027	14,452	161	46	28	22,662	8,271,647
2028	16,151	180	52	32	25,343	9,250,093
2029	17,937	200	58	35	28,141	10,271,618
2030	19,822	221	64	39	31,102	11,352,260
2031	21,474	239	69	42	33,682	12,293,875
2032	23,219	258	74	45	36,402	13,286,587
2033	24,964	278	80	48	39,145	14,287,756
2034	26,707	297	85	51	41,862	15,279,476
2035	28,452	317	91	55	44,618	16,285,687

*Costs of Daily Transportation (5) = (1)x((I) + (II)) + (4)x(a) + (3)x(b) +(2)x(d)

**Costs of Annual Transportation (6) = (5) x 365

Source: Study Team

Estimated project benefit of all items (VOC/TTC saving and barge transportation) is summarized as shown in Table 3.2-9.

Table 3.2-9 Summary of Project Benefit

Without Project Case

Year	VOC (1000VND/day)										Total VOC (1000VND/day)	(A) Annual Total VOC (Mil.VND/yr)	TTC (1000VND/day)	
	Tan Vu IC - Dinh Vu					Ninh Tiep-Ben Got							Tan Vu IC - Dinh Vu	
	Motorcycle	Car	Mini Bus	Large Bus	Trailer	Motorcycle	Car	Mini Bus	Large Bus	Trailer			Bicycle	Motorcycle
2015	14,270	1,319	9,847	792	48,773	7,080	8,439	4,404	408	0	95,333	34,796	10,600	30,879
2016	15,409	1,443	10,639	849	87,045	7,646	9,111	4,757	435	0	137,334	50,127	11,432	33,343
2017	16,638	1,567	11,488	905	125,510	8,254	9,842	5,138	462	0	179,805	65,629	12,352	36,004
2018	17,974	1,690	12,394	962	164,283	8,913	10,633	5,546	489	0	222,883	81,352	13,359	38,894
2019	19,416	1,814	13,412	1,019	203,170	9,629	11,483	5,981	516	0	266,440	97,251	14,410	42,015
2020	20,965	1,979	14,488	1,075	242,289	10,402	12,392	6,470	571	0	310,630	113,380	15,549	45,366
2021	22,437	2,103	15,506	1,132	336,373	11,132	13,262	6,932	598	0	409,475	149,458	16,644	48,552
2022	24,001	2,268	16,581	1,188	400,571	11,912	14,190	7,421	652	0	478,786	174,757	17,827	51,936
2023	25,686	2,432	17,770	1,245	469,461	12,743	15,179	7,938	707	0	553,160	201,904	19,053	55,582
2024	27,477	2,597	19,015	1,358	543,352	13,637	16,246	8,481	761	0	632,925	231,018	20,367	59,459
2025	29,405	2,762	20,373	1,471	622,089	14,590	17,392	9,080	816	0	717,978	262,062	21,812	63,630
2026	31,470	2,968	21,788	1,585	493,925	15,613	18,617	9,705	870	0	596,541	217,737	23,345	68,098
2027	33,671	3,175	23,316	1,698	555,891	16,709	19,922	10,384	924	0	665,690	242,977	24,966	72,861
2028	36,024	3,381	24,957	1,811	621,243	17,875	21,325	11,118	979	0	738,713	269,630	26,718	77,953
2029	38,544	3,628	26,711	1,924	689,940	19,128	22,827	11,907	1,060	0	815,671	297,720	28,601	83,406
2030	41,247	3,875	28,579	2,037	762,446	20,467	24,428	12,749	1,142	0	896,971	327,394	30,616	89,253
2031	43,721	4,123	30,277	2,150	825,990	21,698	25,891	13,511	1,223	1	968,585	353,533	32,456	94,608
2032	46,347	4,370	32,088	2,264	893,111	23,001	27,452	14,326	1,305	2	1,044,265	381,157	34,383	100,291
2033	49,126	4,618	34,012	2,377	960,231	24,383	29,092	15,196	1,386	3	1,120,424	408,955	36,442	106,303
2034	52,071	4,906	36,049	2,547	1,027,275	25,843	30,832	16,120	1,468	4	1,197,115	436,947	38,632	112,676
2035	55,198	5,195	38,200	2,716	1,094,396	27,397	32,689	17,099	1,549	5	1,274,444	465,172	40,953	119,443

Year	TTC (1000VND/day)										Total TTC (1000VND/day)	(B) Annual Total TTC (Mil.VND/yr)	(C) Cost of Barge Transports (Mil.VND/yr)	(D) Total Cost (A+B+C) (Mil.VND/yr)
	Tan Vu IC - Dinh Vu				Ninh Tiep-Ben Got									
	Car	Mini bus	Large bus	Trailer	Bicycle	Motorcycle	Car	Mini bus	Large bus	Trailer				
2015	4,982	57,159	12,417	7,405	9,227	4,813	9,849	7,884	1,971	0	157,187	57,373	736,192	828,362
2016	5,450	61,758	13,304	13,216	9,967	5,198	10,634	8,517	2,102	0	174,920	63,846	1,305,041	1,419,014
2017	5,917	66,686	14,191	19,056	10,765	5,611	11,487	9,198	2,234	0	193,500	70,627	1,876,372	2,012,629
2018	6,384	71,942	15,078	24,943	11,622	6,059	12,410	9,928	2,365	0	212,983	77,739	2,451,675	2,610,767
2019	6,851	77,855	15,965	30,847	12,556	6,546	13,402	10,707	2,497	0	233,649	85,282	3,028,468	3,211,000
2020	7,474	84,096	16,852	36,786	13,559	7,071	14,463	11,583	2,759	0	255,557	93,278	3,603,197	3,809,856
2021	7,941	90,009	17,739	51,071	14,512	7,568	15,478	12,410	2,891	0	284,814	103,957	5,008,945	5,262,361
2022	8,564	96,251	18,626	60,818	15,525	8,098	16,562	13,286	3,154	0	310,644	113,385	5,967,570	6,255,712
2023	9,186	103,149	19,513	71,277	16,615	8,663	17,715	14,211	3,416	0	338,380	123,509	6,988,048	7,313,460
2024	9,809	110,376	21,287	82,496	17,773	9,271	18,961	15,184	3,679	0	368,661	134,561	8,081,521	8,447,100
2025	10,432	118,260	23,061	94,450	19,019	9,918	20,299	16,255	3,942	0	401,078	146,394	9,261,016	9,669,471
2026	11,210	126,473	24,835	74,991	20,352	10,614	21,729	17,374	4,205	0	403,227	147,178	7,350,387	7,715,303
2027	11,989	135,342	26,609	84,400	21,773	11,359	23,251	18,591	4,468	0	435,608	158,997	8,271,647	8,673,621
2028	12,767	144,869	28,382	94,322	23,302	12,152	24,889	19,905	4,730	0	469,989	171,546	9,250,093	9,691,270
2029	13,702	155,052	30,156	104,752	24,937	13,004	26,642	21,316	5,125	0	506,693	184,943	10,271,618	10,754,280
2030	14,636	165,893	31,930	115,760	26,679	13,914	28,510	22,825	5,519	0	545,535	199,120	11,352,260	11,878,775
2031	15,570	175,748	33,704	125,408	28,275	14,751	30,217	24,187	5,913	1	580,838	212,006	12,293,875	12,859,414
2032	16,504	186,260	35,478	135,599	29,969	15,637	32,040	25,647	6,307	2	618,116	225,612	13,286,587	13,893,357
2033	17,438	197,429	37,252	145,790	31,770	16,576	33,954	27,205	6,701	3	656,861	239,754	14,287,756	14,936,465
2034	18,528	209,255	39,913	155,969	33,677	17,569	35,984	28,859	7,096	4	698,160	254,829	15,279,476	15,971,252
2035	19,618	221,738	42,574	166,160	35,702	18,625	38,152	30,611	7,490	5	741,070	270,490	16,285,687	17,021,349

With Project Case

Year	VOC (1000VND/day)										Total VOC (1000VND/day)	(E) Annual Total VOC (Mil.VND/yr)	TTC (1000VND/day)		
	Tan Vu IC - Dinh Vu					Dinh Vu - Ben Got							Tan Vu IC - Dinh Vu		
	Motorcycle	Car	Mini Bus	Large Bus	Trailer	Motorcycle	Car	Mini Bus	Large Bus	Trailer			Bicycle	Motorcycle	Car
2015	174,686	31,695	5,949	2,607	34,490	180,440	50,557	9,505	4,171	55,202	549,303	200,496	278,568	86,461	24,663
2016	192,739	43,381	7,261	3,079	41,974	201,234	69,163	11,556	4,890	66,514	641,791	234,254	313,389	95,396	33,756
2017	208,846	56,987	8,726	3,555	49,785	220,687	90,194	13,771	5,644	78,990	737,184	269,072	345,582	103,368	44,343
2018	222,120	72,354	10,137	4,011	57,760	238,798	114,058	15,975	6,321	91,081	832,615	303,904	374,490	109,938	56,301
2019	233,801	89,483	11,779	4,479	66,606	255,568	140,752	18,622	7,052	105,086	933,228	340,628	401,427	115,720	69,629
2020	242,119	108,372	13,593	4,973	76,094	270,325	170,277	21,373	7,818	119,580	1,034,523	377,601	425,736	119,837	84,327
2021	259,462	129,022	16,232	5,983	92,980	263,617	188,883	23,869	8,764	136,345	1,125,157	410,682	444,132	128,421	100,395
2022	274,154	151,432	19,123	6,985	110,814	254,226	209,106	26,449	9,651	153,260	1,215,202	443,549	455,301	135,693	117,834
2023	285,657	174,323	22,281	8,037	130,931	243,494	228,924	29,213	10,543	171,797	1,305,200	476,398	458,586	141,386	135,646
2024	294,506	199,775	25,674	9,161	152,288	230,078	250,765	32,167	11,491	190,978	1,396,882	509,862	454,644	145,766	155,451
2025	300,524	226,828	29,299	10,287	175,646	215,992	273,819	35,434	12,413	212,190	1,492,432	544,738	442,818	148,745	176,502
2026	303,532	255,322	33,325	11,357	199,544	198,551	297,278	38,754	13,229	232,279	1,583,170	577,857	422,451	150,234	198,673
2027	303,710	285,416	37,619	12,455	226,239	180,440	322,354	42,519	14,065	255,456	1,680,274	613,300	394,857	150,322	222,090
2028	301,055	315,991	42,189	13,509	253,768	158,975	347,026	46,292	14,815	278,426	1,772,047	646,797	359,379	149,008	245,881
2029	295,393	349,286	47,093	14,610	282,776	136,839	373,721	50,293	15,620	302,122	1,867,753	681,730	316,674	146,205	271,790
2030	286,897	384,183	52,335	15,725	313,445	112,691	401,628	54,642	16,439	327,529	1,965,515	717,413	266,085	142,000	298,944
2031	298,223	422,601	59,869	16,580	344,432	102,630	423,874	60,051	16,630	345,426	2,090,314	762,965	253,602	147,606	328,838
2032	307,427	461,820	67,993	17,350	376,102	91,897	446,523	65,753	16,784	363,951	2,215,600	808,694	235,863	152,161	359,356
2033	314,860	502,159	76,694	18,025	408,442	80,494	470,386	71,892	16,879	382,500	2,342,333	854,952	212,211	155,840	390,745
2034	320,170	543,459	86,072	18,608	441,387	67,749	494,249	78,220	16,915	401,217	2,468,046	900,837	184,617	158,468	422,881
2035	323,887	585,879	96,216	19,321	474,305	53,663	518,517	85,103	17,100	419,688	2,593,677	946,692	150,453	160,308	455,890

Note: Design speed of 50km/hr is applied for "With Project Case".

Year	TTC (1000VND/day)									Total TTC (1000VND/day)	(F) Annual Total TTC (Mil.VND/yr)	(G) Total Cost (E+F) (Mil.VND/yr)	(H) Total VOC Saving (A-E) (Mil.VND/yr)	(I) Total TTC Saving (B-F) (Mil.VND/yr)	(J) Annual Incremental Benefit (D-G, or H+I+C) (Mil.VND/yr)
	Tan Vu IC - Dinh Vu			Dinh Vu - Ben Got											
	Mini bus	Large bus	Trailer	Bicycle	Motorcycle	Car	Mini bus	Large bus	Trailer						
2015	7,023	8,311	4,707	445,105	137,447	39,213	11,185	13,254	7,510	1,063,447	388,158	588,654	-165,699	-330,785	239,708
2016	8,572	9,815	5,729	496,400	151,127	53,644	13,598	15,537	9,049	1,206,012	440,195	674,448	-184,127	-376,349	744,565
2017	10,302	11,330	6,795	544,385	163,259	69,957	16,205	17,931	10,746	1,344,204	490,635	759,707	-203,443	-420,007	1,252,922
2018	11,968	12,786	7,884	589,061	172,969	88,465	18,799	20,083	12,391	1,475,135	538,424	842,329	-222,552	-460,686	1,768,438
2019	13,906	14,277	9,091	630,428	181,573	109,170	21,914	22,404	14,297	1,603,837	585,400	926,028	-243,378	-500,118	2,284,972
2020	16,047	15,850	10,386	666,831	187,748	132,071	25,151	24,840	16,269	1,725,092	629,659	1,007,259	-264,221	-536,380	2,802,596
2021	19,163	19,072	12,691	650,284	187,748	146,501	28,088	27,846	18,550	1,782,891	650,755	1,061,438	-261,224	-546,798	4,200,923
2022	22,576	22,266	15,125	627,119	186,868	162,186	31,124	30,665	20,851	1,827,608	667,077	1,110,626	-268,792	-553,692	5,145,087
2023	26,304	25,619	17,871	600,644	185,101	177,558	34,377	33,498	23,373	1,859,962	678,886	1,155,284	-274,495	-555,377	6,158,176
2024	30,310	29,199	20,786	567,551	182,453	194,498	37,853	36,508	25,982	1,881,001	686,565	1,196,427	-278,844	-552,004	7,250,673
2025	34,589	32,791	23,974	532,803	178,926	212,379	41,698	39,438	28,868	1,893,529	691,138	1,235,876	-282,676	-544,744	8,433,595
2026	39,342	36,200	27,235	489,781	174,293	230,574	45,604	42,031	31,601	1,888,021	689,128	1,266,985	-360,120	-541,950	6,448,318
2027	44,412	39,702	30,879	445,105	169,216	250,024	50,034	44,688	34,754	1,876,085	684,771	1,298,071	-370,323	-525,774	7,375,550
2028	49,807	43,061	34,636	392,156	162,819	269,160	54,475	47,070	37,879	1,845,332	673,546	1,320,343	-377,167	-502,000	8,370,926
2029	55,596	46,568	38,596	337,552	155,760	289,865	59,183	49,630	41,103	1,808,522	660,111	1,341,841	-384,010	-475,168	9,412,440
2030	61,785	50,123	42,782	277,984	147,818	311,511	64,300	52,232	44,560	1,760,124	642,445	1,359,858	-390,019	-443,325	10,518,917
2031	70,679	52,848	47,011	253,164	147,596	328,765	70,666	52,837	46,995	1,800,606	657,221	1,420,186	-409,431	-445,215	11,439,228
2032	80,270	55,303	51,334	226,689	146,713	346,332	77,375	53,326	49,515	1,834,237	669,496	1,478,191	-427,537	-443,884	12,415,166
2033	90,542	57,455	55,748	198,560	145,389	364,841	84,600	53,630	52,039	1,861,599	679,484	1,534,435	-445,997	-439,729	13,402,030
2034	101,614	59,314	60,244	167,121	143,625	383,350	92,046	53,744	54,585	1,881,609	686,787	1,587,624	-463,890	-431,959	14,383,627
2035	113,589	61,585	64,737	132,373	141,418	402,172	100,146	54,331	57,098	1,894,099	691,346	1,638,039	-481,520	-420,856	15,383,311

Source: Study Team

3.2.3. Economic Evaluation

(1) General Conditions for the Evaluation

The following conditions are assumed for the purpose of the economic evaluation:

- Price level is adapted to 2010 constant prices
- Economic project life is set at 21 years toward year 2035 after the first opening to traffic
- Standard Conversion Factor (SCF) at 0.85 is applied for non-traded goods and services in the project costs, benefits and O&M costs
- Major rehabilitation works are assumed every seven years after the opening
- Procurement costs for O&M equipment and materials are assumed at 5% of the construction costs
- Opportunity cost of capital (discount rate) is set at 12%.
- The project costs are allocated to 1st stage during 2011-2014, and 2nd stage during 2024-2026, according to the disbursement schedule presented above.

(2) Updates of Investment in Economic Price and Investment Schedule

Total financial project costs are updated from the value in the F/S. All the costs and benefits, estimated from market prices, need to be converted into economic terms in the economic analysis by excluding price escalation and transfer items such as taxes and subsidies. In this study, the Standard Conversion Factor (SCF) is at 0.85, which is generally used in the recent studies in Vietnam's transport sector, is applied to the construction costs in order to obtain the economic prices. The obtained economic project costs for the 1st Stage and 2nd Stage are presented in Table 3.2-10 and Table 3.2-11, respectively.

Table 3.2-10 Economic Project Cost for 1st Stage

Item	Local Currency (in VND)	Foreign Currency (in JPY)	Economic Project Cost in VND
I Construction Expenses			
0 Temporary Facility	417,188,903,883	62,507,179	428,938,373,702
1 Tan Vu Interchange	203,302,142,187	26,706,678	208,322,194,405
2 Hai An Side Road Work+Approach Road	626,447,041,684	82,544,184	641,962,865,731
3 Approach Bridge (Hai An Side)	1,064,721,534,766	2,773,335,178	1,586,025,139,630
4 Main Bridge	244,003,107,963	1,594,080,071	543,642,218,963
5 Approach Bridge (Cat Hai Side)	126,857,697,755	382,913,184	198,833,860,067
6 Cat Hai Side Road Work + Approach Ro	584,742,457,998	75,252,457	598,887,656,715
Total Expenses	3,267,262,886,236	4,997,338,930	4,206,612,309,212
II Price Escalation (I×10.3%(L), I×1.8%(F))	-	-	-
III Physical Contingency ((I+II)×5%)	163,363,144,312	249,866,947	210,330,615,461
IV Cosulting Service	74,402,200,000	779,000,000	220,830,771,429
V Land Acquisition, HIV/AIDS prevension	267,012,096,300	-	267,012,096,300
VI Administration Cost ((I+II+III+Ⅳ+Ⅴ)×5%)	188,602,016,342	301,310,294	245,239,289,620
VII VAT ((I+II+III+Ⅳ)×10%)	-	-	-
VIII Import Tax (10%)	-	-	-
IX Interest during Construction (Temporary)	-	-	-
X Commitment Charge	-	-	-
Total Economic Cost	3,960,642,343,190	6,327,516,171	5,150,025,082,021

Source: Study Team

Table 3.2-11 Economic Project Cost for 2nd Stage

Item	Local Currency (in VND)	Foreign Currency (in JPY)	Economic Project Cost in VND
I Construction Expenses			
0 Temporary Facility	417,188,903,883	62,507,179	428,938,373,702
1 Tan Vu Interchange	0	0	0
2 Hai An Side Road Work+Approach Road	47,932,350,000	0	47,932,350,000
3 Approach Bridge (Hai An Side)	1,025,287,403,849	2,670,619,060	1,527,283,467,792
4 Main Bridge	173,723,000,000	0	173,723,000,000
5 Approach Bridge (Cat Hai Side)	122,159,264,504	368,731,214	191,469,643,027
6 Cat Hai Side Road Work + Approach Roa	15,977,450,000	0	15,977,450,000
Total Expenses	1,802,268,372,236	3,101,857,453	2,385,324,284,521
II Price Escalation (I×10.3%(L), I×1.8%(F))	-	-	-
III Physical Contingency ((I+II)×5%)	90,113,418,612	155,092,873	119,266,214,226
IV Cosulting Service	44,641,320,000	467,400,000	132,498,462,857
V Land Acquisition, HIV/AIDS prevension	-	-	0
VI Administration Cost ((I+II+III+IV+V)×5%)	96,851,155,542	186,217,516	131,854,448,080
VII VAT ((I+II+III+IV)×10%)	-	-	-
VIII Import Tax (10%)	-	-	-
IX Interest during Construction (Temporary)	-	-	-
X Commitment Charge	-	-	-
Total Economic Cost	2,033,874,266,391	3,910,567,842	2,768,943,409,684

Source: Study Team

The economic project costs are allocated according to the implementation schedule as shown below.

Table 3.2-12 Disbursement Schedule of Economic Project Costs

(Unit: Mil. VND)

Stage	Year	Costs	
		Mil.VND	%
1st Stage	2011	103,001	2%
	2012	927,005	18%
	2013	3,090,015	60%
	2014	1,030,005	20%
	2015	-	-
	Total	5,150,025	100%
2nd Stage	2024	830,683	30%
	2025	1,107,577	40%
	2026	830,683	30%
	Total	2,768,943	100%

Source: Study Team

(3) Evaluation Indicators and Cost-Benefit Streams for the Four Alternatives

The following three kinds of evaluation indicators are calculated:

- Economic Internal Rate of Return (EIRR)
- Net Present Value (NPV)
- Benefit / Cost Ratio (B/C)

The cost and benefit streams and the results of evaluation for the four alternatives are presented below.

Table 3.2-13 Results of Economic Evaluation

(Unit: Million VND)

Year	1st Stage Investment Cost	2nd Stage Investment Cost	Routine/Repair Works*	Major Replacement	Annual Total Cost	Annual Incremental Benefit	Annual Net Benefit
2011	103,001				103,001	0	-103,001
2012	927,005				927,005	0	-927,005
2013	3,090,015				3,090,015	0	-3,090,015
2014	1,030,005		210,331		1,240,336	0	-1,240,336
2015			15,522		15,522	239,708	224,186
2016			15,522		15,522	744,565	729,043
2017			15,522		15,522	1,252,922	1,237,400
2018			15,522		15,522	1,768,438	1,752,916
2019			15,522		15,522	2,284,972	2,269,450
2020			15,522		15,522	2,802,596	2,787,074
2021			15,522	63,776	79,298	4,200,923	4,121,625
2022			15,522		15,522	5,145,087	5,129,565
2023			15,522		15,522	6,158,176	6,142,654
2024		830,683	15,522		846,205	7,250,673	6,404,468
2025		1,107,577	15,522		1,123,099	8,433,595	7,310,496
2026		830,683	15,522		846,205	6,448,318	5,602,113
2027			18,626		18,626	7,375,550	7,356,924
2028			18,626	76,531	95,158	8,370,926	8,275,769
2029			18,626		18,626	9,412,440	9,393,813
2030			18,626		18,626	10,518,917	10,500,290
2031			18,626		18,626	11,439,228	11,420,602
2032			18,626		18,626	12,415,166	12,396,540
2033			18,626		18,626	13,402,030	13,383,404
2034			18,626		18,626	14,383,627	14,365,001
2035			18,626	76,531	95,158	15,383,311	15,288,153
						EIRR =	30.3%
						NPV =	16,372,222
						B/C =	4.7
						Discount rate =	12%

*Note: - Procurement cost for O&M equipment is included as 5% of construction cost before opening.
- O&M costs are assumed to increase by 20% after the 2nd Stage completion.

Source: Study Team

The above results indicate that implementation of the project is economically feasible with values of EIRR sufficiently higher than the opportunity cost of capital (>12%), B/C ratio higher than unity (>1), and positive NPV (>0).

(4) Sensitivity Analysis

The robustness of economic feasibility of the project was tested by changing related factors within a probable range. The sensitivity analysis is conducted with respect to the following cases.

- Test 1: Project Cost: 10% up, Project Benefit: 10% down simultaneously
- Test 2: Project Cost: 20% up, Project Benefit: 20% down simultaneously
- Test 3: Traffic Demand: 20% down
- Test 4: Container Demand: 20% down
- Test 5: Container Demand: 50% down

The results of the five tests are summarized as below:

Table 3.2-14 Results of Sensitivity Analysis

Test	EIRR	NPV (Billion VND)	B/C
Test 1	28%	13,872	3.9
Test 2	25%	11,372	3.2
Test 3	27%	12,220	3.8
Test 4	26%	11,490	3.6
Test 5	18%	4,164	1.9

Source: Study Team

(5) Conclusions of Economic Analysis

The above results indicate the strong validity of economic feasibility, showing that the values of EIRR are much higher than 12%, very much positive figures of NPV (>0), and B/C ratios higher than unity (>1) in any case undertaken for the sensitivity analysis.

The higher values of all evaluation indicators are as expected because of the costs of barge transportation for containers, which could be almost impossible in practice. This is indicated from the result of the sensitivity analysis that container demand is the most sensitive factor to the evaluation indicators. In addition, repetition of changes in container demand reduction indicated that a breakeven point for the indicators lies at 65-70% reduction of container volume. It can be concluded that the road and bridge be realized before starting container handlings at the Lach Huyen Port as it has been numerically verified from the analysis.

3.3. Intangible Effect from the Project

Road and bridge development will reduce the cost of production in most industries at a given level of output by making it faster and cheaper to obtain parts and raw materials, and to get finished products to market. Particularly, Tan Vu-Lach Huyen Highway directly links the new port with the Hanoi-Hai Phong Expressway and other major national road networks. It will enhance faster and smoother cargo transportation at much lower costs. Moreover, lower costs lead to lower prices and greater demand, which translate to a growth in output of the economy as a whole. There are many kinds of expected benefits other than VOC and TTC savings that are considered in economic evaluation of this study. They could be categorized as the following:

(1) Direct Benefits

- Avoiding disastrous maritime traffic congestion at Nam Trieu Channel
- Reducing possible damages to freight,
- Reducing transport cost and time of freight and passengers, and
- Reduction of traffic accidents, especially on nearby existing roads.

(2) Indirect Benefits

- Expanding the market sphere,
- Integrating the regional economy,
- Streamlining the distribution industry,
- Promoting and attracting entries for new industries, and
- Enhancing productivity.

It is important to foster these benefits and monitor them so as to maximize the benefit from the Project. Thus, RRMU should obtain the data for indicators of operation and effect during operation. Proposed indicators of operation and effect are summarized in Table 3.3.1

Table 3.3-1 Proposed Operation and Effect Indicators for Tan Vu-Lach Huyen Highway Project

Indicators	Index	Methodology	Target	Purpose	Remarks
Operation Indicators	Annual Average Daily Traffic (AADT)	- Traffic counting at fixed points along the Tan Vu - Lach Huyen port. - 24hrs traffic volume shall be counted on the same day of the year. - Traffic by vehicle type and time band shall be recorded.	Need discussion with RRMU about vehicle type, survey dates and frequency.	To analyze patterns and tendency of traffic conditions on and around the Tan Vu-Lach Huyen port. To monitor cargo volumes transported from and to the Lach Huyen port.	To prepare database for traffic O&M. To prepare time series database for scientific traffic analysis.
	Vehicle Speed	- Travel speed survey at fixed sections of the routes including Tan Vu - Lach Huyen port. - Survey shall be carried out in morning and evening peak hours and off-peak hours. - Survey shall be carried out on the same day of the year.	Design speed at 50km/hr could be the target for the section of Tan Vu - Lach Huyen port section. Need discussion with RRMU about survey dates and frequency.	To analyze actual travel and transport times. To analyze annual service level provided by the Tan Vu-Lach Huyen port.	To prepare database for traffic O&M. To prepare time series database for scientific traffic analysis.
Effect Indicators	Traffic Accident on and nearby existing roads	- Number of traffic accidents shall be counted and recorded along the Tan Vu - Lach Huyen port -Causes and degrees (fatal or injury) of accidents shall be remarked.	Need discussion with RRMU about and recording forms of the accidents.	To monitor frequencies of accident occurances.	To prepare database for traffic O&M.
	Land Price at nearby areas of the Tan Vu-Cat Hai roads and bridge	- Land prices at nearby the Tan Vu-Lach Huyen port section shall be surveyed on the same day of the year.	Areas and categories of land use pattern shall be discussed with RRMU and local administrations concerned.	To monitor the induced land development by the project	To promote industrial / commercial development. To prevent unplanned land development
	Number of industrial and business / commercial facilities	- Number of facilities in Hai An side and Cat Hai island shall be surveyed on the same day of the year.	Areas and categories of land use pattern shall be discussed with RRMU and local administrations concerned.	To monitor and promote industrial / commercial development induced by the project	Number of employees and vehicles held by each enterprise shall be remarked.

Source: Study Team

(3) Proposed Impact Indicators

Based on the above concept, the Study proposes to set the following impact indicators according to the results of survey.

Table 3.3-2 Proposed Impact Indicators, Baseline and Target for the Project

Indicator	Baseline Value in 2010	Target Value in 2017	Remarks
Travel Time	➢ 155 minutes including ferry transportation	➢ 19 minutes at average speed at 50km / hr. ➢ 12 minutes at average speed at 80km /hr.	Section applied to Tan Vu IC area ~ Ben Got
Annual Average Daily Traffic (PCU/day)*	➢ 557 PCU/day (Dinh Vu~Ferry~Ninh Tiep ~Ben Got Section)	➢ 15,607 PCU/day (Tan Vu IC ~ Dinh Vu Section) ➢ 9,790 PCU/day (Dinh Vu ~ Ben Got Section)	Each PCU includes more than 4-wheel vehicles, not including bicycle and motorcycle.

*Note: Annual Average Daily Traffic is adapted from Appendix 2-2:
Baseline Value in 2010: 8. Daily Traffic Volume Based on Traffic Survey (Page Appendix 2-31: Dinh Vu ~ Cat Hai Ferry ~ Ninh Tiep Ferry Section = 22+237+22 =281 PCU/day, Cat Hai Road Section = 29+221+26 = 276 PCU/day, Total: 557 PCU/day)
Target Value in 2017: 6. Revised FS Daily Traffic Volume, PCU Daily Traffic Volume Tan Vu - Dinh Vu (Page Appendix 2-29), and 7. Revised FS Daily Traffic Volume, PCU Daily Traffic Volume Dinh Vu - Cat Hai (Page Appendix 2-30)

Source: Study Team

3.4. Environmental and Social Considerations

3.4.1. Review and Confirmation of EIA

(1) Review of EIA report

A draft of EIA report had been prepared by Vietnam Infrastructure Development and Finance Investment Joint Stock Company (VIDIFI) in July 2009. Hyder Consulting Ltd was the body in charge of preparation of this EIA report. The EIA report was then submitted to Hai Phong People's Committee (HPPC) for approval. However, while it was on the way to be approved by HPPC, Prime Minister decided to transfer the project ownership from VIDIFI to MOT. Therefore, PMU2, as an implementing agency of MOT in charge of this project, was appointed to be the body in charge of revising the EIA report, and submitting it to MOT for approval.

On April 20, 2010, the Preparatory Survey Team had received a copy of the EIA report (in Vietnamese) revised by PMU2. At the time being, the Preparatory Survey Team had found several deficiencies in the report as followings.

a) Data on wind direction and wind speed are not sufficient to identify in which direction the wind has highest speed, and in which direction it has the lowest speed. Such data are necessary to predict concentrations of pollutants in ambient air in the future.
b) Surveys on air quality and water quality were conducted only one time during rainy season in August 2008. In order to be able to assess current state of natural environment properly, it needs to carry out such surveys during the dry season (around January ~February) in addition to the surveys in rainy season.
c) Survey on air quality (and noise) was conducted at 4 sites in 2008. However, survey on air quality (and noise) at the site near the Dinh Vu Industrial Zone had not been conducted, while many factories here are considered as potential sources of air pollutants (and noise). Therefore, (in the D/D stage) number of sites for survey on air quality (and noise) should be increased.
d) Survey on quality of surface water had been conducted at 8 sites in 2008. This number of survey sites is considered not sufficient, when comparing to the extension (about 16km) of the planned road. In order to have appropriate baseline data for a proper environmental management plan, it suggests that (in the D/D stage) number of sites for survey on surface water quality should be increased. In addition, survey on surface water quality should be conducted at least one time in the dry season and one time in the rainy season.
e) In the survey on surface water quality in August 2008, only parameters of pH, turbidity, DO, SS, and BOD5 were analyzed and assessed. However, in order to avoid/mitigate impacts to aquaculture and salt produce which are local residents' main sources of income, it also needs to carry out analysis and assessment on several metallic concentrations (asen, cadmium, lead, etc.) in surface water those may affect the local aquaculture and salt produce.
f) The socio-economic conditions of the project-affected communes, and local residents' living conditions, religious activities, neighborhood, etc. were not described appropriately. The roles of the Dinh Vu Ferry, schools, hospitals, etc. in the local society were not discussed in the report.

g) Methods to predict impacts on air quality, noise, vibration, etc. were not appropriate. Therefore, it can be said that impacts on air quality, noise, vibration, etc. had not been assessed in a reasonable manner.

h) Impacts to aquaculture, salt produce, and other means of livelihood of local residents were not assessed appropriately. Impacts that may cause by a large number of construction laborers came from outside during the construction phase were also not assessed properly. Main issues described in the RAP report were not appropriately referred to.

i) In the report, it lacks a section to describe about the measures to mitigate impacts in the pre-construction phase (such as impacts of land acquisition, resettlement, relocation of tombs, loss of source of income, impacts caused by the termination of ferry operation, etc.)

j) Role of an independent organization to be in charge of environmental monitoring during the construction phase was not identified clearly.

(2) Item of the EIA report to be improved

Table 3.3.1 describes items of the EIA report that should be improved.

Table 3.4-1 Items to be Improved by Brief Review of Revised EIA Report

No.	Item	Action			
		PMU2	Preparatory Survey	D/D	C/S
Environmental Consideration					
a	Data on wind direction and speed	○			
b&c	Survey on air quality			○	
d&e	Survey on surface water quality			○	
g	Prediction of impacts on air quality and noise by proper methods		○		
Social Consideration					
f	Descriptions on socio-economic conditions of project-affected communes	○			
h	Assessment of impacts on social environment	○			
i	Mitigation measures for impacts on social environment	○	○	○	
j	Environmental Management Plan and Environmental Monitoring Plan	○	○	○	

(3) Public Consultation

A public consultation meeting was organized on 28 April 2010 at Civilization Center of Cat Hai City. Approximately 80 local residents and representatives of local authorities of Cat Hai District, Cat Hai Townlet, Nghia Lo Commune, and Dong Bai Commune have participated the meeting. Record of the meeting is attached as an appendix in the EIA Report.

A number of comments and requests had been raised by participants at the meeting, such as the followings.

a) Residents' comments on environmental impacts

- Measures to mitigate impacts of exhaust gas, dust, and other air pollutants should be carefully examined, due to the fact that aquaculture and salt production which are main sources of income of local residents would be affected significantly.
- Polluted water from construction activities and waste water from worker camps should be discharged somewhere outside of the Cat Hai Island, to avoid polluting surface water bodies of the island.
- In the operation phase, noise generated by moving vehicles with high speed would be significant and should be mitigated by appropriate measures.
- Sites to dispose waste soils, construction wastes, etc. should be appropriately examined.

b) Residents' comments on socio-economic impacts

- A significant number of workers would come and cause disturbance of local community's security.
- Land prices (including residential land, aquaculture land, salt production land, etc.) s stipulated by Hai Phong City PC are too low compared to market price.
- Resettlement at site (near existing residence, fish ponds, salt pan, and ancestor's tombs) would be considered as first priority mode of resettlement for residents who would lose their residential land. It will be very hard for them to maintain the existing production, spiritual activities, neighborhood, etc. if they have to resettle far away from their existing residence.
- It is anticipated that about 120 graves would be removed to make land for the project. However, the project proponent should soon be discussed with local residents to work out a plan to construct a new cemetery or expand the existing cemetery. Relocation of graves should be carried out prior to the relocation of people, since relocation of ancestors' graves is considered very important for local residents.
- Aged people are depending on lands for aquaculture and salt production for their livelihood. So, it will be very difficult for them to seek other means of livelihood if they lose these existing lands.
- As may be seen in other development projects, the livelihood restoration programs were not duly implemented as promised by the project owners. Young people might be supported to get new job in companies, factories, etc. after obtained vocational trainings. But they were soon fired or found themselves difficult to maintain their job for a long time. Therefore, competent authorities should carefully examine proper measures to deal with this problem.

(4) Revision and approval of EIA report

On April 29, 2010, the Survey Team had discussed with PMU2 about the result of the EIA review. Based on the Survey Team's comments, local residents' opinions raised in the public consultation meeting held on April 28, 2010, and comments from MOT's environmental experts,

PMU2 had revised the EIA report and submitted it to MOT for approval on May 4, 2010. Following Decision 1214/QD-BGTVT made by MOT's Vice Minister on May 10, 2010, the Appraisal Council of EIA Report for the Project was established on the same day which consists of 9 members. The Appraisal Council had organized a meeting on May 13, 2010 to appraise the EIA Report for the Project.

Based on comments raised by the Appraisal Meeting, PMU2 had revised the EIA Report, and submitted it again to the Appraisal Council on May 24, 2010.

On May 27, 2010, MOT had issued Decision 1420/QD-BGTVT on the approval of the EIA report.

Decision 1420/QD-BGTVT lists up a number of requirements as following for the project owner to obligate.

a) Apply proper technical and management methods, and organizational arrangement to mitigate adverse impacts to ambient air, soil, surface water, underground water, and ecosystem in the project area;
b) Closely coordinate with relating agencies to prevent and control unexpected traffic accidents, working accidents, explosion and fire, oil leakage, and other incidents. Carry out proposed measures to restore construction sites, cleansing river beds to ensure safety of the waterways and environmental sanitation of the rivers;
c) During construction phase, ensure that noise, vibration, dust concentration, exhaust gas and waste water are in compliance with the Vietnam Environmental Standards and Protocols. Properly collect and treat waste water generated from the worker camps;
d) Properly collect, classify, store, transport and treat domestic wastes, construction wastes, and hazardous wastes generated by the Project in compliance with relevant regulations;
e) Coordinate with local authorities to implement compensation, resettlement for affected people in compliance with relevant regulations;
f) Store and handover all documents relating to environment protection of the project to the Highway Management and Operation Agency after completion of the project.

3.4.2. Review and Confirmation of RAP

(1) Review of RAP report

A RAP Report for the Project was prepared as a part (Volume IV: Resettlement Action Plan) of the F/S Report prepared in July 2009 by Vietnam Infrastructure Development and Finance Investment Joint Stock Company (VIDIFI). Hyder Consulting Ltd was in charge of preparation of this RAP.

However, after Prime Minister's decision to transfer the project ownership from VIDIFI to MOT, PMU2 became the body in charge of revising the RAP.

At the time being, as a result of the review of the RAP prepared in July 2009, the Preparatory Survey Team had found several deficiencies in the RAP as described in the following table. Recommendations on necessary actions to revise the RAP are also described.

Table 3.4-2 Result of review of the RAP report prepared in July 2009

Requirements by JBIC	Descriptions in the RAP	Requirement for further actions
1. Introduction		
1.1 Project Scope		
a) Project background b) Objectives of the project c) Project Scope d) Project location map	- Section 1.1 of the RAP includes a brief description on project objectives, project background, scope, location map.	-
1.2 Objectives of Resettlement		
a) Land acquisition and resettlement principles and objectives b) Consideration under the "JBIC Guidelines for Confirmation of Environmental and Social Considerations (2002. 4)" c) Legal framework	a) Lack of relevant description b) Lack of relevant description (Section 1.4 describes about differences between resettlement policies of Vietnam and WB, ADB) c) Section 1.3 & 1.5 include a list of Vietnam legal documents related to land acquisition, compensation and resettlement. However, it lacks of description on recently-issued legal documents (such as Decree 69/2009/ND- CP, decisions issued by Hai Phong City PC)	- Descriptions on Decree 69/2009/ ND-CP, decisions recently issued by Hai Phong City PC, and parts of JBIC Guidelines relating to land acquisition, resettlement, etc. should be added.
2. Scope of Land Acquisition and Resettlement		
2.1 Land acquisition		
a) Map of the area and villages affected by land acquisition b) Total land area acquired for the project	a) Lack of administrative maps b) Land areas acquired for the project are described in detail in Section 3.2, 6.4, etc.	- A map showing the administrative boundary of project- affected communes, townlet, district, etc. should be added.
2.2 Population/households affected by land acquisition and resettlement		
a) Total number of PAPs b) Size of relocation (number of population/households to be relocated) c) Size of those who lose their assets d) Size of those whose business, occupation, work are adversely affected	- Scale of land acquisition, affected properties, number of households affected by the project, etc. are described in detail in Chapter 4.	- A detailed Inventory of Losses (IOL) should be carried in the D/D stage to update data on lands, properties, etc, to be affected by the Project.
2.3 Census and Inventory of Losses (IOL)		
a) Demographic, education, income and occupational profiles of PAPs b) Land type and land use (agricultural, residential, commercial land) c) Type of crops and trees d) Buildings type (size, materials used)	- A survey on IOL was carried out during July~August 2008. - The following data on PAHs were collected: legal land-use-right, area of land to be acquired (divided by type of land use), structures to be lost, crops and trees to be lost, graves to be relocated, public structures to be	

Requirements by JBIC	Descriptions in the RAP	Requirement for further actions
e) Inventory of common property resources f) Inventory of assets to be acquired g) Existing civic facilities and infrastructure, etc.	relocated.	
2.4 Information on those without legal title to land or assets	- Information on residents without legal land-use-right was also collected during the IOL survey.	
3. Measures to minimize Land Acquisition and Losses		
3.1 Actions and measures to be conducted for minimizing impact	- Although compensation for losses of land and properties, and allowances for relocation, life stabilization, etc. are described, it lacks descriptions on necessary measures to avoid / mitigate impacts.	- Route alignment should be examined again carefully in the D/D stage with intention to minimize land acquisition and losses.
3.2 Consideration of alternatives with special attention to avoid and minimize involuntary resettlement	- Lacks of description	
4. Socio-Economic Feature of the Project- Affected People		
4.1 Socio-economic profiles of PAPs		
a) Size, gender, age, number of school children of each household b) Occupation and means of livelihood c) Income level and economic activities of PAPs, including vulnerable groups d) Race, language, religion e) Social support system, infrastructure of the community f) Needs of PAPs regarding the income restoration program and relocation g) Perception towards the project and resettlement, etc.	- Several key data on current socio-economic conditions of PAHs were collected during the IOL survey. - Socio-economic characteristics of PAHs are described in Chapter 3, including gender characteristic, ages and marital status, education level of head of PAH, mean of livelihood, number of family's member who is in labor age, income level, subsistence level, etc. - It lacks data and information on: (e) social support system, infrastructure of the community (such as schools, hospitals, etc); (f) needs of PAPs regarding the income restoration program and relocation; (g) perception towards the project and resettlement, etc.	- At least two surveys should be carried out (the first one in the early days of the D/D stage, and the second one at the commencement of the mass resettlement or construction) to collect data and information on socio-economic conditions of PAHs and affected communes.
5. Resettlement Policy and Entitlement		
5.1 Compensation policy	- Compensation policy is described in Section 2.4, 2.5	- Compensation policy should be revised based on Hai Phong City PC's recently-issued decisions, and other relevant legal documents issued by the GOV.
5.2 Eligibility for compensation/assistance/ rehabilitation	- PAP's entitlement for compensation was identified based on Vietnam laws (Section 2.3, Entitlement Matrix)	
5.3 Entitlement Matrix	- An Entitlement Matrix was prepared based on Vietnam laws and regulations, and is described in detail in Appendix 1.	
5.4 Assistance, support, compensation	- Additional assistances	

Requirements by JBIC	Descriptions in the RAP	Requirement for further actions
options	(allowances and other measures) for relocation, production stabilization, occupational change, and special assistance for poor and vulnerable PAPs are described briefly in Section 2.6.	
5.5 Cut-off date	- Lacks of description	- Description on the cut-off date should be added.
5.6 Compensation/assistance policy towards those who without legal title	- Compensation/assistance policy towards PAPs who without legal title is described in the Entitlement Matrix	-
6. Resettlement Site		
6.1 Method of site selection and site alternatives	- Lacks of description	- The RAP should be revised in the D/D stage, which should include concrete arrangements for relocation of houses, public structures, graves, etc., and construction plan of resettlement sites.
6.2 Location, layout, and design of resettlement site	- Lacks of description	
6.3 Resettlement site development (infrastructure, social service, etc.)	- Lacks of description	
7. Income Restoration Program		
7.1 Background of Income Restoration	- Lacks of description	- An income/ livelihood restoration program should be prepared in line of Decree 69/2009/ND-CP
7.2 Objective and policy of income restoration	- Lacks of description	
7.3 Income Restoration Program	- Lacks of description	
a) Constraints and opportunities for income generation	- Lacks of description	
b) Analysis of needs, capacity, and existing skills of PAPs	- Lacks of description	
c) Analysis of economic activities of PAPs and communities	- Briefly described (in Section 3.3)	
d) Consultation and participation process	- Lacks of description	
e) On-going income-generating or livelihood development programs (e.g., poverty alleviation) in the project area	- Lacks of description	
f) Provisions for group-specific, targeted income restoration plans (e.g., microcredit or small development)	- Lacks of description	
g) Income restoration options	- Lacks of description	
h) Financial source of income restoration plans	- Lacks of description	
i) Implementing arrangement of the program (e.g., assistance from government agencies, community organizations, NGO, or CBO)	- Lacks of description	

Requirements by JBIC	Descriptions in the RAP	Requirement for further actions
j) Consideration of vulnerable people	- Lacks of description	
k) Program implementing schedule	- Lacks of description	
l) Monitoring	- Lacks of description	
8. Implementation Arrangement		
8.1 Responsibilities and roles of related organization (organizations in charge of Basic Resettlement Plan preparation, resettlement execution, land acquisition, monitoring, consultation, resettlement site preparation, income restoration, etc.)	- Responsibilities and roles of related organizations are described briefly in Chapter 5. However, it should be revised based on the recently-issued Decree 69/2009/ND-CP	- In the D/D stage, the RAP should be revised, and include detailed descriptions on organizations and arrangements for the RAP implementation, as well as roles and participation of local mass organizations and NGOs, etc.
8.2 Description of cooperation between related organization (e.g., coordination between an executing agency and NGO/CBO.	- Roles of local mass organizations (such as Farmers' Unions, Women Union, and other NGOs) are described briefly in Chapter 5.	
9. Implementation Schedule		
9.1 Schedule of resettlement-related activities	- Lacks of description	- It should be added in the revised RAP.
10. Participation and Consultation		
10.1 Policy of participation and consultation	- Objectives of public information and consultation are described in Section 6.1.	- Activities necessary for information dissemination and public consultation and participation should be planned and described in the revised RAP.
10.2 Place, timing, method, topics, meeting memorandum of public consultation meeting held in the past (including PAPs' opinion regarding the project and resettlement)	- During the IOL survey, PAP was asked about their preferred mode of compensation (i.e. whether they prefer compensation by cash or by land). - However, no any public consultation meeting has been organized during the preparation of the RAP.	
10.3 Plan of participation and consultation	- Several activities required for consultation and information disclosure during RAP implementation are proposed briefly in Section 6.3.	
10.4 Leaflet of resettlement distributed to PAPs, including followings: - Objectives of the Project - Service area of the Project and Project site - Cost estimation and sources of capital - Project Implementation Planning (i.e., F/S, EIA, and Basic Resettlement Plan preparation) - Project Impact - Definition of Eligibility - Resettlement and compensation	- Lacks of description (leaflet has not been made yet)	- At least, a leaflet should be made in the D/D stage to disseminate information about the Project, its impacts, and proposed mitigation measures.

Requirements by JBIC	Descriptions in the RAP	Requirement for further actions
principles - Compensation policy - Subsidize allowances - Settling complain (Grievance Redress procedure) Note: Leaflet should be attached in the Annexes.		
11. Monitoring and Supervision		
11.1 Monitoring of flowing aspects:		
a) Performance monitoring: physical progress against milestones established in the Resettlement Plan b) Impact monitoring: assessment of the effects of resettlement (effectiveness of the Resettlement Plan and its implementation in meeting the needs of the PAPs)	- Objectives of monitoring and two purposes of monitoring are described in Section 8.1	- A Resettlement Monitoring Plan (including detailed arrangements for internal monitoring and external monitoring) should be prepared and added in the RAP.
11.2 Internal performance monitoring process (method, indicators, period, frequency, implementation arrangement of the monitoring)	- Method, indicators, period, frequency, implementation arrangement of internal monitoring are described briefly in Section 8.2.	
11.3 Methodology for external monitoring	- Methodology, and indicators for external monitoring are described briefly in Section 8.3.	
11.4 Frequency of reporting and content for internal and external monitoring	- These issues are described briefly in Sections 8.2 and 8.3.	
11.5 Evaluation method of monitoring result	- Lacks of description	
11.6 Process for integrating feedback from internal monitoring into implementation	- Lacks of description	
12. Grievance Redress		
12.1 Step-by-step process for registering and addressing grievances and specific details regarding a cost-free process for registering complaints, response time, and communication modes	- A four-stage procedure for redressing grievances is proposed in Section 6.5.	- Procedure for redressing and resolving grievances should be described in more detail.
12.2 Mechanism for appeal	- Only brief description.	
12.3 Provisions for approaching civil courts if other options fail	- Only brief description.	
13. Cost Estimate		
13.1 Statement of financial responsibility and authority	- Lack of description.	- Cost for monitoring (to implement the Resettlement Monitoring Plan) should be estimated and included in the cost for detailed design.
13.2 Source of funds and the flow of funds	- Lack of description.	
13.3 Estimated budget, by cost and by item, for all resettlement costs including planning and implementation, management and administration, monitoring and evaluation and contingencies	- Chapter 7 covers estimation of costs for: (1)compensation for losses of land and structures; (2) compensation for losses of crops and trees; (3) relocation of graves; (4) allowances for relocation, life	

Requirements by JBIC	Descriptions in the RAP	Requirement for further actions
	stabilization, occupational change, etc. (5) administration charges; (6) contingencies. - Cost for monitoring and evaluation is not included.	- Cost estimated for land acquisition, compensation, resettlement, livelihood restoration, monitoring, etc, should be revised.
13.4 Provisions to account for physical and price contingencies	- At the time of RAP implementation, adjustment of prices and costs is recommended.	

Source: Preparatory Study Team, May 2010.

(2) Revision and approval of RAP report

PMU2 had revised the RAP report prepared in July 2009, based on the Preparatory Survey Team's comments, and local residents' opinions raised in the public consultation meeting held on April 28, 2010. The RAP report was also revised in accordance with the decision to consider the plan of railway construction separately from the highway construction plan, and consequently reduce the scale of land acquisition and resettlement.

According to person in charge of PMU2, the revised RAP report was submitted to Hai Phong City PC for approval.

(3) Issues to be improved in RAP report

Table 3.4.3 summarizes major actions those are considered necessary to improve the RAP report.

Table 3.4-3 Required actions to improve the RAP Report

No.	Item	Action		
		PMU2	Preparatory Survey	D/D
Measures to minimized land acquisition and losses				
a	Change route alignment to avoid passing through Trung Hamlet			○
Grasping socio-economic feature of PAP				
b	Conduct two detailed socio-economic surveys in the pre-construction phase			○
Update resettlement policy and entitlement				
c	Update compensation policy based on Hai Phong PC recently-issued decisions	○		○
Resettlement site construction plan				
d	Prepare concrete plan to relocate affected houses, public structures, graves, etc. and to develop resettlement sites			○
Income/livelihood restoration plan				
e	Prepare an income/livelihood restoration plan for PAP			○
Implementation Arrangement				
f	Identify organizational arrangements for RAP implementation	○	○	
g	Work out a schedule of resettlement-related activities	○		○
Public participation and consultation				
h	Prepare a plan for information dissemination and public consultation		○	○
i	Make a leaflet to introduce about the Project			○
Monitoring and supervision				
j	Prepare a RAP Monitoring Plan		○	○
Grievance Redress				
k	Identify procedure for redressing and resolving grievances	○		○
Cost estimation				
l	Revise cost estimation for land acquisition, compensation, resettlement, livelihood restoration, monitoring, and supervision	○	○	○

3.4.3. Recommendations on Socio-Environmental Considerations

(1) Prediction of impacts on ambient air quality by proper method

The Plume Model (when wind velocity is higher then 1.0m/s) is used to predict impact of ambient air quality during operation phase of the Project and the results of prediction are presented in Appendix 7.

According to the prediction results described in Appendix 7, at A1 survey site, where the traffic volume is the highest among the planned highway, even at the survey point located 10m from the road side, the predicted concentrations of SO2, NO2, CO and TSP are lower than the maximum allowable values stated by the Vietnam Ambient Air Quality Standard TCVN 5937-2005 (SO2: 60.7μg/m^3, NO2: 52.7μg/m^3, CO : 3,566μg/m^3, and TSP : 132.5μg/m^3).

In all projected years (2015, 2020, and 2030), at all survey sites (A1, A2, A3, and A4), all predicted concentrations are lower than the maximum allowable values stated by the Vietnamese ambient air quality standard.

It should be noted that there are two constraints in this prediction: (1) due to the lack of data on air pollutants emission by vehicles in Vietnam, the coefficients of air pollutants emitted by moving vehicles using in this study are referred to the ones applied in Japan, and therefore, they may be inconsistent with actual situation in Vietnam; and (2) due to the lack of data on meteorology, the wind velocity (1.7m/s) described in the EIA Report is used for the prediction in this study. It may need to carry out further study with the use of other different data on wind velocity and wind direction to ensure the accuracy of the prediction.

(2) Impacts of noise during operation phase

Road traffic noise prediction model "ASJ RTN-Model 2003" developed by the Acoustical Society of Japan is used to predict impact of noise caused by the Project during operation phase and the results of prediction are presented in Appendix 7.

According to the prediction results described in Appendix 7, at A1 survey site, in 2020, the predicted noise levels at the survey point located 100m from the road side in the midnight is 52.1 dBA, and exceed the maximum allowable level for a business service-shopping-industrial mixed residential area stated by the Vietnam Standard (Acoustics - Noise in public and residential areas, maximum permitted noise level TCVN 5949-1998).

At A1 survey site, in 2020, the predicted noise level at the survey point located 100m from the road side in the midnight is 52.1 dBA, and exceed the maximum allowable level for a business service-shopping-industrial mixed residential area stated by the Vietnam Standard (Acoustics - Noise in public and residential areas, maximum permitted noise level TCVN 5949-1998).

At the A2, A3 and A4 survey sites, in midnight in 2030, the noise levels predicted in the area within 100m from the road side exceed the maximum allowable level for a residential area stated by Vietnam Standard TCVN 5949-1998.

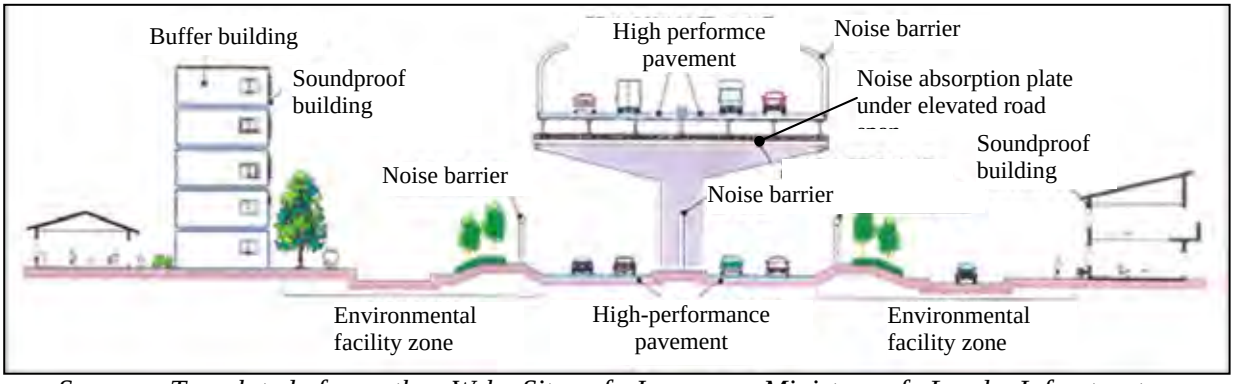
Therefore, along the route close to the residential areas, the proper mitigation measures such as the followings should be introduced.

- Apply high performance pavement
- Install noise barriers
- Install environmental facility zones
- Attach noise absorption plate under elevated road span
- Plant trees along sections of road near the populous residential areas;
- Install warning signs on road for horning bans and speed control at the road sections close to residential areas;
- Regular maintenance on road to keep good road surface condition;
- Respond to monitoring results which show higher noise than projected by the EIA.

Table 3.4-4 shows the functions of the typical noise mitigation measures and their effectiveness.

Table 3.4-4 Typical Noise Mitigation Measures

Mitigation Measure	Function	Effectiveness
High performance pavement	Absorb noise generated by friction between the car tires and road surface.	About 3 dB
Noise barrier	Reduce noise by diffraction	About 10 dB
Environmental facility zone	Reduce noise by distance from noise sources	5~10 dB
Noise absorption plate attached under elevated road span	Reduce noise reflected from the under surface of the elevated road span	2 ~ 5 dB (depends on level of reflected noise)



Source: Translated from the Web Site of Japanese Ministry of Land, Infrastructure, Transportation, and Tourism: http://www.mlit.go.jp/road/ir/data/souon/souon3.html.

(3) Survey on ecosystem

Dinh Vu - Cat Hai area is located in the estuary of Bach Dang River, where the land surface is formed by sediments consisting of mud, sand, etc.

In Appendix 3 of the EIA Report of the Tan Vu-Lach Huyen Highway Construction Project (May 2010), there is a description on results of the "Basic Investigation and Assessment of Regional Resources, Ecological Wonders, Geology of Vietnam Seas and Islands", carried out by Institute of Marine Environment and Resources (IMER/VAST) in November 2007 with supports provided by Belgium Government. According to this description, vegetable covering and land use structure of the area (within the coordinates : $20^0$47' ~ $20^0$50' north latitude and

$106^{0}45'$ ~ $106^{0}55'$ longitude), which covers the study area of Tan Vu – Lach Huyen Highway Construction Project [3] are as shown in Figure 3.4.1.

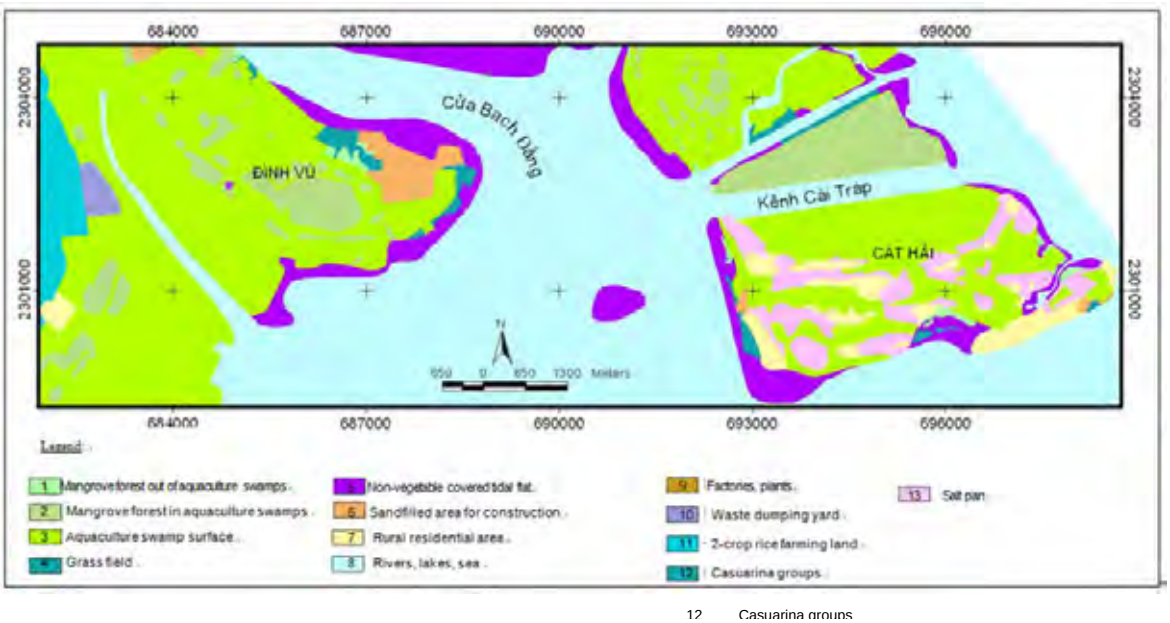


Figure 3.4-1 Distribution of vegetable covering and land use structure of the study area (in 2007)

In the study area, vegetable covering and land use are classified into 13 categories (see Table 3.4.4). Of which, rivers, lakes, sea occupy 77.56% of the study area, following by aquaculture swamps (15.76%) spreading evenly all over the study area. Mangrove forest in aquaculture swamps occupies 1.52%, distributing mainly in Dinh Vu peninsula and partly in Cat Hai Island. Paddy field concentrates in Trang Cat commune and makes up 1.03% of the area. Non-vegetable tidal flat occupies over 1.70% area, locating along the edge of Cat Hai Island and Dinh Vu, and all islands in the middle of Bach Dang River. Salt pan occupies 0.69% area, concentrating in Cat Hai. Sand-filled area for construction locates mainly in the Dinh Vu Industrial Zone. Rural residents concentrate mainly in Cat Hai and occupy 0.52% area. Casuarinas trees are grown in strips along the coast. Sea grass fields are also small and locate along former Cai Trap canal.

[3] According to the "*Basic Investigation and Assessment of Regional Resources, Ecological Wonders, Geology of Vietnam Seas and Islands"* , carried out by Institute of Marine Environment and Resources (IMER/VAST), November 2007, supported by Belgium.

Table 3.4-5 Vegetable covering and land use structure in the study area

Category	Vegetable covering and land use structure	Area (hectare)	Area (%)
1	Mangrove forest in aquaculture swamp	619.40	1.52
2	Mangrove forest out of aquaculture swamp	43.17	0.11
3	Aquaculture swamps	6,442.07	15.76
4	Grass field	73.96	0.18
5	Non-vegetable covered tidal flat	694.69	1.70
6	Sand-filled area for construction	307.97	0.75
7	Rural residential areas	211.79	0.52
8	Rivers, lakes, sea	31,694.26	77.56
9	Factories, plants	18.13	0.04
10	Waste dumping yard	35.44	0.09
11	Paddy field (2-crop rice field)	420.45	1.03
12	Casuarinas groups	20.79	0.05
13	Salt pan	281.94	0.69
	Total	40,864.06	100.00

Source: EIA Report of Tan Vu-Lach Huyen Highway Construction Project, May 5, 2010, Appendix 3.

As shown in Table 3.4.4, ecosystem of the water bodies (including river, lakes, and sea) is the most important in the study area, following by ecosystem of aquaculture swamps, and then ecosystem of non-vegetable covered tidal flats. These main ecosystems in the study area are described and assessed briefly in Section 2.1.5 of the EIA Report of the Tan Vu-Lach Huyen Highway Construction Project, May 2010. In this Section, results of a survey on ecosystem carried out by the Institute of Marine Environment and Resources (IMER/VAST) in 2007 are referred to as followings.

a) Water flora system

- Ephemera flora system: The majority is the species living in the tropical and subtropical warm coast, in which siliceous diatom (Bacillariophyceae) and Giap algae (Diniphyceae) predominate over Kim algae (Dictyochophyceae) and Lam algae (Cynophyceae). Density of the ephemera algae changes obviously under the seasons: density changes 5,000tb/l – 25,000 tb/l in the rainy season, and 1,000 – 10,000 tb/l in the dry season. In Dinh Vu Island, 145 species under 45 branches and 4 classes are discovered. Among the species, the green and indigo-blue algae are the freshwater species from the downstream when the tidal penetration in the estuaries weakens (Nguyen Huy Yet – Hai Phong Sub-Institute of Oceanography).

- Seaweed system: The area of Dinh Vu Island has about 16 species distributing on the tidal area, estuaries, aegiceras field and in the brackish water pond. In the high tidal area, there are often Ulva seaweed, Porphyra jam seaweed, Galidium agar seaweed and Brachytri shiny seaweed...

- Sea-grass plays an important role in the tidal area, so the sea-grass ecosystem is one of the

potential ecosystems about bio-diversification and ecological environment.

b) Water fauna system

In the project area, there are mainly ephemera fauna system and bottom fauna system. The ephemera fauna system includes spawns and young fishes with a large number in March and April. The bottom fauna system in the tidal area has about 538 species with 3 groups of the bottom fauna with a great number of sea-shell, crustaceans and silk worms.

In addition, in the area, there are also a number of fish species and the vertebrate species except fish such as reptile – amphibian, birds and animals.

c) Mangrove forest ecosystem

26 mangrove vegetable species are discovered in Cat Hai and Dinh Vu belonging to 20 families, including all three origin groups: major species group, halophilic-origin species group joining mangrove forest, and migrating inland species group. In which the number of species in Cat Hai (23 species) is more than that in Dinh Vu (17 species). Total number of species discovered in these two locations make up 63% (26/41) compared to total number of species of Hai Phong coastal region, in which Cat Hai makes up 56% (23/41), Dinh Vu takes 41% (17/41). Total number of species of the two studied locations occupies 52% compared to total number of species in the whole Northeast region (26/50), in which Cat Hai makes up 46% (23/50) and Dinh Vu makes up 34% (17/50). The data mentioned above show that Dinh Vu has less species than Cat Hai. It is worth to note that there were 30 mangrove vegetable species identified in Dinh Vu area during a research carried out in 1984, but now there are only 17 mangrove vegetable species identified in this area, so it may conclude that 23 species of mangrove vegetable have lost during about 23 year since 1984.

d) Brackish aquaculture pond ecosystem

In the brackish aquaculture ponds in the study area, there are edible sea species like shrimp, crab, fish, seaweed, especially glacilaria sp. Benthos group in aquaculture ponds is determined to include 71 species, less than those in tidal flats.

In conclusion, the studied area is rich in estuary ecosystems, biodiversity, and organism resources, including endemic species. However, the development of shrimp and fish ponds, as well as the urbanization are contributing to the deterioration of the ecosystems of the area. Ecological environment in the study area, especially in Dinh Vu Island, is being severely degraded with the plans to develop large-scale industrial zones in Dinh Vu Island and Cat Hai Island. No protected fauna or flora species are identified. And there was not indication of the existence of valuable nature habitats in the study area.

(4) Environmental Management Program

a) Summarization of adverse impact mitigation measures

The following Table 3.4.5 shows a summarization of recommended measures to mitigate

adverse impact described in the approved EIA Report. These measures are designed separately for pre-construction phase, the construction phase, and the operation phase.

Table 3.4-6 Summarization of adverse impact mitigation measures

Item	Mitigation measure
Pre-construction phase	
Land acquisition, relocation, resettlement	1) Inform / involve local stakeholders in the resettlement process from the early stage of the project through informative / discussion meetings in order to understand their needs and to build consensus on resettlement; 2) Carry out a socio-economic survey to collect data and information on project-affected people (PAP), their opinions, their expections, etc. and to feed back them into the D/D, detailed RAP (Resettlement Action Plan), the livelihood restoration plan, etc. 3) Re-evaluate land price to be used for calculation of compensation (referring to Circular 14/2009/TT-BTNMT issued on October 1, 2009) in order to reasonably adjust compensation price; 4) Revise and update the RAP (including the plan to relocation of graves, and public facilities affected by the project), the livelihood restoration plan (including the vocational trainings, the job promotion activities, etc.) 5) Coordinate with members of the technical design teams to examine and work out the following proposed impact mitigation measures: - Shift the route alignment of the section 13K+800 to the North to minimize affects to Trung Hamlet (Đồng Bài Commune, Cát Hải District), and consequently minimize number of PAP to be relocated; - Use riprap, or rock to embed slope faces of road embarkment, and/or grass the slope faces to minimize soil runoff by rain; - Plant trees along sections of road near the populous residential areas in Thon Hamlet and Ninh Tiep Hamlet, to mitigate impacts of noise, exhaust gas and dust to local residents; - Construct the separate drainage system along road and bridge sections near aquaculture ponds and salt pans to collect and catch polluted rainwater from road surface in the retention ponds and treat it properly before discharging to surface water body; - Construct several underpass routes at road sections near populous residential areas in Trung Hamlet and Ninh Tiep Hamlet in order to mitigate impacts of split of community; - Construct 2 interchanges at suitable locations near Ninh Tiep Hamlet and Trung Hamlet to improve local residents' accessibility to other cities; - Construct a parking area / service zone near the Cat Hai side-terminal of Got Ferry with an appropriate scale in order to facilitate the implementation of livelihood restoration plan for PAP (i.e peddlers and shopkeepers on Dinh Vu Ferry, at this ferry terminals, people with means of livelihood depending on aquaculture or salt produce affected by the project, shopkeepers along the existing road in Cat Hai Townlet, etc.) - Appropriately design of bridge piers (number of piers, pier shape) and apply proper pier construction method, in order to mitigate impacts of

Item	Mitigation measure
	erosion and sediment of rivermouth bed. 6) Properly relocate and/or repair public facilities (including the banks around Cat Hai island) which are affected by the project; 7) Carry out a survey for unexploded bombs along the project site, properly dismantle and treat the ones after discovered; 8) Carry out monitoring on RAP implementation and livelihood restoration plan implementation to confirm these plans are appropriately carried out; 9) Prepare an HIV/AIDS Prevention Plan in the early days of D/D stage; 10) Entrust a consultant or a NGO to implement the HIV/AIDS Prevention Plan during pre-construction phase and construction phase..
Construction phase	
a) Temporary obstruction of traffic	- Carefully prepare the construction plan in order to minimize the area and period of road occupation/ closure, and avoid concentration of construction vehicles; - Prior notice local residents on the road occupation / closure through sign boards and mass media; - Specify road occupation sites, construction sites, etc. to avoid vehicles mistakenly enter the sites; - Allocate personnel at place vulnerable to traffic congestion to instruct detour.
b) Air pollution	1) Carry out monitoring on ambient air quality; 2) Include the following tasks in bidding documents and contracts, and obligate contractors to duly carry out these tasks under supervision of Environmental Supervision Consultant (ESC): - Secure distance between construction machinery and construction site boundary as much as possible; - Avoid concentration of construction machinery and vehicles near the populous residential areas; - Use temporary barriers to control noise (and dust) around the construction sites near the populous residential areas; - The asphalt melting station should be equipped with flue gas control device, operation of asphalt melting will be in enclosed mode; cement and concrete will be mixed within an enclosed structure; - Construction roads should be paved with gravel or asphalt to reduce generation of air-borne dust, and mitigate impacts to residential areas, aquaculture ponds, salt pans, etc.; - Provide water spray vehicles to water the unpaved ground, storage piles and other areas where airborne dust may originate. The water spray operation should be carried out in dry and windy day, at least twice a day (morning and afternoon); - Trucks transporting construction materials should meet allowable exhaust gas emission standards (stated in Decision 249/2005/QĐ-TTg on October 1, 2005), and should be carefully covered.
c) Surface water quality	1) Carry out monitoring on surface water quality; 2) Include the following tasks in bidding documents and contracts, and obligate contractors to duly carry out these tasks under supervision of ESC:

Item	Mitigation measure
	- Construction of piers should be done by enclosing the site with retaining walls to minimize impact by turbulence; - The material stockpile site, the earthwork sites where exposed land surface is vulnerable to runoff, etc. should be consolidated and/or covered; - The material stockpile site should be far away from surface water body and the area prone to surface run-off. The loose materials should be bagged and covered. Open ditch should be built around the stockpile site to intercept wastewater; - Construction wastes should be collected and re-used wherever possible, otherwise should be disposed in the small deposit area invulnerable to surface run-off, along with soil erosion prevention measures; - Prevent the oil leak from the operation of the machinery by the regular check; - Clean up and restore the temporarily-used construction yards, facilities, etc.
d) Noise / vibration	1) Carry out monitoring on noise and vibration; 2) Include the following tasks in bidding documents and contracts, and obligate contractors to duly carry out these tasks under supervision of ESC: - A noise and vibration mitigation plan should be developed by the GC for implementation by the contractors; - On Cat Hai side, construction materials will be transported mainly on the construction road to the construction sites. On Tan Vu side, and Dinh Vu side, transportation will be done on existing road, and transportation schedule should be carefully designed to minimize adverse impact on residents, as well as traffic on the existing road. The transportation vehicles should be required to slow down and banned from horning when passing populous residential areas; - Construction activity near residential areas should be scheduled in daytime only, and the noisy equipment should be prohibited from night operation. During construction in daytime, the construction site will be fenced; - Construction equipment should be well maintained to keep it in a best operating conditions and lowest noise levels; - For workers who must work with highly noisy machines such as piling, explosion, mixing, etc., ear pieces should be provided for noise control and workers protection; - Although construction will be banned in night time some may still occur for technical and other reasons (e.g., bridge piles required continued, around clock concrete pouring). If the work is occurred in the night time and near villages and other residential areas, which would result in particularly significant impacts, special measures (such as use of noise barriers) should be taken into consideration to mitigate impact of noise and vibration; - Notice boards will be erected at all construction sites providing information about the project, as well as contact information about the site managers, environmental staff, telephone number and other contact

Item	Mitigation measure
	information so that any affected people can have the channel to voice their concerns and suggestions.
e) Construction waste	- Analysis of toxic material of soil to be excavated; - Utilization of excavated soil through recycling within the project; - Contracting out treatment / dumping / recycling of residual soil depending on soil quality; - Contracting out treatment / dumping / recycling of construction waste; - Measures for treatment / dumping / recycling carried out by the contractors should be monitored and supervised by the ESC.
f) Wastes from worker camps	- Obligate contractors to contract out collection of domestic waste from workers residents for appropriate treatment; - Obligate contractors to comply with Vietnamese standards for sewage emission from workers residents; - Obligate contractors to report measures taken for appropriate treatment of waste and sewage from workers residents.
g) Infectious diseases from workers	- Obligate contractors to duly implement the HIV/AIDS Prevention Plan during construction stage; - Obligate contractors to prepare and execute the health education plan for construction workers; - Obligate contractors to periodically report about the health education activities carried out by the contractors; - ESC shall monitor execution on health education activities carried out by the contractors; - Periodical reporting and consultation on health education activities to local health authorities.
Operation phase	
a) Ambient air quality	- Carry out monitoring of ambient air quality; - Carry out regular maintenance of road and bridge pavement. Spray water regularly on road surface at least 10 days/time in dry season; - Forbid trucks with over-emission from using the road; - Take care of trees and landscape along the road.
b) Surface water quality	- Build up two retention ponds nearby the road, one close to the Ninh Tiep Hamlet, and one close to the Trung Hamlet, where polluted water run-off from road and bridge is collected and treated by specific processes before being discharged into the surface water body. Class B of Integrated Standard for Wastewater Discharge QCVN 08:2008/BTNMT will be applied for wastewater discharge into river; - Regularly clean up the road and bridge (about 10 days/time) to mitigate runoff of polluted water to surrounding surface water body; - The leaky or uncovered truck will be forbidden from the road; - The wastewater system installed in the service zone / parking area near the terminal of Got Ferry will be maintained regularly.
c) Noise and vibration	- Take care of trees planted along the road, and grasses planted at the road slope surfaces; - Install warning signs on road for horning bans and speed control at the road sections close to residential areas of Trung Hamlet and Ninh Tiep Hamlet;

Item	Mitigation measure
	- Respond to monitoring results which show higher noise than projected by the EIA; - Regular maintenance on road to keep good road surface condition.
d) Dangerous material accident	- Emergency leading group will be established; - "Three licenses" system will be enforced to the trucks transporting dangerous material; - The trucks transporting dangerous material will be marked - Special lane and parking lots will be designated for the trucks transporting dangerous material.

b) Objectives of the Environmental Management Program (EMP)

JBIC Guideline for Confirmation of Environmental and Social Considerations (April 2002) requires to confirm the progress of the activities related to environment management as following.

+ It is desirable that, after a project begins, the project proponents monitor: (i) whether any situations that were unforeseeable before the project began have arisen, (ii) the implementation situation and the effectiveness of the mitigation measures prepared in advance, and that they then take appropriate measures based on the results of such monitoring;
+ In cases where sufficient monitoring is deemed essential for the achievement of appropriate environmental and social considerations, such as the projects for which mitigation measures should be implemented while monitoring their effectiveness, project proponents must ensure that project plans include monitoring plans which are feasible;
+ It is desirable that project proponents make the results of the monitoring process available to project stakeholders; and
+ When third parties point out, in concrete terms, that environmental and social considerations are not being fully undertaken, it is desirable that a forum for discussion and examination of countermeasures be established based on sufficient information disclosure and include the participation of stakeholders in the relevant project. It is also desirable that an agreement be reached on procedures to be adopted with a view to resolving the problem.

To respond to the above-mentioned requirements, the Preparatory Survey Team recommends to prepare an Environmental Management Program (EMP) with the following components in the D/D stage.

The recommended EMP which includes an Environmental Monitoring Plan, is considered as a tool to ensure the environmental commitments made at the EIA study are implemented in an efficient and effective manner. The policy, objective and target of the EMP are recommended as followings.

Table 3.4-7 Recommended Policy, Objective and Target of EMP

Policy	Objective	Target
Foster sound environmental management program to oversee the environmental performance of the Project	Set up Environmental Management Program (including an Environmental Monitoring Plan) for design, construction, operation stages to follow up implementation of EIA requirements	Carry out routine monitoring and data analysis to avoid adverse impact; audit and review environmental performance and implement mitigation measures in accordance with the Environmental Management Program

Major items to be included in the EMP are as follows:

+ Institutional arrangement for environmental management,
+ Method for environmental management (covering design phase, construction phase and operation phase, including project information disseminations, public consultations, and environmental impacts mitigation measures, such as traffic management plan, resettlement action plan, etc.),
+ Required budget and source of budget,
+ Time schedule for environmental management activities,
+ Basic criteria to be referred for environmental management activities,
+ Environmental Monitoring Plan
  - Monitoring items,
  - Monitoring method,
  - Frequency, duration of monitoring activities,
  - Implementation body for monitoring activities,
  - Required budget and source of budget,
  - Recording / public information system for monitoring results

c) Contents of the EMP

Design Phase EMP

* Objectives

The Design Phase EMP is designed to ensure and assure the environmental protection, and pollution prevention and control designs are able to comply with the approved EIA report's recommendations, DONRE's requirements and conditions, as well as endorsed public comments on the Project. The Design Phase EMP will outline, *inter alia*, its objectives and the means to achieve these objectives as:

(a) Management framework of the Design Phase EMP;
(b) Project organization for the design activities, including the designation of responsibility for each design function and level;
(c) Works program for the design and the deliverables arising from the translation of EIA, DONRE and other requirements/commitments into the project design;
(d) Systematic design protocols; to increase efficiency in use of resources (i.e. materials and energy); minimize pollution from chosen materials/form of design; reduce

impacts associated with the disposal of materials; encourage the recovery, reuse and recycling of materials; as well as minimize potential nuisances, such as, noise, smell and vibration, etc;

(e) Scope and content of design environmental monitoring and audit, and duty of the design engineer;
(f) Design audit procedure and duty of the Environmental Supervision Consultant (ESC);
(g) Systematic protocols to ensure all requirements are translated from the EIA process to design, contract and subsequent tendering documentation, with the aim to ensure the implementation of all the project's environmental requirements, in a coherent, consistent and timely manner;
(h) Protocol/procedures to deal with any environmental design changes and the necessary actions to achieve the required or enhanced project environmental performance, including the implementation of the ESC's recommendations.

* EIA Recommendations/DONRE Requirements

All environmental protection conditions, recommendations stated in the EIA report, DONRE's requirements and any endorsed public comments related to the design phase of the development project will be clearly identified in the Design Phase EMP, in a tabulated format for easy reference.

* Environmental Monitoring

The Design Phase EMP will require a self-monitoring and audit approach for the design engineer to certify completed environmental design elements. Such an audit will ensure compliance with the requirements resulting from application of the EIA process.

In addition, as described in the following Table 3.4.7, a number of specified social and environmental items will be monitored, with corresponding indicators, frequency, and sites (see Figure 3.4.2 for locations of sampling sites). These monitored data will be used as baseline data for assessment of environmental status during the next coming phases of the Project. Contents of this table will be reviewed and revised during the D/D stage.

Table 3.4-8 Environmental Monitoring - Pre-construction Phase

Items	Indicators	Frequency	Sites
1 Resettlement	Conformation that explanatory meetings were held, Confirmation that comments were collected from local residents	Once	-
2 Air Quality	SPM, CO, NO2, SO2, Carbohydrates, microclimate parameters	Once	7 sites
3 Noise	Leq, L10, L90	Once	7 sites
4 Water Quality	Temperature, pH, Turbidity, EC, BOD, COD, DO, Total-P, Total-N, Oil-grease, Coliform	Once	9 sites
5 Health Education Activities	State of health education plan preparation by the contractor (as described in the HIV/AIDS Prevention Plan)	Once	-

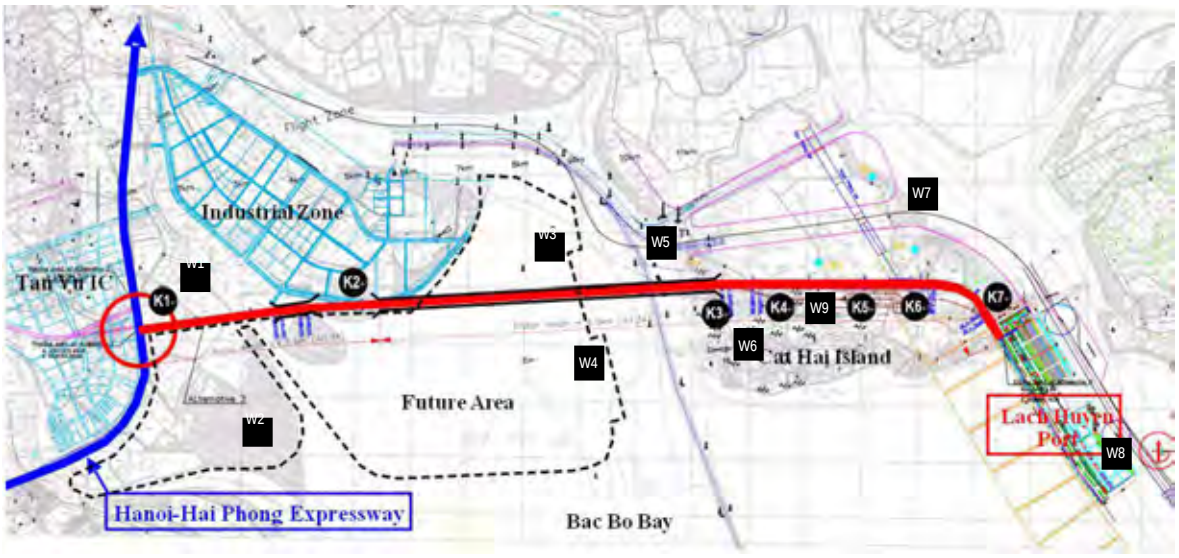


Figure 3.4-2 Locations of sampling sites of ambient air, noise, and surface water

Table 3.4.8 shows coordinates of locations of sampling sites of ambient air and surface water:

Table 3.4-9 Coordination of location of sampling sites of ambient air and surface water

Sampling sites of surface water			Sampling sites of ambient air		
Location	Coordinates		Location	Coordinates	
Wl	20°48'25.56"N	106°46'28.33"E	K1(Al)	20°48'13.09"N	106°44'48.78"E
W2	20°47'26.02"N	106°46'23.17"E	K2	(to be identified)	(to be identified)
W3	20°49'4.60"N	106°48'50.27"E	K3(A2)	20°48'36.89"N	106°50'51.76"E
W4	20°47'51.63"N	106°48'21.03"E	(A3)	20°48'0.59"N	106°51'10.64"E
W5	20°48'44.65"N	106°50'26.22"E	K4	(to be identified)	(to be identified)
W6	20°48*6.84"N	106°50'38.56"E	K5(A4)	20°47'56.32"N	106°53'31.48"E
W7	20°48'51.35"N	106°52'57.39"E	K6	(to be identified)	(to be identified)
W8	20°47'58.23"N	106°54'12.09"E	K7	(to be identified)	(to be identified)
W9	(to be identified)	(to be identified)			

* Environmental Auditing

The Design Phase EMP will be audited by Environmental Experts of General Consultant to validate compliance with the environmental protection conditions, and EIA process recommendations and requirements. The audit is required to confirm that no resultant secondary or unforeseen or cumulative impacts arising due to the design or design changes, etc. have been introduced into the project implementation process.

* Documentation Requirement

The reporting requirement and the frequency of reporting will be stated in the EMP. A Design Phase EMP report will be produced to conclude the environmental design work at the end of

each audit period. The audit period will be documented in the Design Phase EMP and agreed with DONRE and JICA.

Construction Phase EMP

* Objectives

The purpose of the Construction Phase EMP is to guide the environmental management during the project's construction phase to ensure compliance with the environmental protection conditions, EIA study recommendations, relevant environmental protection, and pollution prevention and control legislation. The Construction Phase EMP will be used to assess the effectiveness of, inter alia, the implementation of the recommended environmental impact mitigation measures and to identify the need for any additional mitigation measures or remedial action.

The Construction Phase EMP will contain the following:

(a) Further clarification of duties of the Environmental Experts of General Consultant, the Environmental Supervision Consultant (ESC), Environmental Team of Contractors, in relation to the Project's environmental monitoring and audit requirements during construction;
(b) Information on the project organization and programming of construction activities;
(c) The project construction schedule and the necessary environmental monitoring and audit program to track the environmental impacts;
(d) Requirements for the review of pollution sources and working procedures in the event of non-compliance of the project's environmental performance criteria;
(e) Environmental monitoring protocols and their technical requirements;
(f) Environmental auditing procedures;
(g) Requirements for the documentation of environmental monitoring and audit data, and appropriate reporting procedures; and
(h) Complaint resolution procedures.

* EIA Recommendations and EMP Requirements

All environmental protection conditions, EIA study recommendations and requirements, DONRE's requirements, and any endorsed public comments related to construction phase of the development project, will be included in the Construction Phase EMP, in a tabulated format for easy reference (i.e. Implementation Schedule)

* Implementation Organization

Arrangement of persons in charge of EMP implementation is recommended in Figure 3.4.2

* Technical Requirements for Monitoring: Location, Sampling, Frequency and Laboratory Analysis

The Construction Phase EMP will cover the project's requirements for environmental monitoring and audit stated in the approved EIA Report. Following issues will be taken into account.

(a) All sources of environmental impacts due to the activities of the development will be identified and quantified and documented in the EMP reports;

(b) All environmentally sensitive areas as a result of the development project will be identified and documented in the EMP reports;

(c) A systematic collection of data for (i) Baseline Monitoring; (ii) Impact Monitoring; and (iii) Compliance Monitoring, will be designed.

The following Table 3.4.9 describes items to be monitored, as well as its indicators, frequency, and sites. However, contents of this table will be reviewed and revised during the detail design phase.

Table 3.4-10 Environmental Monitoring Program - Construction Phase

Items	Indicators	Frequency	Sites
1 Resettlement	Conformation that resettlement activities are done in compliance to the RAP	Once	-
2 Air quality	SPM, CO, NO2, SO2, Carbohydrates, microclimate parameters	6 months/ time	7 sites
3 Noise	Leq, L10, L90	6 months/ time	7 sites
4 Water quality	Temperature, pH, Turbidity, EC, BOD, COD, DO, Total-P, Total-N, Oil-grease, Coliform	6 months/ time	9 sites
5 Soil (waste disposal)	PH, Total-organic, Total-P, Total-N, acidity, CL-, SO4-, Cu, Zn, Pb, Hg, fertilizer, Report from contractor on treatment / dumping of the soil	Once for each site	6 sites (will be revised in D/D stage)
6 Health education activities	Execution of health education activities (in coordination with the body in charge of implementation of HIV/AIDS Prevention Plan)	2 times / year during construction	-

* Site Surveillance

Site surveillance provides a direct means to assess and ensure the project's environmental protection and pollution control measures are in compliance with the contract specifications. Site surveillance will be undertaken regularly and routinely by the ESC to inspect the construction activities in order to ensure that appropriate environmental protection and pollution control mitigation measures are implemented in accordance with EIA recommendations.

The ESC is responsible for formulation of the environmental site inspection, deficiency and remedial action reporting system, and for carrying out the site inspection works. He shall in consultation with the Environmental Experts of GC, prepare a procedure for the site inspection, deficiency and remedial action reporting requirements.

Regular site inspections shall be carried out at least once per week for all works areas.

The inspections shall cover the environmental situation, pollution control and mitigation measures within the Site; they shall also review the environmental situation outside the Site area which is likely to be affected, directly or indirectly, by the site

activities.

The Contractor shall update the ESC with all relevant information of the construction contract for him to carry out the site inspections. The inspection report results and its recommendations for any necessary improvements in the project's environmental performance shall be submitted, in a site inspection proforma, to the Environmental Experts of GC and to the Contractor within 24 hours, for reference and the taking of immediate remedial action. The Contractor shall follow the procedures and time-frame as stipulated in the environmental site inspection, deficiency and remedial action reporting system (formulated by the ESC) to report on any remedial measures subsequent to the site inspections.

Ad hoc site inspections shall also be carried out by the ESC or Environmental Experts of GC if major unacceptable or unforeseen environmental problems are identified. Inspections may also be required subsequent to receipt of an environmental complaint, or as part of the investigation work, as specified in the detailed action plan for environmental monitoring and audit.

* Complaint Procedure

Complaints will be referred to the ESC for carrying out complaint investigation procedures. The ESC will undertake the following procedures up on receipt of the complaints:

a) Log complaint and date of receipt onto the complaint database and inform the Environmental Experts of GC immediately;
b) Investigate the complaint to determine its validity, and to assess whether the source of the problem is due to project works;
c) If a complaint is valid and due to project works, identify mitigation measures in consultation with the Environmental Experts of GC;
d) If mitigation measures are required, advise the Contractor accordingly;
e) Review the Contractor's implementation of the identified and required mitigation measures, and the current situation;
f) Undertake additional monitoring and audit to verify the complaint if necessary, and ensure that any valid reason for complaint does not recur through proposed amendments to work methods, procedures, machines and/or equipment, etc.;
h) Report the investigation results and the subsequent actions to the complainant; and
i) Log a record of the complaint, investigation, the subsequent actions and the results in the monthly EMP reports.

* Documentation

All documentation shall be filed in a traceable and systematically manner. Site document, such as, monitoring field records, laboratory analysis records, meeting minutes, correspondences etc., shall be cross-referenced by the ESC's leader and be ready for inspection upon request. All Construction Phase EMP results and findings shall be documented in the Construction Phase EMP reports prepared by the ESC and endorsed by Environmental Experts of GC prior to disseminate to the PMU2 and JICA.

The content and frequency of the EMP reporting shall be determined in the detail design stage.

Operation Phase EMP

* Objective

There is often a considerable span of time between the preparation stages of a development project and its operational stage. Changes adopted during the course of a project's implementation might ultimately affect the predicted environmental performance of the project. An Operation Phase EMP is required to ensure the long-term impacts (such as ground subsidence, groundwater movement, noise/vibration, resettlement, etc.) are monitored, and appropriate mitigation measures are duly implemented.

* Operation Phase EMP Requirements

The environmental protection conditions, including, all statutory limits for project operation, all EIA study recommendations and requirements, DONRE's comments and any endorsed public comments related to the operation phase of the development project shall be clearly defined in the Operation Phase EMP. The various measures for implementation by the road management authority shall be in a tabulated format for easy reference

* Methodology

(a) Pursuance of an Environmental Management System

For long-term environmental monitoring, it needs to pursue a structured environmental management system (EMS) integrated with the day-to-day management of the operation of the development project. The EMS shall be a systematic, independent evaluation of the operational environmental impacts and shall verify compliance with statutory limits, any relevant standards and criteria, and the EIA study recommendations and requirements.

The following Table 3.4.10 describes items to be monitored, as well as its indicators, frequency, and sites. However, contents of this table will be reviewed and revised during the detail design phase.

Table 3.4-11 Environmental Monitoring Program - Operation Phase

Items	Indicators	Frequency	Sites
1 Resettlement	Collection of comments from residents resettled	Once	-
2 Air quality	SPM, CO, NO2, SO2, Carbohydrates, microclimate parameters	Once	7 sites
3 Noise	Leq, L10, L90	Once	7 sites
4 Water quality	Temperature, pH, Turbidity, EC, BOD, COD, DO, Total-P, Total-N, Oil-grease, Coliform	Once	9 sites

(b) Clarification of an Environmental Policy

The Operation Phase EMP shall include an Environmental Policy statement represents a commitment by the road management authority to carry out project activities, either directly or indirectly under his control, in a sustainable manner and with the aim of protecting the environment.

* Planning and Management

The formulation of environmental objectives represents the translation of a project's policy into action and paves the way to achieve a project's environmental targets. The following issues will be clarified in the Operation Phase EMP:

(a) Environmental organization

It is recommended that an Environmental Team (ET) should be established in the organization structure of Highway Operation and Management Authority (HOMA), and be integrated into the normal management system and the routine production/operation of the HOMA. The environmental manager leading the ET should report directly to senior management, such as, CEO or GM of the HOMA.

In the ET, there should be at least one expert in charge of environmental management, monitoring and landscape conservation. He should have basic knowledge on environmental legislation and technique, and should understand clearly about major issues described in the EIA Report. His responsibility is to ensure that all requirements described in the EIA Reports and in the relevant legal documents are duly implemented. In addition, the ET should have a task unit in charge of cleaning up the road, taking care the trees, and improving landscape along the road, etc., under the environmental expert's instruction and supervision.

(b) Resource arrangements

The quality and training of ET staff; provision of appropriate and effective instrumentation and equipment, transportation; laboratory analyses, and comprehensive equipment and instrument calibration and maintenance contracts are important elements for the successful performance of an Operation Phase EMP. A resource allocation schedule will be recommended for timely and effective implementation of the Operation Phase EMP.

(c) Empowered authority and responsibility

Necessary and sufficient empowerment is an efficient and effective management mechanism to enable the Environmental Team to prevent, correct and stop any unfavorable or unforeseen environmental impacts.

(d) Conflict resolution

Mechanism proactive environmental review of all project operational activities is the optimum means to reduce "end-of-pipe" environmental problems. The Environmental Team should establish close communication channels with all of the project's components or facilities; and through routine environmental meetings, seek mutual understanding and the resolution of environmental problems. In addition promote environmental awareness amongst all staff.

* Documentation

The documentation and reporting requirements as well as the frequency of reporting shall be stated in the Operation Phase EMP. A generic outline for Operation Phase EMP reports is proposed as following:

a) Project Background
b) Project Proponent/Operator Particulars
c) Environmental Policy
d) Environmental Objective
e) Description of Operation Process (Uses of raw materials resources, output of the

process, by products and the associated environmental impacts.)

f) Organization Structure (option for an EMS within the management structure; Flowchart to show the hierarchy of the environmental team and the inter-relationships with other department of the facility)
g) Operation Phase EMP Requirements
h) Duty of Environmental Team and Independent Auditing (if necessary)
i) Technical Requirement for Monitoring
j) Compliance Requirements
k) Complaint Procedure
l) Environmental Training and Awareness Program

Appendices

i) Location Plan and Facility Process Flowchart
ii) Location of Sensitive Receivers
iii) Monitoring Locations
iv) Implementation Schedule
v) Environmental Monitoring Technical Summary
vi) Process Audit Proforma
vii) Listing of relevant Regulations

In addition, following reports shall also be prepared and submitted in accordance with the commitments stated in the Operation Phase EMP:

(a) Baseline EMP Report (submit 1 month prior to the commissioning of project operation)
(b) Operation Phase EMP Reports (Monthly, quarterly and annually reports will be prepared and submitted within 10 working days subsequent to the reporting period.)

d) Organization in charge of EMP implementation

Based on experiences obtained from similar transportation infrastructure development projects in Viet Nam, in order to ensure that all activities planned in the EMP are efficiently and successfully carried out, it is recommended that the authorities, entities, etc. listed below should take part in the organization in charge of EMP implementation.

- Department of Natural Resources and Environment of Hai Phong City (Hai Phong DONRE), and other local authorities in charge of environmental protection in Hải An District and Cát Hải District;
- Project Management Unit 2 under Ministry of Transportation (PMU2, who has an environmental team in charge of supervision of the EMP implementation, with the assistance of General Consultant);
- General Consultant (who is in charge of detailed design, preparation of bidding documents, and construction supervision of the project, including supervision of the EMP implementation, with the assistance of a sub-consultant taking role as the Environmental Supervision Consultant);
- Contractors (with several environmental staffs in charge of carrying out activities relating to environmental protection, management and monitoring described in the

EMP and in the contract).

e) Organization chart

Figure 3.4.3 shows organization chart for the EMP implementation in pre-construction phase and construction phase.

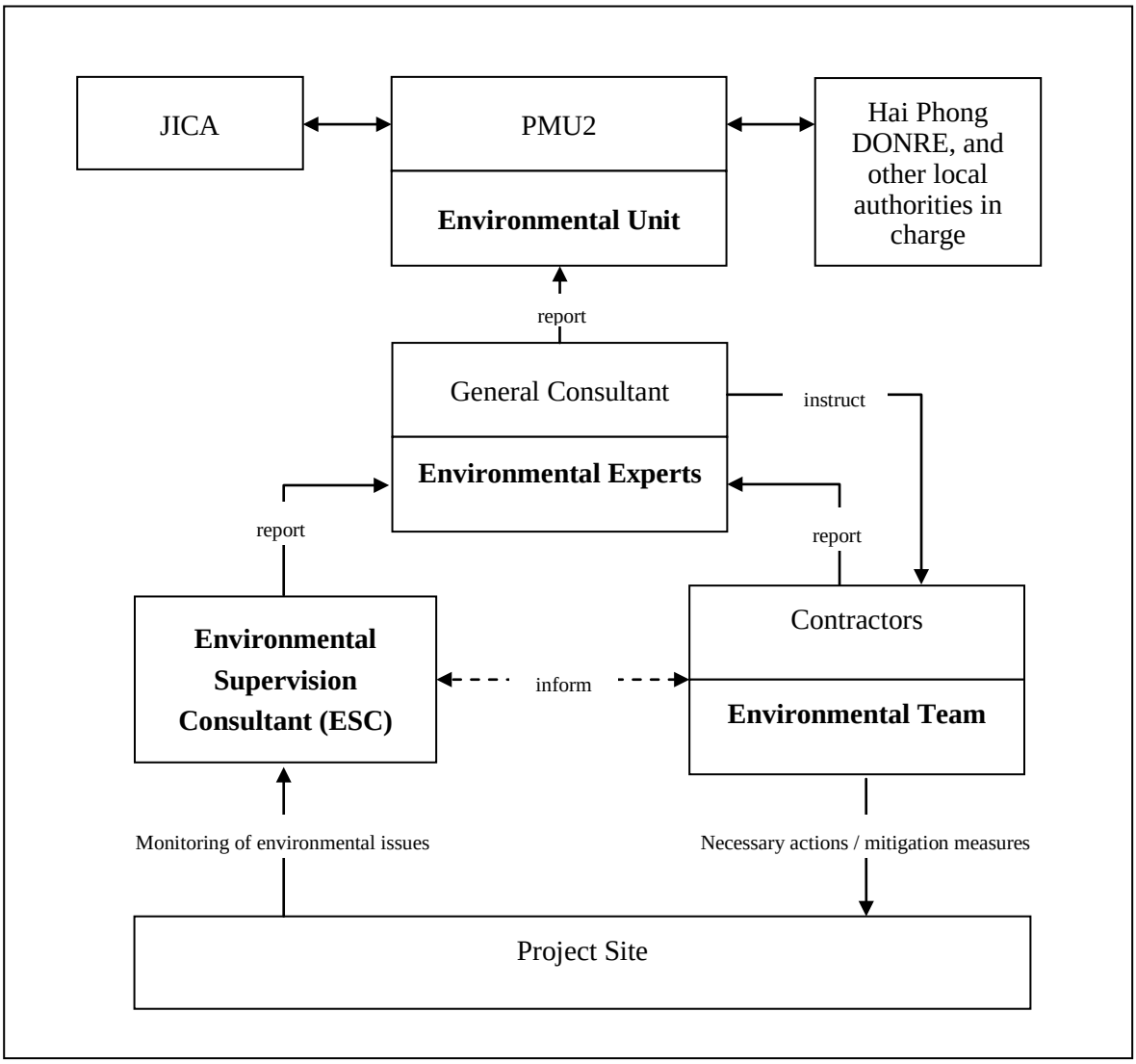


Figure 3.4-3 Organization chart for EMP implementation (pre-construction phase and construction phase)

f) Responsibilities of local environmental management authorities

Hai Phong DONRE and environmental management authorities of Hai An District and Cat Hai District are responsible for supervision of project activities which are described in the approved EIA Report as causes of impacts to environment within their territory. These environmental authorities will also supervise the realization of requirements which are described in the approval decision issued by MOT, and the environmental commitment submitted by project proponent to affected districts. Their roles and responsibilities are:

- Supervise the implementation of EMP;
- Enforce applicable laws, regulations and standards;

- Coordinate the environmental protection effort among departments concerned;
- Check and supervise construction, completion and operation of environment facilities within their jurisdiction scope;

g) Responsibilities of Project Management Unit 2 (PMU2)

On behalf of MOT, PMU2 has the ultimate responsibility for environmental performance of the project during both construction and operational phases. This is a day to day management organization for management of all aspects of project preparation and construction. In order to be able to fulfill this responsibility, PMU 2 should have an Environmental Unit which consists of full time professional staffs on board to directly lead the supervision and management efforts from the PMU2 for environmental management of the project.

During pre-construction phase, the Environmental Unit takes charge of supervising the preparation of the EIA Report and application procedures for the approval of the EIA Report.

During the D/D stage, the Environmental Unit will take charge for the following tasks

- Supervise the preparation of the detailed EMP;
- Supervise the implementation of the EMP; the additional surveys to collect baseline data on ecosystem, ambient air quality, noise, surface water quality, etc.
- Ensure the interactions between the environmental experts and project planners and engineers for integrating mitigation measures and other environmental considerations and programs and requirements into project design;
- Supervise the incorporation of environmental requirements into bidding documents, and construction contracts;
- Supervise the trainings organized by General Consultant to strengthen environmental management capacity of contractors, and local staffs of PMU 2;
- Supervise the conduction of periodical inspections of the construction sites;
- Engage and supervise environmental monitoring plans, receive and review monitoring reports from the ESC as well as from contractors on their regular reports for environmental performance and timely initiate necessary remedial actions as may be needed in response to the findings and/or recommendations, including any emergency, accidental situations and chance finds during construction;
- Consult and/or communicate to the local communities, project affected people, regulatory agencies, JICA and other stakeholders during the project preparation and construction to ensure them the full knowledge about the project progress, potential issues and mitigation actions, as well as to listen and respond to their concerns, suggestions and demands for environmental and community protection.

h) Responsibilities of General Consultant

On behalf of the project proponent, General Consultant will take charge of ultimate supervision of all activities relating to environmental management of the project. General Consultant will have at least two Environmental Teams (ET), one will be in charge of management of natural environment, and one will be in charge of management of socio-economic environment. Each team may have at least one foreign environmental expert and one local environmental expert. Besides, General Consultant will entrust an Environmental Supervision Consultant (ESC) through a sub-contract to take charge of direct supervision of the EMP implementation.

Environment-related responsibilities of General Consultant will be identified in detail in the contract for consultant services, and will cover at least the following tasks.

- Review construction organization design to ensure compliance with project engineering design and the EMP with regard to environmental protection and impact mitigation. The construction may only be ordered to start after the review is completed and the ET in charge is satisfied with the environmental arrangement;
- Provide assistance to the ESC as necessary in the implementation of the environmental monitoring and supervising program;
- Regularly monitor the performance of the contractor's environment staff, verifying monitoring methodologies and results. In case the contractor's environment staff fails to discharge duties or fails to comply with the contractual requirements, instruct the contractor(s) to replace the contractor's environment staff;
- Instruct the contractors to take corrective actions within the ET determined timeframe. If there is breach of contract or strong public complaints on contractor environmental performance, the ET will order contractor to correct, change or stop the work, reporting to relevant agencies and the Client at the same time;
- Supervise the contractor's activities and ensure that the requirements in the EMP and contract specifications are fully complied with;
- If the contractor discovered cultural relics by chance, the ET will order site protection and report to the relevant authorities and PMU2;
- Adhere to the procedures for carrying out complaint investigation, receiving and settling complaints relating to environmental issues;
- Response to requests made by Hai Phong DONRE and other local environmental management authorities.

i) Responsibilities of Environmental Supervision Consultant (ESC)

Environmental Supervision Consultant (ESC) will be selected through a bid and work under a contract with General Consultant. ESC will have two main responsibilities: (1) supervise contractor's activities to ensure that they are complied with content of the EMP and the construction contract; (2) carry out monitoring of environmental changes, in order to be able to quickly discover unexpected accidents and work out appropriate measures to response to these accidents.

The ESC will send at least one supervisor for each construction package, in order to be able to visit any construction site at any time, and be easy to follow up contractor's daily activities and changes in environment at site. Major responsibilities of ESC are described as followings:

Phase I: Conduct trainings to strengthen environmental management capacity

The success of environmental management for the Project relies on the knowledge, and experience of the personnel involved in environmental management. As contemporary methodologies and approach towards environmental management for road construction and operation are still new to the agencies in the local department concerned, extensive training will be needed.

In the pre-construction phase, ESC will carry out the following tasks which aim to strengthen capacity in environmental management and supervision of relevant authorities and entities:

- Reviewing the EIA, EMP and the project design and technical specifications and

confirm that there have been no major omissions of mitigation measures;
- Preparing a guide for contractors on implementing the EMP;
- Preparing a guide on how to undertake supervision, including monitoring of effectiveness;
- Preparing and executing a training program in support of the above two guides.

Phase II: Carry out supervision and monitoring

- Review, inspect and audit independently all aspects of the implementation of the EMP;
- Validate and confirm the adequacy and accuracy of monitoring data, equipment, locations, procedures and locations of sensitive receivers;
- Carry out random monitoring checks and audits on monitoring and supervision data, etc;
- Collect local residents' opinions on environmental issues around the construction sites, and feed back them in the measures to avoid / minimize adverse impacts to local environment;
- Conduct regular site inspections;
- Audit the status of implementation of environmental protection measures against the EMP and contract documents;
- Review the effectiveness of environmental mitigation measures and project environmental performance;
- Review the environmental acceptability of the construction methodology (both temporary and permanent works), relevant design plans and submissions.
- Where necessary, seek and recommend the least environmental impact alternative in consultation to the designer, the contractor(s), and the relevant environmental management authorities;
- Verify the investigation results of any non-compliance of the environmental quality performance and the effectiveness of corrective measures;
- Provide regular feedback audit results for the ET of General Consultant;
- Provide training programs at a minimum of three month intervals for contractor's staff, and local staff of PMU 2, etc., to appraise issues and method to improve environmental compliance.

Relating to environmental monitoring, the ESC will have the following responsibilities.

- Carry out regular monitor of noise, air and surface water quality of the construction sites and provide the General Consultant with the monitoring reports ;
- The monitoring time will be consistent with the construction activities, and monitoring will be conducted during active construction;
- Upon request by the General Consultant, conduct monitoring during environmental pollution accident investigation and provide the General Consultant with the monitoring reports;
- Upon request by the General Consultant when necessary, conduct public complaint investigation and assessment.

j) Responsibilities of contractors

The duties of the contractors include but not limit to:

- Strictly implement the listed impact mitigation measures in EMP;
- Undertake self-check and self-rectify activities;
- Strengthen the coordination, information sharing, opinion exchange with the ESC, and General Consultant;
- Compliance with relevant environmental legislative requirements;
- Work within the scope of contractual requirements and other tender conditions;
- Each contractor will appoint 1~2 full time environmental personnel, working with the ESC for mitigation implementation, site inspection and any corrective actions instructed by the General Consultant;
- Provide and update information to the ESC regarding works activities which may contribute, or be continuing to the generation of adverse environmental conditions;
- In case of non-compliances / discrepancies, carry out investigation and submit proposals on mitigation measures, and implement remedial measures to reduce environmental impact;
- Stop construction activities which generate adverse impacts upon receiving instructions from the ESC / General Consultant. Propose and carry out corrective actions and implement alternative construction method, if required, in order to minimize the environmental impacts;
- Adhere to the procedures for carrying out complaint investigation;
- Take responsibility and strictly adhere to the guidelines of the EMP and complementary protocols developed by the project staff.

h) EMP Implementation Schedule

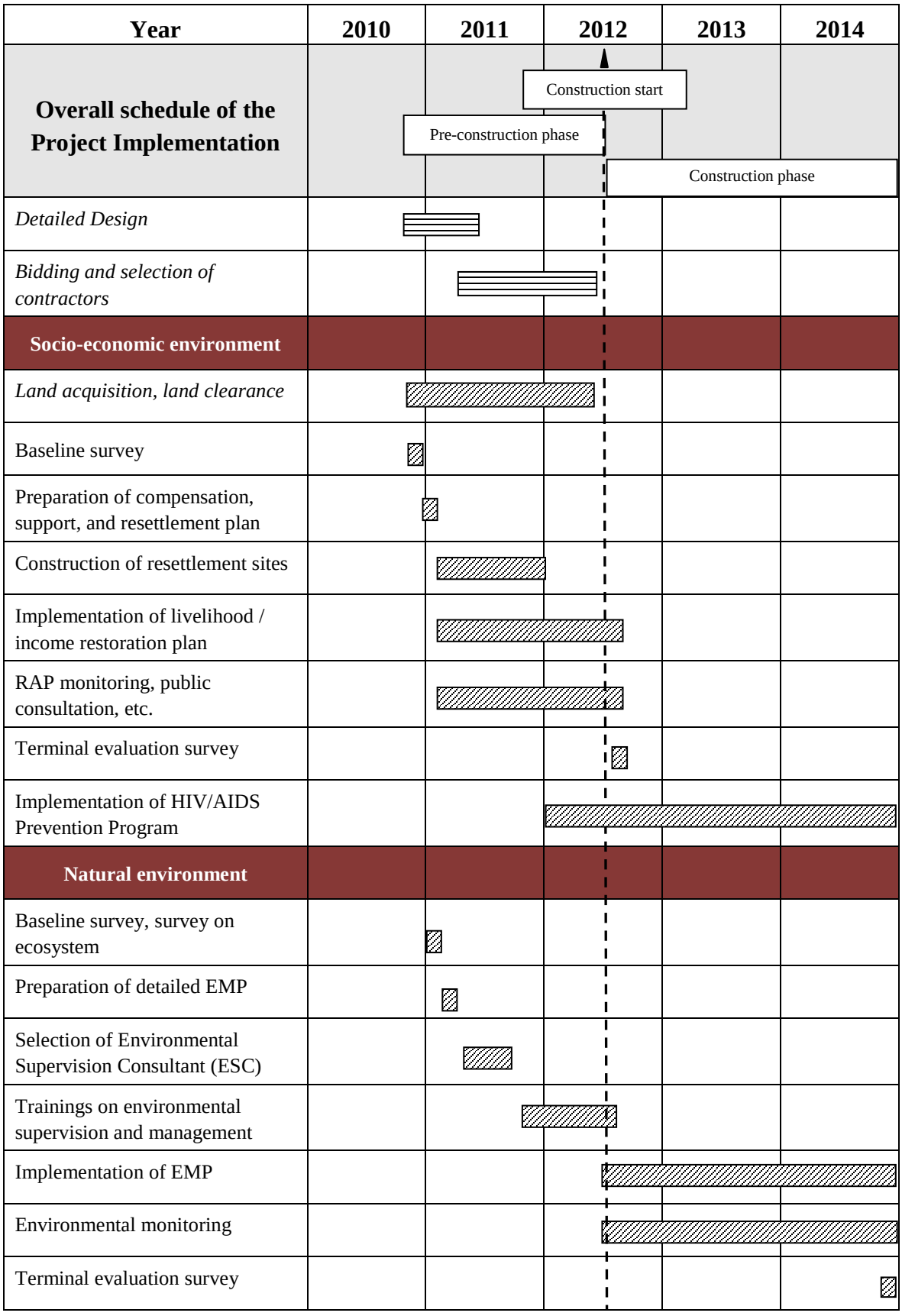


Figure 3.4-4 EMP Implementation Schedule

(5) RAP Monitoring Plan

In addition to the EMP, the Preparatory Study Team also recommends to prepare an RAP Monitoring Plan which has the following components.

a) Follow up the preparation of the detailed plans on compensation, resettlement

The "Resettlement Action Plan (RAP) for the Project was prepared by VIDIFI in July 2009, and updated by PMU2 in May 2010. This RAP has the content in line of Vietnam regulations related to land acquisition, compensation and resettlement (in particular, it refers to "*Decree No. 69/2009/ND-CP issued on August 13, 2009 on Additionally providing for land use planning, land prices, land recovery, compensation, support and resettlement"*), and it can be considered as a *"Master Plan on Compensation, Support, and Resettlement"* (in Vietnamese: *"Phương án tổng thể bồi thường, hỗ trợ, tái định cư"*, as stated in Article 29 of Decree No.69/2009/ND-CP) for the Project.

In accordance with Decree No.69/2009/ND-CP, the people's committees of project-affected districts shall take responsibility to prepare the *"Detailed Plan on Compensation, Support and Resettlement"* and the *"Plan on Vocational Training and Occupational Change*" (in Vietnamese: *"Phương án đào tạo, chuyển đổi nghề nghiệp"*) for guiding tasks relating to compensation, resettlement, livelihood restoration, and other measures for mitigating adverse impacts caused by the Project to local residents living in the district.

According to the above-mentioned RAP, Hai An District and Cat Hat District would be affected by the Project in term of land acquisition, compensation, and resettlement.

Table 3.4-12 List of Land Acquisition

	Hai An District		**Cat Hai District**			Total
	Trang Cat Ward	Dong Hai 2 Ward	Nghia Lo Com-mune	Dong Bai Commune	Cat Hai Town-let	
Aquaculture land (ha)	57. 30	18.60	28.26	9.51	14.61	128.28
Salt production land (ha)	0	0	1.008	2.29	2.81	6.18
Residential land (ha)	0	0	3.45	0.83		4.29
Sub-total (ha)						138.75
Public land (cemetery, etc.) (ha)						1.82
Total (ha)						140. 57

Therefore, people's committees of these 2 districts should prepare its respective Detailed Plan on Compensation, Support and Resettlement and the Plan on Vocational Training and Occupational Change (hereinafter refer to as *"the RAPs"*). The preparation of these plans should be monitored, and followed up in the D/D stage.

b) Preparation of the RAP Monitoring Plan

* Objectives

A RAP Monitoring Plan should be prepared to manage and supervise the implementation of the RAPs (prepared by the people's committees of project-affected districts). The RAP Monitoring Plan will be used as a tool to facilitate appropriate corrective measures during resettlement implementation based on the information obtained through routine collection of data.

* Various stages to be covered by the RAP Monitoring Plan

The proposed RAP Monitoring Plan will cover various stages of resettlement and will target the activities described in the following table.

Table 3.4-13 Stages of resettlement and targeted activities covered by the RAP Monitoring Plan

Stages	Targeted activities
1. Preparatory Stage	+ Conduct of baseline survey + Consultations + Identification of project-affected people (PAP) and the numbers + Identification of different categories of PAP and their entitlements + Collection of gender disaggregated data + IOL survey (inventory of losses survey) + Asset inventory + Entitlements + Valuation of different assets + Budgeting + Information dissemination + Institutional arrangements + Implementation schedule + Review budgets and line items expenditure
2. Relocation Stage	+ Payment of compensation + Delivery of entitlement + Grievance handling + Land acquisition + Preparation of resettlement site, including civic amenities + Consultations + Relocation + For PAP who do not relocate: • Payment of Compensation • Livelihood restoration assistance.
3. Rehabilitation Stage	+ Initiation of income generation activities + Provision of basic civic amenities and essential facilities in the relocated area + Consultations + Assistance to enhance livelihood and quality of life + Assistance to host populations

* Scope of Monitoring: Internal & External

(a) Internal Monitoring

Internal monitoring is an important responsibility and component of project management. The RAP Monitoring Plan will provide details of the monitoring and reporting framework for resettlement activities, including entitlements, timeframe, budget, costs, etc.

Internal monitoring should focus on the following indicators.

Table 3.4-14 Indicators to be applied for the internal monitoring

Sequence	Dimensions of the resettlement process	Indicators
Project Inputs	Institutional preparedness	Qualified staff in place
	Institutional preparedness	Equipment available
	Institutional preparedness	Finance on deposit
Project Process	Information to PAP	Information disseminated
	Capacity building	Training of PAP
	Consultation and participation	Meetings held and committees formed
Project Outputs	Compensation	Compensation paid for acquired assets
	Acquisition	Assets acquired
	Compensation	Community assets replace and relocation site prepared
	Relocation of PAP	Relocation completed and grants paid
	Rehabilitation	Jobs/businesses/income provided

The following activities will be recommended for the institutional preparedness.

1 Creation of a project implementation unit (PIU)
2 Acquisition of office space, furniture & computers, etc.
3 Assignment of adequate staff
4 Budget allocation
5 Training needs assessment & capacity building plan of staff
6 Establishment of monitoring unit with adequate staff
7 Capacity building for staff
8 Establishment of field office with all infrastructure & computers and transport
9 Preparation of activities implementation schedule with specific monitoring indicators
10 Formation of Monitoring Committee at field level
11 Capacity building for committee members
12 Creation of database
13 Hiring an External Monitor
14 Reporting protocols of external monitor

(b) External Monitoring

In addition to internal monitoring, external (or independent) monitoring is required to provide an independent periodic assessment of resettlement implementation and impacts, to verify internal monitoring and to suggest adjustment of delivery mechanisms and procedures as required.

The main objectives of the external monitoring is to review implementation and assess the achievement of resettlement objectives, the changes in living standards and livelihoods, restoration of the economic and social base of the affected people, the effectiveness, impact and sustainability of entitlements, the need for further mitigation measures if any, and to learn strategic lessons for future policy formulation and planning. A social and economic assessment of resettlement, measurement of the income and standards of living of the PAP before and after resettlement are integral components of the external monitoring activity.

To function effectively, the organization responsible for external monitoring should be independent of the government agencies involved in resettlement implementation.

Regular external monitoring should begin along with implementation activities and continue until the end of the project. Sample socio-economic surveys should be conducted before beginning resettlement (baseline survey), repeated one year and three years after resettlement is completed, to assess the effectiveness of remedial measures.

Table 3.4-15 Indicators to be applied for the external monitoring

Sequence	Dimensions of the resettlement process	Indicators
Project Process	Information to PAP	Information disseminated
	Capacity building	Training of PAP
	Consultation and participation	Meetings held and committees formed
Project Outputs	Payment of compensation and timing	Compensation paid for acquired assets
	Land acquisition, land readjustment	Assets acquired
	Preparation and adequacy of resettlement sites, house construction	Community assets replace and resettlement site prepared
	Relocation of PAP	Relocation completed and grants paid
	Rehabilitation, provision of employment, adequacy and income levels	Jobs/businesses/income provided
	Training	Training provided
	Rehabilitation of vulnerable groups	Jobs/businesses/income provided
	Infrastructure repair, relocation or replacement	Repaired, relocated or replaced infrastructure
	Enterprise relocation, compensation and its adequacy	Relocated enterprise
Project Impacts	Results of RAP implementation	Incomes restored
	Results of RAP implementation	Living standards restored

Organ responsible for the external monitoring should be equipped with adequate human resources, logistics, computers, etc. It should be a dedicated monitoring team with adequate gender representation. The skill of team members plays a crucial role in effective monitoring. Hence, the team needs to have members who are trained and skilled in data base management, interview techniques, social and economic assessments and financial audit.

It is recommended that the external monitoring organ should include following experts:

- A team leader
- Social scientist
- Gender specialist
- Research and Statistical specialist
- Accounts & Financial expert

* Reports and Reporting

The importance of regular reporting on financial and physical progress will form the basic functions of project management. Responsible project managers will rely on timely feedback regarding availability of inputs, flow of finances, and delivery of services. Progress will be reported against time bound actions. Quantitative monitoring indicators will be identified and used to monitoring many aspects of project performance. With regard to socio-economic impacts, however, supplementary qualitative assessment will also be identified and used.

The reports will be classified as:

- Progress reports during implementation of the RAP
- Qualitative reports highlighting qualitative aspects
- Financial reports
- Evaluation reports based on benefits and impact of assistance provided.

The reporting cycle is determined on the need and relevance of regularly monitoring essential components. A monitoring time line described in Table 3.4.15 is recommended.

Table 3.4-16 Monitoring Time Line to be Examined and Recommended

Activity	Content	Time line
Quarterly Financial Reports	Expenditure vs. budgeted amount by budget heads and sub heads	Submitted within 30 days of end of financial quarter
Six Monthly Progress Report	Narrative and as per Monitoring Plan format giving details on activity, results, issues affecting performance and variance if any and reason for same and corrections recommended	Submitted within 30 days of end of the six month period
Annual Reports	Narrative and as per reporting format giving details on activity, results, issues affecting performance and variance if any and reason for same and corrections recommended	Submitted within 30 days after the year end
Annual Financial Audit	Professional audit of accounts, prepared by qualified CA firm	Within 90 days of end of fiscal year
Final Report	Projects achievements, failures and impact from the project	Submitted within 90 days of end of the project

* Data Management

In addition to the findings of regular monitoring, some specific information are also required to develop a comprehensive database on the PAP, their situation and changing patterns during the period. To track disbursements, the monitoring unit should establish and maintain a completed database on all affected households/persons and a full inventory of lost assets. Computers can be extensively used both for analysis of data and presentation. The available data can be analyzed and depicted in various forms such as graphs, statistics, and spreadsheets.

In order to manage various kinds of data and information on PAP, we will assist the monitoring unit in establishing a Management Information System (MIS) whose outline is as following.

Table 3.4-17 Management Information System (MIS)

Functions	Source of Information, Data collection method	Responsibility for collection and analysis
(a) Procurement and physical delivery of goods, structures, and services, and the costs incurred	Internal, monthly, or quarterly, physical and financial reporting	Implementing agency, resettlement unit, if existing
(b) Use of the structures and services by PAP and their initial reactions	PAP contact monitoring	Project resettlement unit and contracted external monitoring agency
(c) Reasons (social, economic, or environmental) for unexpected reactions by the PAP, when these are revealed by the information obtained in (b) or through other sources	Diagnostic studies, and other special studies	External monitoring agency or other agency contracted to study the issue (such as academic institution, NGO or consultants)
(d) Measurement of output indicators such as productivity gains and income restoration to the extent that these can be measured during implementation	Internal reporting and external sample surveys	Project resettlement unit or external agency, (such as consultants, NGO, or academic institution)

(6) Conduct information dissemination and public consultations

Activities for information dissemination and public consultation should be carried out, in order to facilitate the Project implementation, and particularly to realize smooth implementation of resettlement and compensation.

* Objectives

The main objectives of the information dissemination and public consultation are suggested as:

- To help local residents and, in particular the APs, to comprehend goals, benefits, scale and scope of the Project; and to grasp possibly adverse impacts of the project etc… Through this basis, people will be able to analyze advantages and disadvantages affecting local communities or the whole city. They will also have opportunities to get better opinions about the project.
- To identify stakeholders, especially who will be negatively affected by the Project and extents of the impacts. Based upon this information the Project can be designed so as to reach solutions that can avoid, limit or mitigate the negative impacts and protect people's benefits.
- To grasp people's expectations and worries and to consult people's opinions and suggestions on issues related to resettlement, livelihood rehabilitation, means of support to persons in special difficulties, means of community organization, etc. This information will be reflected into the preparation and revision of compensation programs and resettlement plans.

* Methodology

The following activities for information dissemination and public consultation are recommended.

a) Identify the various stakeholders who will be involved in the Project;
b) Prepare a plan for disseminating information to the stakeholders;
c) Identify participation mechanism to facilitate the consultation process;
d) Prepare a detailed plan for public consultation;
e) Identify institutional and financial provisions for continuing consultation;

As for information dissemination, it is recommended to make prints of several kinds of brochures and leaflets to introduce about outline of the Project, key impacts caused by the Project, the compensation and resettlement policy, the decisions on compensation tariffs, and other issues concerned. These brochures and leaflets will be distributed widely to all affected households and to all concerned people.

It also needs to coordinate with PMU2 to mobile mass media, such as newspaper, TV broadcasting, radio broadcasting, and particularly the broadcasting system of the communes, to frequently disseminate updated information on the Project.

As for consultation with PAPs, it needs to coordinate with competent authorities to organize consultation meetings with participation of the PAPs, representatives of Hai Phong City, districts and commune authorities, representatives of citizen organizations, NGOs, etc. to disseminate information and consult about the issues relating to the Project implementation. The organization of the meetings is announced broadly to people in advance so that all people in the affected areas can attend to get information on the Project, particularly on the compensation policy, etc. and they can address their opinions and discuss related issues.

In addition, following activities should be conducted in order to facilitate the implementation of compensation procedures, resettlement plan, livelihood restoration plan, and other measures for mitigating adverse impacts cause by the Project to local communities.

a) Organizing visits to the project-affected areas. Consulting with PAP on the measures for mitigating adverse impacts caused by the Project
b) Conducting socio-economic surveys, and other kinds of public hearing surveys to PAP, in order to grasp their living conditions, recording their opinions and expectations on relevant issues, and on measures for mitigating adverse impacts, etc.
c) Assisting local authorities in carrying out *inventory of loss survey* (making and distributing guidance documents to PAP to instruct them on how to classify lost assets, on applicable prices of lands, plants, and other assets... in order to fulfill the forms of declaration of lost lands and assets)
d) Promoting PAP to participate in the *inventory of loss survey*. Their participation in these surveys will help ensuring the rights of the poors and vulnerable people, and to avoid unfair and unreasonable compensation due to wrong inventories.
e) Assisting projected-affected communes to organize meetings right in the communes in order to inform local residents about the Project, the commpensation program, the RAP, etc. and to consult with local residents on the Project implementation.

(7) Estimated cost for implementation of Environmental Management Plan

a) Cost Estimate for Training

Estimated cost for the personnel training is presented in Table 3.4.17.

Table 3.4-18 Personnel Training Program

Feature	Description	Staff	Number of people	Time	Cost (Million VND)
Environmental protection	Once a year for : - EMP - Environmental monitoring and report, - Emergency Plan - Cultural property protection - Biodiversity protection	Members of Environmental Team of contractors	10 pers	2012~2015	200.0
Environmental supervision	Once a year for: Site supervision, methodology, procedures, etc.	Leaders and members of the Environmental Team of contractors	18 pers	2012~2015	300.0
Total					500.0

b) Cost Estimate for Environmental Protection

The cost estimated for environment management covers both the capital cost and recurring cost, including monitoring cost, for environmental facilities. All of the cost has been included in the overall budget of the project.

* Cost Estimate for Environmental Protection

Table 3.4.18 and Table 3.4.19 show estimated costs for environmental protection that should be done by contractors. These costs should be included in the bidding documents for the contractors.

Table 3.4-19 Estimated Costs for Environmental Protection (1)
- for construction of environmental facilities

Item	Mitigation Measures	Quantity	Cost (Million VND)
Surface water	Septic tanks and garbage pit in construction site	4	410
	Surface run-off collection device on bridge deck	2 sets	120
Air	Water spray vehicle		
Eco-environment	Soil conservation measures in excavation area, filling area, bridge sites, spoil tipping area, and temporary works site	-	1,000
	Temporary ditch, settling tank	-	
	Materials to be used in rain season	-	
	Greening works design	-	
Noise	Planting trees at the road section near residential areas of Ninh Tiep Hamlet and Trung Hamlet (1.5km, 4m/tree, 200,000VND/tree)	375	75
Surface water	Wastewater treatments near Ninh Tiep Hamlet and Trung Hamlet (in the parking area / service area)	2 sets	70
	Septic tank near Ninh Tiep Hamlet and the parking area / service zone	2 sets	12
	Emergency measures for accidental pollution	2 sets	60
Environmental management	Implementation of EMP in construction phase	3 years	40
Environmental monitoring	Implementation of monitoring plan in construction phase	3 years	75
Personnel training	Training for leaders and members of the Environmental Teams of contractors	-	25
Acceptance	Inspection and acceptance of mitigation measures	-	40
Total			1,927

Table 3.4-20 Estimation of environmental facility annual operation cost

No.	Item	Cost (Million VND)	Remark
1	Monitoring cost in operation stage	30	Wastewater treatment facilities
2	Staff training cost	4	
3	Energy and medical consumption	5	
4	Environmental facilities operation, maintain and update	10	
5	Staff salary of environmental facilities operation and maintain (2 pers, 3,000,000VND/month/per)	72	
6	Vegetation plant maintain	10	
Sub-total		131	
Total (2years)		262	

Table 3.4-21 Estimated cost for socio-economic survey (unit:US$)

		Unit	Quantity	Day	Unit price	Sub-total
1	Preparation (4 persons, 3 days)					480
	Making of questionnaire	person, day	1	1	50	50
	Questionnaire printing	sheets	150	1	0.2	30
	Personnel fees	person, day	4	2	50	400
2	Logistics, hotel, accommodation					0
	Air ticket	round	0	0	150	0
	Hotel, accommodation	person, day	0	0	20	0
3	Survey (9 surveyors, 5 field days)					7,550
	Rent-cars	car, day	0	30	50	0
	Rent-motorbikes	motorbikes, day	5	5	20	500
	Personnel fee: Project Manager	person, day	1	5	150	750
	Personnel fee: administrative assistant	person, day	1	5	50	250
	Personnel fee: surveyors	person, day	5	5	80	2,000
	Communication	day	6	5	10	300
	Foods	person, day	6	5	10	300
	Training course for interviewers	set	1	3	100	300
	Provincial guiders	province	2	2	50	200
	Local guiders at communes and villages	commune	9	5	50	2,250
	Allowance for interviewers	person, day	5	5	4	100
	Gift for the Householders	HH	120	1	5	600
4	Report making					5,710
	Data input	sheets	120	1	1	120
	Report writing: Project Manager	person, day	1	6	150	900
	Report writing: Team leaders	person, day	3	6	80	1,440
	Printing (Vietnamese)	copy	50	1	15	750
	Translation (English)	page	100	1	15	1,500
	Printing (English)	copy	50	1	20	1,000
5	Management and others					1,374
	Management (5% of total cost)					687
	Contingency (5% of total cost)					687
	Total (during pre-construction stage)					15,114
	During construction stage, one year after resettlement					18,288
	During construction stage, three years after resettlement					20,404
	Grand total cost for socio-economic surveys (US$)					53,806

Table 3.4-22 Estimated cost for environmental sampling survey – direct expenses

Project Phase	Item	Monitoring Parameter	Location	Frequency	Total cost (x 1000 VND)	Reference Standards
Pre-construction phase	Air quality	NO2, SO2, CO, SPM, Carbohydrates, Microclimate conditions	7 sites (3 samplings /site)	Once	38,556	TCVN 5937: 2005
	Noise	Laeq, L10, L90	7 sites (24 hours continuous measurement)	Once	33,600	TCVN 5948: 1998 TCVN 5949: 1998 Japanese guidelines for road construction and operation
	Surface water quality	Temperature, pH, SS, DO, BOD, COD, E.Coli, Total-P, Total-N, NO3-, NH4+, Oil/Grease, CN, Heavy metals (Cd, Pb, Cr, As, Hg)	9 sites	Once	17,172	TCVN 5942: 1995 TCVN 5945: 2005
	Sub-total				89,328	
Construction phase	Air quality	NO2, SO2, CO, SPM, Carbohydrates, Microclimate conditions	7 sites (3 samplings /site)	6 times = 2.5 years x 2 times/year +1	231,336	TCVN 5937: 2005
	Noise	Laeq, L10, L90	7 sites (24 hours continuous measurement)	6 times = 2.5 years x 2 times/year +1	201,600	TCVN 5948: 1998 TCVN 5949: 1998 Japanese guidelines for road construction and operation
	Water quality	Temperature, pH, SS, DO, BOD, COD, E.Coli, Total-P, Total-N, NO3-, NH4+, Oil/Grease, CN, Heavy metals (Cd, Pb, Cr, As,	9 sites	6 times = 2.5 years x 2 times/year +1	103,032	TCVN 5942: 1995 TCVN 5945: 2005

Project Phase	Item	Monitoring Parameter	Location	Frequency	Total cost (x 1000 VND)	Reference Standards
		Hg)				
	Sub-total				535,968	
Operation phase	Air quality	NO2, SO2, CO, SPM, Carbohydrates, Microclimate conditions	7 sites (3 samplings /site)	Once	38,556	TCVN 5937: 2005
	Noise	Laeq, L10, L90	7 sites (24 hours continuous measurement)	Once	33,600	TCVN 5948: 1998 TCVN 5949: 1998 Japanese guidelines for road construction and operation
	Water quality	Temperature, pH, SS, DO, BOD, COD, E.Coli, Total-P, Total-N, NO3-, NH4+, Oil/Grease, CN, Heavy metals (Cd, Pb, Cr, As, Hg)	9 sites	Once	17,172	TCVN 5942: 1995 TCVN 5945: 2005
	Sub-total				107,194	

Table 3.4-23 Estimated cost for environmental sampling survey – indirect expenses

Item	Parameter	Unit	Unit cost	Sample number	Cost
			(US$)		(US$])
Reporting	Data input	set	100	1	100
	Report writing	set	100	1	100
	Printing(Vietnamese 10, English 10) and CDs	set	200	1	200
	Translation (about 30 pages)	page	5	30	150
Office Consumer		set	50	1	50
Traveling Cost (7pers x 1 day)		man-day	30	7	210
Personnel cost	Manager	MM	1,200	0.1	120
	Expert	MM	800	0.1	80
	Surveyors (7pers x 3 days)	man-day	50	21	1,050
Other Indirect Expenses		set	618	1	618
Sub-total of Indirect Cost					2,678
VAT(5%)					134
Total of Indirect Cost					2,812
Baseline survey					2,812
During construction phase (2.5 years *2 + 1 = 5 times)					15,465
Evaluation survey (at the end of construction phase)					3,374

Table 3.4-24 Estimated cost for monitoring

Resettlement Action Plan (RAP) Monitoring					
RAP Monitoring Staffing (work during 1.5 years or 18 months of pre-construction stage)					
			Quantity	Unit	Unit price (US$)	Sub-total (US$)
		Team Leader	18	man-month	1,200	21,600
		Account & Financial Expert	18	man-month	720	12,960
		Social scientist	18	man-month	600	10,800
		Gender specialist	18	man-month	600	10,800
		Research and Statistical specialist	18	man-month	600	10,800
		Rent office	18	months	600	10,800
		Transportation (3 motorbikes x 18 months)	54	bike-month	12	648
		Communication	18	months	120	2,160
		Computer system	2	computers	2,400	4,800
		Printer	1	set	6,000	6,000
		Copy machine	1	set	9,600	9,600
		Stationery and consumption articles	18	months	180	3,240
		Reporting - monthly	18	reports	240	4,320
		Reporting - quarterly	6	reports	240	1,440
		Reporting - six-monthly progress	3	reports	360	1,080
		Reporting - annual	0	reports	360	0
		Reporting - final	1	reports	600	600
		Sub-grand total				111,648
		Management cost (5% of total cost)				5,582
		Contingency (5% of total cost)				5,582
		Grand total				122,813

Environmental Monitoring					
			Quantity	Unit	Unit price (US$)	Sub-total (US$)
		Team Leader	30	man-month	1,200	36,000
		Administrative assistant	30	man-month	720	21,600
		Data input and management	30	man-month	600	18,000
		Field surveyors (5pers x 30 months)	150	man-month	600	90,000
		Rent office	30	months	600	18,000
		Transportation (5 motorbikes x 30 months)	150	bike-month	12	1,800
		Communication	30	months	120	3,600
		Computer system	3	computers	2,400	7,200
		Printer (from the RAP Monitoring)	0	set	6,000	0
		Copy machine (from the RAP Monitoring)	0	set	9,600	0
		Stationery and consumption articles	30	months	180	5,400
		Reporting - monthly	30	reports	240	7,200
		Reporting - quarterly	10	reports	240	2,400
		Reporting - annual	0	reports	360	0
		Reporting - final	1	reports	600	600
		Sub-grand total				211,800
		Management cost (5% of total cost)				10,590
		Contingency (5% of total cost)				10,590
		Grand total				232,980

Table 3.4-25 Estimated cost for public consultation and information dissemination

			Unit	Quantity	Unit price (US$)	Sub-total (US$)	Total cost (US$)
Information Dissemination							25,000
	Printing of leaflets						7,500
		Pre-construction stage (1st year)	copies	1,000	0.5	500	
		Pre-construction stage (2nd year)	copies	1,000	0.5	500	
		Pre-construction stage (3rd year)	copies	1,000	0.5	500	
		Construction stage (1st year)	copies	5,000	0.4	2,000	
		Construction stage (2nd year)	copies	5,000	0.4	2,000	
		Construction stage (3rd year)	copies	5,000	0.4	2,000	
	Printing of brochures						17,500
		Pre-construction stage	copies	500	5	2,500	
		Construction stage	copies	5,000	3	15,000	
Organization of consultation meetings							28,800
	Pre-construction stage (subject to PAPs, during 2 years)						16,800
		Meetings with PAPs in Hai An	time	24	100	2,400	
		Meetings with PAPs in Ninh Tiep	time	24	100	2,400	
		Meetings with PAPs in Dong Bai	time	24	500	12,000	
	Construction stage (during 2.5 years, to resolve complaints, etc.)						12,000
		Meetings with local residents	time	30	200	6,000	
		Meetings with relocated PAPs	time	30	200	6,000	
Grand total cost for information dissemination and public consultation (US$)							**53,800**

Table 3.4-26 Estimated cost for implementation of HIV/AIDS Prevention Program

No.	Item	Unit	Unit price (1000VND)	Quantity 1	Quantity 2	Cost (1000VND)	Cost (USD)
Cost for Service Provider							
1	Personnel	lump				3,891,600	194,580
2	Office and equipment	lump				975,200	48,760
3	Taskforce Unit's activities	lump				1,251,200	62,560
4	Supports, capacity training, etc. for local health staff	lump				1,051,100	52,555
5	Information dissemination, public relations, public motivation, etc.	lump				2,415,000	120,750
6	Develop and strengthen referral mechanisms	lump				437,000	21,850
7	Increase the use and availability of condom	lump				166,336	8,317
8	Monitoring and reporting (making monthly reports)	month	2,300	3	12	82,800	4,140
9	Contingencies (15% of total cost)	lump		0		1,540,535	77,027
	Sub-total (1)					11,810,771	590,539
Cost for General Consultant							
10	International supervisor (including air tickets, allowance, etc.)	MM	690,000	3	3	6,210,000	310,500
11	National supervisor	MM	69,000	3	6	1,242,000	62,100
12	Making quarterly reports	report	2,300	3	4	27,600	1,380
13	Conduct mid-term evaluation	lump	230,000	1	1	230,000	11,500
14	Conduct terminal evaluation	lump	345,000	1	1	345,000	17,250
15	Organize JCC meetings	time	11,500	3	4	138,000	6,900
	Sub-total (2)					8,192,600	409,630
	Grand total (= Sub-total 1 + Sub-total 2)					20,003,371	1,000,169

Table 3.4-27 Estimated cost for implementation of RAP

STT	Items	Unit	Quantity	Unit price (1000 VND)	Total (1000VND)	Total (USD)
1	**Compensation for loss of land**		**899,171**		**58,833,960**	2,941,698
1.1	Residential land	m2	28,936	700	20,255,200	1,012,760
1.2	Aquaculture land	m2	823,180	45	37,043,100	1,852,155
1.3	Salt production land	m2	44,755	32	1,432,160	71,608
1.4	Other lands	m2	2,300	45	103,500	5,175
2	**Compensation for lost crops**		**868,038**		**13,782,938**	689,147
2.1	Aquaculture produce	m2	823,180	15	12,347,700	617,385
2.2	Salt produce	m2	44,755	32	1,432,160	71,608
2.3	Corn produce	m2	103	30	3,078	154
3	**Compensation for lost fruit trees**		**5,641**		**488,720**	24,436
3.1	Fruit trees - category 1	cây	498	400	199,200	9,960
3.2	Fruit trees - category 2	cây	182	150	27,300	1,365
3.3	Banana	cây	3,373	40	134,920	6,746
3.4	Bamboo	cây	420	25	10,500	525
3.5	Wood	cây	1,168	100	116,800	5,840
4	**Compensation for lost structures**		**49,972**		**35,996,800**	1,799,840
4.1	House	m2	5,249	2,500	13,122,500	656,125
4.2	Ancillary structures	m2	2,255	700	1,578,500	78,925
4.3	Outdoor toilet	m2	120	500	60,000	3,000
4.4	Outdoor shower/bath	m2	206	800	164,800	8,240
4.5	Fishing hut or shed	m2	2,413	500	1,206,500	60,325
4.6	Others	m2	39,729	500	19,864,500	993,225
5	**Compensation for relocation of graves**				**2,529,468**	126,473
	Relocation of graves	ngôi	275	3,945	1,084,875	54,244
6	**Relocation of public facilities**	TT			**10,000,000**	500,000
7	**Cost for construction / expansion of cemetery**	TT			**5,000,000**	250,000
8	**Construction of resettlement sites**		79	200,000	**15,800,000**	790,000
9	**Allowances** (refer to Decisions 197, 84 and 69)				**78,253,240**	3,912,662
9.1	Relocation allowances	hộ	79	3,000	237,000	11,850
9.2	Life stabilization allowances (residential land)	hộ	79	8,000	632,000	31,600
9.3	Temporary resettlement allowance	hộ	79	5,000	395,000	19,750
9.4	Support for occupational change and job creation	m2	823,180	90	74,086,200	3,704,310
9.5	Life and produce stabilization allowances (cultivated land)	hộ	112	25,920	2,903,040	145,152
	Sub total (1-9)				*220,685,126*	11,034,256
10	**Administration cost**				**4,413,703**	220,685
	Sub total (1-10)				*225,098,829*	11,254,941
11	**Contingency 10%**				**22,509,883**	1,125,494
	Total				**243,195,009**	12,159,750

Source: Draft of the RAP Report prepared by MPU2, May 2010.

Table 3.4-28 Total estimated cost for environmental management and monitoring

Item	US$	*1000VND	Yen loan portion (US$)	Vietnam budget portion (*1000VND)
Socio-economic environment				
Land acquisition (including compensation, supports, resettlement, etc)	12,159,750	243,195,009		243,195,009
Baseline survey for further planning and monitoring of RAP	15,114	302,280	15,114	
Survey for mid-term evaluation of RAP implementation	18,288	365,760	18,288	
Implementation of livelihood restoration plan for PAP	2,000,000	40,000,000	2,000,000	
Implementation of monitoring of RAP implementation	122,813	2,456,256	122,813	
Public consultation and information dissemination	53,800	1,076,000	53,800	
Survey for terminal evaluation of RAP implementation	20,404	408,080	20,404	
Implementation of HIV/AIDS Prevention Program	1,000,169	20,003,371	1,000,169	
Natural environment				
Trainings for environmental management and supervision	25,000	500,000	25,000	
Implementation of Environmental Management Program	232,980	4,659,600	232,980	
Implementation of Environmental Monitoring Program				
Pre-construction phase (baseline survey)	7,278	7,278	7,278	
Construction phase	42,264	42,264	42,264	
Operation phase	8,734	8,734	8,734	
Total	15,706,594	314,131,878	3,546,844	243,195,009

Source: Preparatory Study Team, May 2010.

3.4.4 Environmental Checklist

Appendix 8 shows the Environmental Checklist for Tan Vu - Lach Huyen Highway Construction Project

4. NOTES ON THE PROJECT IMPLOEMENTATIONO AND SUPERVISION

In order to implement the project smoothly, the following issues identified in this study should be noted:

(1) Scope of Works of the Project

There are several locations where the work demarcations should be timely determined as follows:

Table 4-1 Locations Where need Clear Work Demarcation Are Needed

No.	Location	Issues
1	Tan Vu Intersection	• The Tan Vu Interchange is planned to be developed through phase-wise construction. At-grade intersection is planned in the initial stage. • Work demarcation between the TV-LH Project and Hanoi - Hai Phong Expressway should be appropriately determined. • Right-of-Way (ROW) of the intersection should be promptly determined at the early stage of the detailed design.
2	Detour Road connecting to NH5	• Progress of the construction of Hanoi - Hai Phong Expressway should be officially monitored. • Widening and improvement works for the detour road connecting to NH5 should be designed and carried out once the delay of expressway opening is confirmed.
3	Dinh Vu Industrial Zone	• Reclamation works of the industrial zone (IZ) is progressing. • The ROW of the TV-LH Project should be timely determined at the early stage of the detailed design in order to avoid unnecessary conflict between two development activities. • Discharge routing of the storm water is especially a potential risk. Hence, the IZ drainage capacity should consider the discharge volume from the TV-LH Highway.
4	Ending Points	• End point of the TV-LH Highway is connecting to the Lach Huyen Port. This section of the highway should be re-aligned in the future in accordance with the port facility development. • This future re-alignment should be considered in the detailed design.

(2) Implementation Program

As described in Section 2.9.4, there are several “Delay Risks”. Progress of the works and

related activities should be officially monitored and appropriate countermeasure should be taken to avoid or reduce further delay.

Anticipated measures for risks on delay are summarized in Table 4-2.

(3) Construction Safety

The construction site is located offshore and typhoon attacks the region almost every year. Very strong winds and high waves could damage the construction site, facilities and equipment. Special attention should be taken for the protection of the construction site from typhoons.

(4) Operation and Maintenance (O&M)

The TV-LH Highway is like an "Industrial Road" with busy freight transport between the industrial core in the northern economic focal region and the port. There will be huge traffic of heavy trucks.

Pavement surface conditions are very much effect to the transport speed, and as a result, it adversely affects the growth of the national economy. O&M quality should be seriously studied, and institutional and organizational preparation should be timely established.

In addition, the highway is hit by typhoons almost every year. Operation of the highway should closely cooperate with the meteorological center of the region.

(5) New Construction Technology

For this project to meet the requirements of 1) a very short construction period, and 2) offshore construction, new construction technologies are introduced as follows:

- Steel Pipe Well (SPW) method for offshore construction, and
- Span by Span (SBS) erection method of PC-BOX girder.

SPW method will be widely used in Vietnam because there are potentially many offshore constructions in Vietnam. SBS PC-BOX will be commonly used in the urban infrastructure project in the near future. For instance, elevated roads and railways will be soon required in the capital Hanoi and HCMC.

Transfer of technology should be paid to these new and advantageous technologies during both the design and construction stages.

Table 4-2 Anticipated Measures for Risks on Delay

No.	Kind of Risk on Delay	Potential Risks	Anticipated Measures
1	Design Works	• Delay of works. • Delay of approval by the client. • Lack of communications between the client and the consultant.	• Select competent consultant. • Coordinate well with relevant stakeholders.
2	Land Acquisition	• Delay of preparation of land acquisition documents. • Delay of land acquisition by local authorities.	• Monitor the progress of the land acquisition progress and review the progress periodically.
3	Procurements	• Delay of preparation of PQ documents. • Delay of approval of PQ documents. • Delay of preparation of tender documents. • Delay of approval of tender documents. • Delay of tender evaluation. • Delay of approval of tender evaluation. • Delay of contract negotiation. • Delay of approval of the contract.	• Timely procure the supervision consultant. • Timely procure the contractors.
4	Construction Works	• Unfamiliar with the local culture and custom. • Not mobilizing the proper equipment, key personnel, and materials on site. • Unfamiliar with technical method. • Unfamiliar with FIDIC conditions of contract. • Unforeseeable natural disaster, i.e. typhoon. • Delay of possession of site. • Delay of clarification of the work demarcation (See Table 4-1) • Lack or delay of work coordination with neighboring works.	• Select competent contractor(s). • Monitor and control the construction progress strictly.
5	Environmental Mitigation Actions	• Unfamiliar with environmental issues. • Lack of regular monitoring.	• Prepare good Environmental Management Program (EMP) in detailed design phase. • Monitor and control the contractor's EMP execution strictly.

No.	Kind of Risk on Delay	Potential Risks	Anticipated Measures
6	Development of Hanoi-Hai Phong (HH) Expressway	• Delay of construction works. • Delay of work coordination between two projects.	• Monitor the construction progress. • Prepare a contingency plan for delay of HH Expressway.
7	Establishment of O&M Organization	• Delay of preparation of O&M unit. • Delay of approval of O&M institutional arrangement for the project road.	• Coordinate with DRVN/RRMU2 for selection of O&M organization. • Prepare good O&M plan.
8	Contractual Arrangement between MOT and Private Sector	• Unclear condition of site hand-over to the private sector. • Unclear work demarcation between public and private.	• Establish Lach Huyen port PPP conference for smooth coordination.

(6) Issues in Environmental and Social Consideration

Although the EIA report was approved on 27 May 2010, there are some items to be improved to meet the requirements of the JICA Environmental Guidelines.

Regarding the approval of the RAP report, however even after clearing all those requirements, it is not possible to be entirely optimistic on the successful and on schedule implementation of land acquisition and resettlement. As usual, this will be one of the most serious concerns for project implementation.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1. Conclusions

The following items/issues are pointed out as conclusions of this Preparatory Study. These are updated in accordance with the results of discussions between JICA and MOT held on 7 and 18 June 2010.

(1) Review of Previous Designs

As a result of review of the previous designs, mainly those from the JBSI JV F/S (July 2009) financed by VIDIFI, the Study Team proposes some design modifications including, particularly, the application of stage construction as well as revision of bridge type and new construction method in order to reduce the construction period. It is hoped that these proposals will be accepted and reflected in the forthcoming detailed design of the Tan Vu – Lach Huyen Highway

(2) Cost Estimate for the Project

On the basis of the proposed scope of works, the Project cost was updated considering the unit cost in March 2010, with due examination of the design and constructability. Especially, for the selection of construction method that would reduce construction period, the Study Team paid special attention to the cost estimates. For standard construction methods in Vietnam, the unit rate was updated in accordance with the revised scope of works. The updated project cost was divided into the following two portions:

- Foreign Currency (F/C) portion and Local Currency (L/C) portion,
- Cost portion for goods and services procured in Japan and the remaining portion under the STEP scheme.

Updated overall project cost is tentatively calculated as VND 8,845 billion (JPY 47.1 billion), in which VND 7,384 billion (JPY 39.3 billion, 83%) is L/C portion, and VND 1,461 billion (7.8 billion JPY, 17%) is F/C portion.

It is confirmed that the procurement ratio from Japan of 44% meets the requirements for applying STEP scheme for the ODA Loan

(3) Project Implementation Program

On the premise that the loan agreement for the Project is signed in September 2010, and the Project will be funded under STEP scheme, procurement of the JICA detailed design consultant should start immediately after the approval by the Prime Minister of the revised scope of works of the project, both protection works, and road and bridge works.

The updated project implementation program in accordance with the M/D between MOT and JICA Follow-up Mission dated 18 June 2010 is as follows:

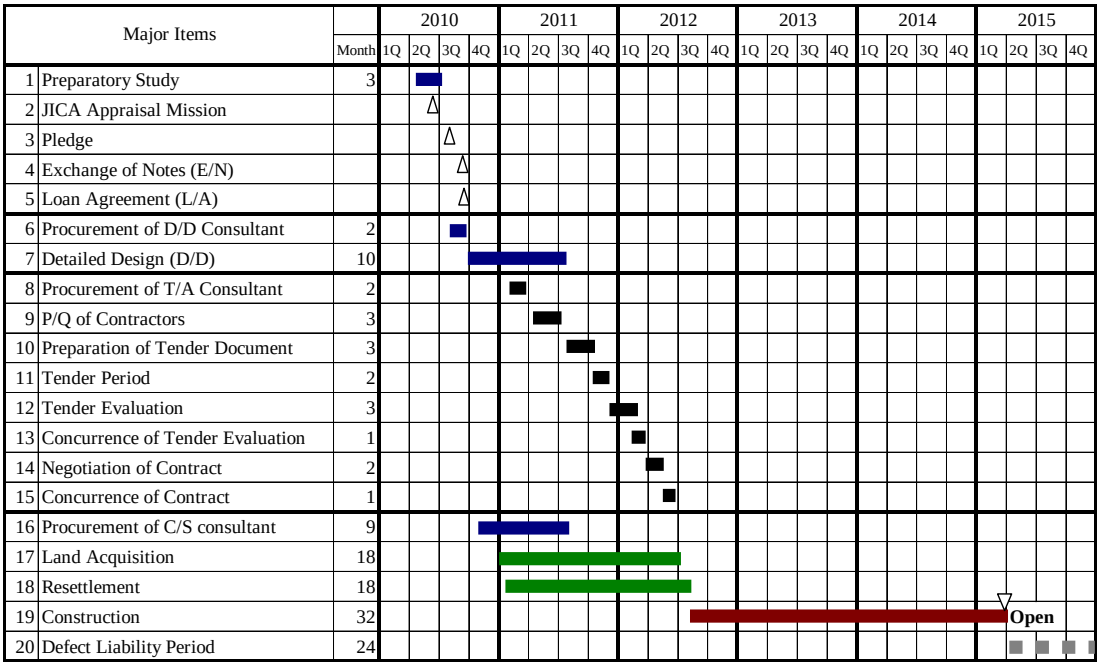


Figure 5-1 Proposed Implementation Program (After JICA Follow-up Mission)

The construction works will either be one package for all the works or divided into two packages, which will be implemented over 32 months at the most, and completed in March 2015.

(4) Review of Social Consideration Issues

PMU 2 revised the RAP report prepared in July 2009, based on the Preparatory Survey Team's comments, and local residents' opinions raised during the public consultation meeting held on April 28, 2010. Said report was submitted to Hai Phong City PC for approval.

After reviewing the existing RAP report, in order to facilitate land acquisition and mitigate impacts caused by the Project to local communities, the Preparatory Survey Team suggests that the following tasks should be carried out during the detailed stage.

1) Change route alignment to avoid passing through Trung Hamlet in order to minimize land acquisition and losses of local residents' properties.
2) Conduct two detailed socio-economic surveys in the pre-construction phase to grasp the socio-economic features of PAP for policy-making and for preparing baseline data for RAP monitoring.
3) Update policies on compensation, resettlement, and entitlement for PAP based on Hai Phong PC's recently-issued decisions, and the results of the first socio-economic survey.
4) Prepare concrete plans to relocate affected houses, public structures, graves, etc. and to construct resettlement sites for PAP.
5) Prepare an income/livelihood restoration plan for PAP.
6) Identify organizational arrangements for RAP implementation.
7) Work out a schedule for resettlement-related activities.

8) Prepare a plan for information dissemination and public consultation (including the preparation of a leaflet to introduce the Project)
9) Prepare a RAP monitoring plan to guide activities related to RAP monitoring and supervision.
10) Revise cost estimation for land acquisition, compensation, resettlement, livelihood restoration, monitoring and supervision.
11) Prepare an HIV/AIDS prevention plan during the early stages of detailed design.
12) Entrust a consultant or NGO with the implementation of the HIV/AIDS prevention plan during pre-construction phase and construction phase.

(5) Review of Environmental Consideration Issues

PMU 2 had revised the EIA report prepared by VIDIFI in July 2009, and submitted it to MOT on 24 May 2010. On 27 May 2010, MOT issued Decision 1420/QD-BGTVT on the approval of the EIA report.

Many parts of the approved EIA report have been improved in accordance with Vietnamese regulations on EIA. A public consultation meeting was also organized on 28 April 2010 in Cat Hai City. Approximately 80 local residents and representatives from local authorities of Cat Hai District, Cat Hai Townlet, Nghia Lo Commune, and Dong Bai Commune participated in the meeting.

However, in order to mitigate impacts to the natural environment of the localities, it is suggested to implement the following tasks during the detailed design stage.

1) Carry out surveys to collect baseline data on air quality, noise, surface water quality, and ecosystems in and around the project area.

2) Co-work with members of the technical design teams to examine and work out concrete measures for mitigating impacts to ambient air, acoustic environment, surface water bodies, ecosystems, etc.

3) Prepare detailed environmental management plan and environmental monitoring plan.

4) Employ an environmental supervision consultant to conduct trainings on environmental management during pre-construction phase, and to carry out environmental supervision and monitoring during construction phase..

5.2. Recommendations

The Preparatory Study recommendations are summarized as follows:

(1) Clarification of Work Demarcation with Neighboring Projects

The Tan Vu – Lach Huyen Highway construction project are related to the following projects:

- Hanoi - Hai Phong Expressway Construction Project
- Hai Phong City Ring Road Construction Project
- Din Vu Industrial Zone Development Project
- Lach Huyen Port Construction Project

It is recommended that the scope of the Project should be determined as early as possible, especially spatial demarcation with related projects, considering the future development plan.

(2) Official Monitoring of Related Projects

Especially for Hanoi - Hai Phong Expressway (HHEXP), the construction process should be officially monitored in order to determine whether the detour route is necessary or not. It is recommended that MOT/PMU 2 should conduct official monitoring of the HHEXP construction progress. Detailed design of the widening of the existing road (the Detour Road) and improvement works for the Detour Road may take six months and one year, respectively.

(3) Use of Tentative Project Cost

The project cost estimated in this study at JPY 43.4 Billion, is still tentative, and should only be used for JICA's appraisal of the Project due in September 2010. A more accurate cost estimate will be provided in the detailed design of the Project road.

(4) Promotion of New Technology

Knowledge on new construction technologies should be transferred to Vietnam through the projects. This Tan Vu – Lach Huyen Highway project can contribute to such transfer of knowledge on new technology involved in the following works:

- Steel pipe well method for offshore construction
- SBS erection method of precast-box girder

During this project, transfer of knowledge on new technologies should be initiated through technical seminars, workshops, construction site visits, and overseas training and study tours.

(5) Steady and Progressive Implementation of Environmental and Social Considerations

The environmental and social requirements to realize a Japanese ODA loan for the Project will be clarified when the RAP is approved. For the successful implementation of the Project, the tasks for the environmental and social consideration must be progressively undertaken by PMU 2 during the entire Project period.