No.

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF TRANSPORT, VIETNAM

THE COMPREHENSIVE STUDY
ON THE SUSTAINABLE DEVELOPMENT OF TRANSPORT SYSTEM
IN VIETNAM
(VITRANSS 2)

Subsector Report No.07
ENVIRONMENT

May 2010

ALMEC CORPORATION
ORIENTAL CONSULTANTS CO. LTD.
NIPPON KOEI CO. LTD.

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PREFACE

In response to the request from the Government of the Socialist Republic of Vietnam, the Government of Japan decided to conduct the Comprehensive Study on the Sustainable Development of Transport System in Vietnam (VITRANSS2) and entrusted the program to the Japan International cooperation Agency (JICA)

JICA dispatched a team to Vietnam between November 2007 and May 2010, which was headed by Mr. IWATA Shizuo of ALMEC Corporation and consisted of ALMEC Corporation, Oriental Consultants Co., Ltd., and Nippon Koei Co., Ltd.

In the cooperation with the Vietnamese Counterpart Team, the JICA Study Team conducted the study. It also held a series of discussions with the relevant officials of the Government of Vietnam. Upon returning to Japan, the Team duly finalized the study and delivered this report.

I hope that this report will contribute to the sustainable development of transport system and Vietnam and to the enhancement of friendly relations between the two countries.

Finally, I wish to express my sincere appreciation to the officials of the Government of Vietnam for their close cooperation.

May 2010

HIROYO SASAKI,
Vice President
Japan International Cooperation Agency

May 2010

HIROYO SASAKI
Vice President
Japan International Cooperation Agency
Tokyo

Subject: Letter of Transmittal

Dear Sir,

We are pleased to formally submit herewith the final report of the Comprehensive Study on the Sustainable Development of Transport System in Vietnam (VITRANSS2).

This report compiles the results of the study which was undertaken both in Vietnam and Japan from November 2007 to May 2010 by the Team comprising ALMEC Corporation, Oriental Consultants Co., Ltd., and Nippon Koei Co., Ltd.

We owe a lot to many people for the accomplishment of this report. First, we would like to express our sincere appreciation and deep gratitude to all those who extended their extensive assistance and cooperation to the Team, in particular the Ministry of Transport of Vietnam.

We also acknowledge the officials of your agency, the JICA Advisory Committee, and the Embassy of Japan in Vietnam for their support and valuable advice in the course of the Study.

We hope the report would contribute to the sustainable development of transport system and Vietnam.

Very truly yours,

IWATA Shizuo
Team Leader
The Comprehensive Study
on the Sustainable Development
of Transport System in Vietnam
(VITRANSS2)

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ABBREVIATIONS

ADB	Asian Development Bank
AIDS	Acquired Immune Deficiency Syndrome.
AP	Affected person
ATC	Area traffic control
CAAV	Civil Aviation Administration of Vietnam
CARB	Compensation, Assistance and Resettlement Board
CE	Critically endangered
CNG	Compressed natural gas
CO_2	Carbon dioxide
COV	Government of Viet Nam
CPC	Commune People's Committee
DMS	Detailed Measurement Survey
DOC	Department of Construction
DOF	Department of Finance
DONRE	Department of Natural Resources and Environment
DPC	District People's Committee
DPI	Department of Planning and Investment
EHS	Environment, health and safety
EIA	Environmental Impact Assessment
EN	Endangered
EURO	European Monetary Unit
GOV	Government of Vietnam
HCMC	Ho Chi Minh City
HIV	Human Immunodeficiency Virus
I/M	inspection and maintenance
IEE	Initial Environmental Examination
IMO	International Maritime Organization
IOL	Inventory of losses
IUCN	International Union for Conservation of Nature
IWT	Inland Waterways Transport
JICA	Japan International Cooperation Agency
LEP	Law on Environmental Protection
LPG	Liquefied petroleum gas
MARPOL	Marine pollution
MOH	Ministry of Health
MOLISA	Ministry of Labour, Invalids and Social Assistance's
MONRE	Ministry of Natural Resources and Environment
MOT	Ministry of Transport
MOT	Ministry of Transport
MRD	Mekong River Delta
NEPA	National Environmental protection Agency
NNW	North-northwest
NO_2	Nitrogen Dioxide.
NOx	Nitrogen Oxide
NSHSR	North-south high-speed railway
NTRB	National Transport Research Board
OPRC	Oil Pollution Preparedness, Response, and Co-operation
PAP	project affected person
PC	Peoples Committee
PIP	Public Investment Program
PMU	Project Management Unit
PPC	Provincial People's Committee
PPC	Provincial Peoples' Committee
PRC	Provincial Resettlement Committees
RAP	Resettlement action plan
ROW	Right of way

RP	Resettlement Plans
RRD	Red River Delta
RT	Resettlement Taskforce
SEA	Strategic Environmental Assessment
SO_2	Sulfur Dioxide
SSW	South-southwest
TCVN	Vietnam standard
URENCO	Environment companies
USA	United States of America
USD	US Dollar
VEA	Vietnam Environment Administration
VINARAIL	Vietnam Rail
VITRANSS	The Study on the National Transport Development Strategy in the Socialist Republic of Vietnam
VITRANSS 2	The Comprehensive Study on the Sustainable Development of Transport System in Vietnam
VIWA	Vietnam Inland Waterway Administration
VND	Vietnam Dong
VNRA	Vietnam Railway Administration
VOC	Volatile organic compound
VRA	Vietnam Roads Administration
VU	Vulnerable
WB	World Bank
WTO	World Trade Organization

1 INTRODUCTION

1.1 The Project

In 2007 the Vietnamese government asked the Government of Japan to provide technical assistance through the Japan International Cooperation Agency (JICA) to carry out "The Comprehensive Study on the Sustainable Development of Transport System in Vietnam" (VITRANSS 2) in order to update VITRANSS, carried out in 1999–2000. The recommendations of VITRANSS became the official development assistance (ODA) platform of multilateral donor agencies, such as the World Bank (WB) and the Asian Development Bank (ADB), as well as bilateral donors, for their projects on transport development. VITRANSS is viewed as having provided the basis for the steady and systematic progress made by the Vietnamese government in the development of its transport sector.

VITRANSS 2 aims to update this ten year old multi-modal national transport strategy, thereby providing an updated planning base, to be used in the development of transport infrastructure to meet the 21st century needs of Vietnam. Specifically, VITRANSS 2 has the following objectives:

(i) To prepare a new comprehensive long-term transport sector development strategy to 2030;

(ii) To prepare a new comprehensive medium-term transport master plan up to the target year of 2020;

(iii) To prepare a short-term investment program for the 2011–2015 period;

(iv) To prepare a master plan for a north-south expressway network and to conduct a pre-feasibility study for the priority section(s);

(v) To complete a preliminary planning study for the north-south high-speed railway; and,

(vi) To provide technology transfer for the Vietnamese counterparts.

The strategies and master plans will include analysis of road, railway, marine port and shipping, inland waterway transport and air transport for both passenger and freight services, as well as facility operations, management and institutional capacity, ensuring that plans for one transport mode complement another and can be sustained. The strategies cover the country and focus on population concentration areas.

For the transport sector, the responsibility is to prevent or minimize the adverse impact of transport projects on the environment. This report will thus focus on the current environmental condition in the country and the environmental framework in which the VITRANSS 2 proposed transport projects will be implemented.

1.2 Overview

Vietnam has an S-shaped land that stretches from latitude 23°30' North to 8°30' North and longitude 102°East to 110°East and covers an area of 330,363 sq km. It faces the shallow gulfs of Tonkin in the north and Thailand in the south and the sea in the east, with its 3,260 km long coastline. Vietnam shares 3,370 km of land border with China, Laos and Cambodia.

Three-fourth of the land is mountainous, and the rest is plain. The two largest deltas in the plains are Red River and Mekong River.

Vietnam's natural environment is richly diverse. The country can be divided into 10 areas and 38 eco-environmental zones indicated in Table 1.2.1 based on the natural conditions relevant to socio-economic and environmental aspects. The areas are the Mountainous North, the Center, the Central Highlands, the Southeast, the Southern Delta, Hanoi, Ho Chi Minh City, and the islands.

Unfortunately, the abundant natural resources were damaged by the war (1961–1975). The result was not only direct casualties among the people and continuing medical complications, but also widespread disruption and degradation of precious ecosystems. Bombs and herbicides were responsible for most of the environmental damage. These weapons were targeted on upland and mangrove forests and agricultural land. Almost 2.5 decades have elapsed since the war and the country's unification. With the passage of time, it has gotten harder to separate war damages from the pressure of rapid economic development and population growth. But it is undoubtedly true that the war caused massive environmental destruction. However, the resiliency of the environment and successful rehabilitation efforts of the Government of Vietnam have mitigated the effects on the ecosystem.

In spite of the many environmental problems facing Vietnam, it is important that the Vietnamese are able to preserve their traditional culture and lead a peaceful and healthy coexistence with nature.

Table 1.2.1 Ecological Areas and Environmental Zones

Ecological Areas	Eco-environmental Zones
1. Northern and North Central Mountains	(i) Northeastern mountains (ii) Dong Van plateau (iii) High mountains between Red River and Black River (iv) Northwestern mountains
2. Northern and North Central Midlands	(i) Northern midlands (ii) North central midlands
3. Northern Delta	(i) Coastal flats (ii) Wetlands in the North (iii) Alluviums (iv) Wetlands in the South
4. Central Vietnam	(i) Hills and mountains in northwestern central Vietnam (ii) Northern central flats (iii) Hills and mountains in southwestern central Vietnam (iv) South central flats
5. Central Highlands	(i) High mountains in northern Central Highlands (ii) Southern Central Highlands (iii) Middle of Central Highlands (iv) Northern Central Highlands (v) High mountains in southern Central Highlands
6. Southeastern Region	(i) Hilly sites above 200 m (ii) Red basalitic soil in the east (iii) Newly created alluviums (iv) Old alluviums
7. Southern Delta	(i) Coastal mangroves (ii) U Mihn Melaleuca forest (iii) Dong Thap Muoi paddy field (iv) Long Xuyen Quadrangle (v) Low area between Tien River and Hau River (vi) Seawater-affected deltas (vii) Central deltas
8. Hanoi City	(i) Urban areas of Hanoi (ii) Hanoi suburbs
9. Ho Chi Minh City	(iii) Urban areas of Ho Chi Minh City (iv) Ho Chi Minh City suburbs
10. Islands along the offshore and sea	(i) Bac Bo Bay island (ii) Central offshore islands (iii) Hoang Sa and Truong Sa islands (iv) Phu Quoc

1.3 Objective of the Report

This technical report gives an overview on the environmental conditions in Vietnam, institutional arrangement on environmental protection and preliminary considerations to be given in the VITRANSS 2.

The projects being developed as part of VITRANSS 2 will have wide ranging social/ natural environment impacts and pollution, both positive and negative. While it is generally accepted that improvements in transport infrastructure lead to social benefits, there is a need to provide some benchmarks and highlight any areas where negative effects are likely and areas where positive impacts could occur and where these benefits could be capitalized on. For any major development project it requires that the nine social environment, eight natural environment, and six pollution areas be examined and impacts and mitigation measures identified. This information can then be used to guide project-specific social/ natural environment and pollution impact analysis.

Therefore, this report is an overview study to identify and examine the importance of impact of transport development in relation to the impact factors, namely:

(1) Social Environment

- Resettlement;
- Economic loss;
- Public facilities, traffic patterns and safety;
- Access restriction and split communities;
- Loss or degradation of cultural property;
- Loss or degradation of water use or land use rights;
- Public health impacts;
- Construction waste management; and,
- Drainage and landform instabilities.

(2) Natural Environment

- Impacts to topography and geology;
- Soil erosion;
- Impacts to groundwater;
- Impacts to hydrological situation;
- Impacts to coastal zone;
- Impacts to fauna and flora;
- Impacts to meteorology; and
- Impacts to landscape.

(3) Pollution

- Air pollution;
- Water pollution;
- Soil contamination;
- Noise and vibration;

- Land subsidence; and
- Offensive odor.

The report also defines the main laws regulations and standards that apply in the management of these impact factors.

1.4 The Social Environment Areas of Concern

1) Resettlement

Likely, the most significant social impact of transport infrastructure projects will be the need for the acquisition of private land for the construction of the transport facility. This will mean serious losses for people and households, involving not only land and fixed assets but the potential destabilization of livelihoods, community life and community cohesion. Any analysis will therefore have to establish boundaries around the resettlement issues as they relate to road, rail, airport and port development defined in the master plans, since the impact stemming from each of these transport modes is quite different in extent and severity.

2) Economic Loss

Closely linked to resettlement impacts are the economic losses associated with land and assets expropriation. In addition to these easily identifiable and quantifiable losses is the degradation of livelihood and depression of employment that comes with involuntary resettlement and is hard to quantify and mitigate. New infrastructure also has the effect of either unrealistically boosting the land prices near the facility, making new small business investments costly or depressing prices due to unwanted noise, vibration , visual intrusion and safety issues, thus devaluing the asset . Therefore the specific analyses should attempt to identify the factors affected, likely impacts and an approach to prevention and mitigation.

3) Traffic Flow and Volume Redistribution and Effects on Public Facilities

The replacement of existing transportation modes and routes with new facilities leads to negative economic impacts, as well as traffic accidents, unwanted traffic volume increases in sensitive areas and increased safety concerns. There are of course the major benefits of overall improved traffic flow improvements such as reduced travel times and less air pollution. The planning of linear facilities such as roads and railways must consider the effect on traffic volume and the flow redistribution/divergence both in terms of location and time. Future analysis would therefore have to identify the key indicators defining the social effects of traffic redistribution and document the likely important impacts and appropriate steps to prevent and mitigate unwanted negative effects. An inventory of likely public facilities affected will also be required.

4) Split Community and Access Restriction

Sometimes new linear development such as the proposed expressway and high-speed rail line leads to access restrictions and/or the elimination of the use of traditional lands. This is considered a very serious impact, but is largely preventable through careful planning. The most obvious impact is the community split in two by an expressway passing through it or the linear development affecting a farming village by cutting off the people from their farmlands. More difficult to identify is the condition where important, sometimes centuries old, cultural ceremonial ties to lands are to be cut off from a community by a poorly planned new road or railway. The future social assessment would therefore have to identify and categorize the possible sources of impact, the types of impact, indicators that are sensitive to these changes, complete a detailed surveys, as well as identify the preferred preventative and mitigation actions to pursue to minimize this effect.

5) Cultural Property

Vietnam is more than a thousand years old, and its archaeological and cultural relics are mostly still underground, mostly along the coastal and foothill area, the same area targeted for infrastructure development. Therefore, there is a real danger that these relics could be damaged or lost due to careless planning and construction. There are also standing historical and culturally important structure and sites such as old temples, churches, important historical geographic locations and graveyards, which planners need to be aware of when establishing an alignment. Linear facilities particularly elevated systems can result in unwanted noise and visual intrusion resulting in significant reduction in the tourism value of the affected property(s). The assessment of the impact on cultural property would therefore include the review of relevant legislation and a presentation of the steps needed to identify archeological and cultural relics, the types of possible project related impacts expected and the means to avoid damage or destruction. This work would have to include consultations with the Vietnam Academy of Social Sciences' Archeological Institute, to obtain mapping and to obtain assistance on defining sensitive areas. Often these organizations are not willing to divulge locations of archeological ruins for fear of archeological theft. Therefore contractors will have to retain specialized services in the field.

6) Water Rights and Common Property Losses

Roads and rail lines frequently cut across rivers and traverse or pass through common property. Further, roads and rail facilities that involve tunneling or the use of deep pile driving and large cuts can affect local wells, drying up or contaminating potable water supplies. Vietnam has a long history of the establishment of common or community property such as wells and water rights and its easy access by local villages is vital to maintaining a community. In addition to the potential polluting effect, linear developments can limit or make access cumbersome and a safety risk. Often certain landforms or specific common sites are considered shrines and regular pilgrimages are an important religious activity. Cutting off or limiting access to such facilities significantly damages the social stability of a community. Therefore the social assessment of this type of effects will need to identify the regulations governing water rights and common lands, identify the key cause-effect linkages to consider, what screening methods to use to identify sensitive sites and the types of preventative and mitigation actions transport planners/designers need to include in their work.

7) Public Health Conditions

Linear developments such as expressways or high speed rail lines, which are designed to carry large volumes of users, also result in the concentration of large volumes of garbage and liquid wastes such as sewage. The implementation of a road or rail line without the necessary infrastructure and services at the correct level of service will lead to health and sanitary problems and frequently a breakdown of the entire transport system. For example, poorly planned and undersized expressway rest areas can be disease vectors resulting in area-wide health problems and ultimately a reduction in demand. Indirect impacts due to discharge of untreated sewage into roadside areas or in open pits, allowing contaminated waters to leach into surface water courses, are the recipe for gastrointestinal disease outbreaks such as cholera and dysentery. Therefore, the examination of this factor as part of any specific social impact assessment will include the identification the specific public health issues associated with the transport sector projects, the appropriate Vietnamese standards to follow and approaches to apply in order to prevent or mitigate them.

8) Waste (Construction-Related)

The construction of transport facilities, be they high speed railways, expressways or ports, generates large volumes of waste, both in terms of construction material wastes, waste excavation soils unsuited for reuse in the engineering works, and contractor operations wastes. Unplanned and careless management of these wastes, leads to health and safety concerns, contamination of large areas of land, including surface and groundwater e.g., refueling and service area petroleum wastes not be properly collected and recycled. Waste will be an important issue in urban areas where structures and underground facilities may have to be demolished. The analysis of this issue in a social assessments will need to define what wastes are of concern, which transport development generates them, the volumes involved, where these are generated and how they need to be handled and managed to prevent long term negative impacts for the social environment.

9) Unstable Landforms and Construction Accidents

The geography, geology and soils conditions vary considerably in the eight to nine geographic areas of the country. Hazards range from landslide and mudslide areas to unstable subsurface geology causing cave-ins. Many of the provinces crossed by the proposed linear developments have steep fast flowing rivers that rapidly drain out of the mountains into the sea from the West to East within 50 ~ 70km, in steep sided unstable channels. Construction in and around these area can be very dangerous and extremely fast erosion events, triggered by rains, can take place overnight, endangering people and communities. The knowledge of these areas and the inclusion of the issue in social assessment analysis will be important and will need to identify the types of landforms most prone to instability, their general location, the construction activities that could contribute or aggravate this instability and the measures to be considered to prevent or mitigate these impacts on people and communities.

1.5 Natural Environment Areas of Concern

1) Topography and Geology

Vegetation removal and change of topography, dredging and reclamation in coastal zone, and change of marine conditions and littoral drift by dredging and reclamation, may be occurred. These will lead change of topography and geology by large-scale cut and fill, cave-ins and upheaval caused by the disruption of soil balance due to large-scale cut, occurrence of water pollution and flooding because of landslides and soil erosion caused by the reclamation of an inclined area, and effect on coastal topography and vegetation by erosion and sedimentation in coastal zone.

2) Soil Erosion

Topsoil erosion will occur by rainfall after land reclamation or vegetation removal. It may lead the followings:

(i) Loss of topsoil by surface runoff may affect the growth of plants and animals, agriculture and forestry

(ii) Paving of a large area would reduce permeability and increase surface runoff in a short period of time. This would cause flood and soil erosion.

(iii) Water use and fishery would be affected or reduced in value by water polluted by soil

(iv) Foundation of the development site may be damaged.

3) Groundwater

In case of the development including groundwater development, overdraft causes the groundwater table to lower and the groundwater sources to become exhausted, involving the exhaustion of springs and wells which affects the people's livelihood. Moreover, the lowering of the groundwater table may cause groundwater pollution by seawater intrusion. For environmental consideration, the present condition of groundwater resources and the available pumping capacity should be examined.

4) Hydrological Situation

During the construction including river improvement work, the peak discharge in the downstream may become larger thereby increasing the risk of flooding. The diversion channels constructed to divert the flood discharge may decrease the river channel flushing function by flood discharge and increase sedimentation due to a decrease in the tractive force of the river. Therefore, in the environmental consideration, it is necessary to consider the present navigation and fisheries situations and the downstream areas that are prone to flooding.

5) Coastal Zone

Conditions of the shoreline and seabed would be changed by excavation for transportation constructions and/or dredging for port facility construction. The supply of sand silt to the surrounding sea area would be change by the alteration of tide and current. These impacts may lead to effects on natural environments, such as mangrove forest and coral reefs, as well as fishery due to the change of fishing spots, and territorial integrity and tourism by the change of shoreline. Impacts on natural environment and economic activities of surrounding area should be considered.

6) Fauna and Flora

Impacts of facility construction on mangroves, coral reefs, etc. in the coastal zone and on animals inhabiting the area may occur. The consequences may lead to a decrease in biodiversity and bring about a decrease of useful species and the extinction of valuable species. The value of plants and animals and features of the ecosystem of the area should be considered thoroughly.

Vegetation on transportation infrastructure would be removed, and animals' habitats would be lost by the removal of vegetation. Breeding, plant life and animals would be affected by exhaust gas and noise caused by vehicles or trains after construction. Migration routes and habitat areas could be interrupted by road or railway facilities. Commencement of road or railway operations would bring an increase of immigrants who would change the forest along the route into cultivated land thereby disrupting the habitats and environment. These impacts would cause a decrease in the number of valuable species or the extinction of precious species that would result in the degradation of biodiversity. The decrease and extinction of predatory species and other species could result in an outbreak of other animals and vermin, especially pests and pathogenic insects. The value of plants and animals and the ecological features of the site, as well as the social significance of the r plants and animals, should be studied thoroughly.

7) Meteorology

Impact to meteorology may occur by change of topography and large-scale clear-cutting for facility construction, and appearance of high-rise buildings/ elevated bridges/ large-scale pavement. This may l lead the following possible environmental impacts:

(i) Change of hydrological condition and micro-climate, such as temperature, precipitation, wind, and humidity;

(ii) Effect on farming caused by temperature and precipitation changes when weather-sensitive crops are planted;

(iii) Effect on the people, including pedestrians and residents, in the area when there is a large change in the wind condition.

Still, no significant effect on meteorology even by a large-scale transportation sector project is anticipated. In fact meteorology in the form of storms, floods and other natural disasters may cause profound adverse effects on transport infrastructures.

8) Landscape

Change of topography and vegetation by land reclamation, and deterioration of aesthetic harmony by appearance of structure will affect landscape. It will lead to change in local landscape and scenery by the appearance of large-scale artificial landscape components.

1.6 The Pollution Areas of Concern

1) Air Pollution

Exhaust gas and dust from construction equipment and vehicles during the construction stage and exhaust gas from vehicular traffic after the commencement of operations would cause air pollution. The health of inhabitants and plants and animals would be affected. If the volume of exhaust gas is enormous, sulphur oxides and nitrogen oxides may contribute to acid rain; carbon dioxide and nitrogen dioxide may contribute to global warming. In urban areas, the effect of soot, carbon monoxide, nitrogen oxides and sulphur oxides must be considered carefully.

2) Water Pollution

Rainwater and wastewater that flows into rivers and lakes in the vicinity could cause water pollution. Groundwater might be contaminated by wastewater containing organic substances when it is discharged out from the site and infiltrate into the soil. Polluted rivers and lakes would negatively affect the water use for living, other activities, including fishery, aesthetics and recreation, and affect growth of aquatic life. Industries and natural environment around the site should be considered thoroughly.

3) Soil Contamination

Dispersion of disposal (heavy metals, pesticides and toxic substances) from port facilities may cause soil contamination. It lead increase of impact through a process whereby, under certain conditions, the heavy metals in dust and the toxic chemicals in herbicides are accumulated in the soil and absorbed by plants and eventually enter the water system. In case of road development, soil contamination may occur by the followings:

(i) Dispersion of paving materials, such as asphalt emulsion, during construction
(ii) Spreading herbicide for maintenance
(iii) Exhaust gas and dust from running vehicles

4) Noise and Vibration

Noise and vibration would be generated by the operation of construction equipment and detonations during construction stage. In the operational stage, vehicles, trains, or aircraft may cause noise and vibration. Facilities that require particular tranquility, such as hospitals and schools, would be affected. Sleep may be disturbed at night, livestock breeding would be affected and wild animals may disperse. Careful consideration is needed in highly populated areas or areas having unique religious facilities.

5) Land Subsidence

Land subsidence is caused by consolidation and contraction of clay layers due to the lowering of groundwater. Land subsidence may bring about the transformation and functional disorder of various structures, and the spread of flood damage area caused by the decrease in drainage capacity. These phenomena will raise the urban development cost. For environmental consideration, the present condition of land subsidence and land use in potentially vulnerable surrounding area of the site should be examined.

6) Offensive Odor

Putrefied odors may be generated from garbage if not covered adequately by soil at the site. Leachate from dumping sites and waste, drainage from incineration plants and waste

drainage from collection vehicles would generate odor. Exhaust gas from incineration plants can be a problem depending on wind direction and emission volume. Exhaust from heavy construction equipment that uses heavy oil would cause odor. Since hospitals, schools and other public facilities tend to be affected by offensive odor, they should be considered thoroughly.

2 ENVIRONMENTAL CONDITION IN VIETNAM

2.1 Social Environment

1) Population

In 2007, the population of Vietnam was 85.1million people (Unconfirmed data put the 2008 population at more than 85.5 million.), (male: 41.86 million; female: 43.30 million) an increase of only 1.26% over 2005 and a decline by 1.8% from earlier years. Vietnam remains a basically rural country with more than 65% of the population, or about 47 million, living in rural areas and much of the remaining 37 million in the five large urban and semi urban zones of the country (Table 2.1.1) (although some of the urban areas operate in a rural fashion).

The South East region (Figure 2.1.1), including HCMC, has the highest share of the urban population, at 54.7%. The growth in urban population is remarkable in the Red River Delta (Region 3), at 4.7% per year while the entire country's rural to urban shift is taking place at about 2.2% per year (Table 2.1.1). The Red River Delta Region has the highest population with more than 18.4 million inhabitants, followed by the Mekong River Delta with 17.52 million people. The North West and Central Highlands have the lowest population with 2.65 and 4.94 million respectively.

In general, the most densely population areas are where there is arable easily accessible flat land and in and around the three large population centers. The population density in the Red River Delta is 1,238 persons/km^2, compared to the national average of 257/km^2. The Mekong Delta Region (No. 8) has 429 people/km^2.

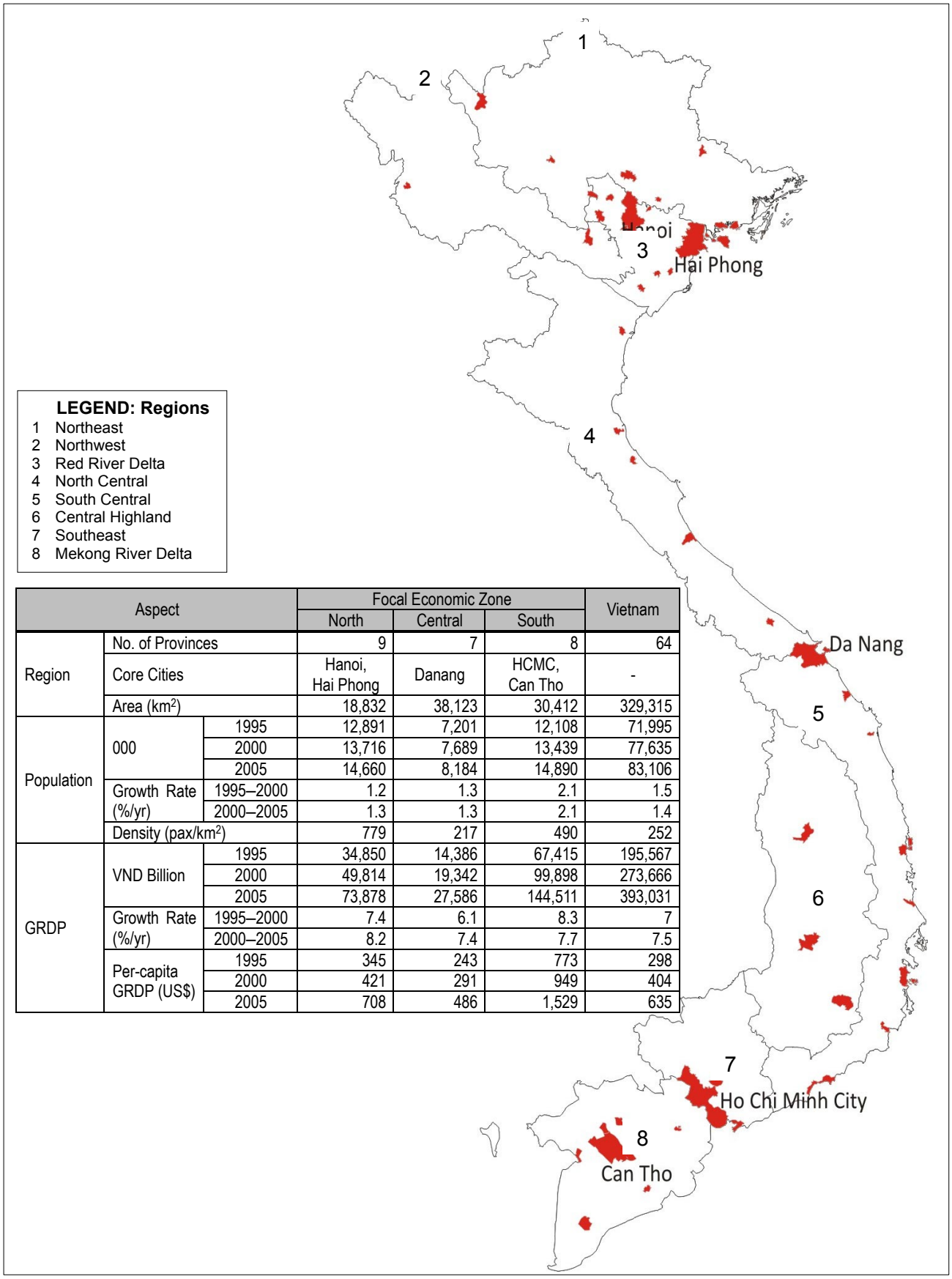
The least populated region is the North West (71/km^2) followed by the Central Highlands (90/km^2), both mountainous and remote areas. If one uses population as a measure of transportation demand and corresponding infrastructure investments, the areas receiving priority actions would be Red River Delta followed by the Mekong Delta including HCMC, the South East and the North Central Coastal Region. This then would also be the areas where the greatest potential social impact would occur. Coupled with the intensively farming areas crossed by the two linear projects, these two types of projects and population density will point to where the social analysis must be concentrated.

Table 2.1.1 Population by Region, 2007

8 Regions	Population		Growth Rate (%)		Density (Persons/km^2)
	Total (000s)	Urban (%)	Total	Urban	
Whole Country	85158	27.1	1.3	2.2	257
Red River Delta	18,401	25.0	1.1	4.7	1,238
North East	9,544	18.9	0.9	1.7	149
North West	2,650	13.9	2.3	4.2	71
North Central Coast	10,723	13.7	0.9	1.9	208
South Central Coast	7,185	30.1	1.2	2.8	217
Central Highlands	4,935	28.1	2.3	3.2	90
South East	14,193	54.7	2.3	3.1	408
Mekong River Delta	17,524	20.7	1.1	3.8	432

Source: National Statistical Yearbook 2000 ~ 2007

Figure 2.1.1 The VITRANSS 2 Study Area Population Centers and Geographic Regions



Aspect			Focal Economic Zone			Vietnam
			North	Central	South	
Region	No. of Provinces		9	7	8	64
	Core Cities		Hanoi, Hai Phong	Danang	HCMC, Can Tho	-
	Area (km^2)		18,832	38,123	30,412	329,315
Population	000	1995	12,891	7,201	12,108	71,995
		2000	13,716	7,689	13,439	77,635
		2005	14,660	8,184	14,890	83,106
	Growth Rate (%/yr)	1995–2000	1.2	1.3	2.1	1.5
		2000–2005	1.3	1.3	2.1	1.4
	Density (pax/km^2)		779	217	490	252
GRDP	VND Billion	1995	34,850	14,386	67,415	195,567
		2000	49,814	19,342	99,898	273,666
		2005	73,878	27,586	144,511	393,031
	Growth Rate (%/yr)	1995–2000	7.4	6.1	8.3	7
		2000–2005	8.2	7.4	7.7	7.5
	Per-capita GRDP (US$)	1995	345	243	773	298
		2000	421	291	949	404
		2005	708	486	1,529	635

Source: VITRANSS 2 Inception Report November. 2007

2) Employment

The 2006 census indicated that about 45% of the country's population was wage earners. The labor force increased by about 3% per year between 2002 and 2006 or from 39.5 million to 43.3 million people, with state ownership of business remaining a steady 9.2–10% and the majority of economic activity being in the resource sectors, including agriculture forestry and fisheries.

The unemployment rate in urban areas declined from 6.01% in 2002 to 4.82% in 2006, while that for the eight regions as a whole averaged at 5.7%; quite acceptable given the large and diverse population base.

In 2006 unemployment rate was highest for the 15–19 years old age group and decreased as a function of increasing age. When compared by gender, the unemployment rate for men was always higher and stood at 4.8% for men and at 3.9% for women; the exception being the > 65 year age group.

Therefore, the main demand for these transportation modes will come first from the urban centers with high employment and higher incomes, then slowly reach the more remote areas once news of the convenient and relatively economical transport means spreads, and once adequate feeder road systems and inter-modal links are in place. The required social analyses will need to understand the employment effect in the urban areas first, followed by assessment of rural impacts.

3) Income

Average income has risen from 356,000 VND/month per capita in 2002 to 484,400 VND/p/month in 2004, a 36.1% increase. By the end of 2006 it almost doubled to an average of 637,000VND/p/month. This has led to a general decline in the urban poverty rate from 28.9% in 2002 to 19.5% in 2004 and further decreases since then (16% in 2006). However, the majority of the poor people still live in the remote parts of the country and the gap in income between these two groups is increasing. Using 2004 data and the Ministry of Labour, Invalids and Social Assistance's (MOLISA) poverty index (≤100,000VND/p/mnth = poor) the poverty level in the North West (Region 1) region was as high as 60%, in the western parts of the Central Highlands (Region 6) at 33.1% and the North Central Coast (Region 4) with 32% of population. The income for an urban resident in Region 4 remains two to three times higher than the average rural income. Therefore, the proper pricing of rail tickets and expressway tolls will be key to generating adequate demand, particularly among the rural population, helping to turn what many will see as an economic burden into a benefit.

4) Education

Based on the 2006 census, 94% of the population (from the age of 10) is literate, up from 91% in 1999. In remote regions of the country literacy is still high, on average 10% below the more accessible mostly urban areas. Educational opportunities for the young have increased as well, such that the number of children who attend school has generally raised by 5–10% since 1999.

From 2002 to 2006, the number of primary, lower secondary and upper secondary schools grew by 1.16%, 3.5% and 7.47% respectively. Improved and more reliable road transportation means should lead to more and better education, particularly for areas previously poorly linked to larger centers and better schools. Further, shorter travel times for

long distance travel will encourage better qualified people from distant locations to consider teaching in locations away from their urban homes.

5) Health Care

In 2006 there were 12,420 health care units including 847 hospital and 10,672 medical service units and total of 176,792 patient beds, or one bed for every 476 people, or one healthcare unit per 4,780 people. In general this is a high ratio and suggests a stressed healthcare service, with particular weaknesses in the rural areas. The North West and Central Highlands are the regions least served by the healthcare system. Most of hospital and health services staff that are good remain in larger centers with better transportation means and more services. Careful planning of the road and rail systems to link smaller centers with the main arteries will be key to shifting some of the urban talent to more rural locations. Secondly more efficient and reliable transportation to medical facilities should improve general health care.

6) Land Use

Land Use in the project area, which spans the country from north to south, varies enormously. Starting on the northwest, there are small landholdings with principally subsistence farming, market gardens and wet rice cultivation. In the Red River Delta area this changes to larger rice growing areas, aquaculture and industrial/commercial land uses. As one moves south agriculture shifts to greater amounts of cash crops, including rice, sugar cane, maize and citrus and other temperate and semitropical fruit crops. In fact this region is crisscrossed by major canal systems. The North Central area is a major producer of poultry, livestock, eggs and milk, in addition to vegetables and fruit. Further south in the central region and the south central region more and more rice and tropical fruit is grown near the coast as well as cooler climate crops such persimmon, star apple, and coffee and tea in the highlands. The costal areas remain the main rice growing areas. Vietnam has its desert regions in the south central region where little else but goat herding is conducted.

The Ho Chi Minh area and south to the Mekong Delta, agriculture is dominated by rice. This region is known as Vietnam's rice bowl, but will be only indirectly affected as the project ends in Can Tho (expressway).

With the exception of the central highlands and the North East, few forest lands remain, much of it logged and converted to agriculture. Vietnam, with one of the richest biodiversities in the world, continues to rapidly loose this irreplaceable resource through careless resource management. If not carefully planned, the proposed roads, rail and port developments could lead to further losses, since lands will be taken and many areas split and likely cause some encroachment on wild lands.

The major social problems will be with urban land uses being split by the linear transportation structures, followed by issues of loss of access in rural farming areas, leading to added costs and restrictions for the movement of goods and livestock. In the urban settings this will translate into rearrangements of traffic patterns, then daily economic activity patterns affecting income and finally community cohesion.

The port development will mean some urban land losses, but mostly urban land renewal, since port work will involve upgrading of existing ports lands which are notoriously run down. Of the five marine facilities being considered, three will be new but all located in unused coastal lands at or below sea level, and needing reclamation. The other two will be in existing industrial zones where work is already ongoing, as for example the Dung Quat Port

in Quang Ngai Province, where there is an existing petrochemical terminal, which will be extended and enlarged. Therefore, in terms of land acquisition coastal ports will not be an issue.

Vietnam has six to seven major airports (4 international gateways), not many for country of > 84 million people. The airport lands are more commonly located at some distance from urban areas, thus reducing social environment effects. A few of the older airport are closer to the city center. One example of this shift is the Nha Trang Airport which was for many years in the center of the city, then in 2004 was moved to a new site, 58km to the south on the Cam Rhon Bay war-time airbase.

7) Traffic Safety and Public Facilities

Major sources of impacts on traffic safety and public facilities will come from the proposed road and rail development during both the construction and operating periods. Both facilities will pass through the most densely population parts of the country and as such have a maximum potential negative impact on people and the social environment. Two major design consideration will reduce this problem very significantly; (i) the rail line elevated for most of its length (There may also be a few stretches where the rail line is in an open trench, separated from other traffic, but creating a significant continuous barrier.), and (ii) the main expressway being a controlled access highway with fencing. However this benefit, at least for the roads, will aggravate the 'split-community' impacts.

When considering Vietnam's general traffic composed of 70% motorbikes and 30% motor vehicles, safety is a major issue, with accident (including fatalities) rates growing by as much as 20% each year. According to the data collected, 46% of all accidents take place on the national road network and of those 70% occur on urban roads, and 30% in more rural settings, most involving motorcycle vehicle and motorcycle-motorcycle accidents. However it is slow, unyielding truck traffic that is often the stimulus for unreasonable or impatient acts by motorcycle drivers.

An analysis of driving behavior of road user revealed that the main reasons of road traffic accident were speeding (34% of total), illegal passing (22%), drunk driving (7%), and poor awareness or ignoring of the rules of the road (7%), e.g. disobeying red lights.

Much of the traffic and traffic growth on a controlled access expressway will be truck traffic since the travel time will be so much faster, vastly reducing the transportation costs. In Vietnam longer distance travel is by bus or train; with both modes being very slow. For example travel from Hanoi to HCMC, a total of 1,750 km by bus, is > 30 hours or about 58km/hr as opposed to the high-speed train requiring about 5–7 hours or the expressway about 18–20 hrs.

Railway associated accidents with people are minor and in 2007 totaled only 379 of which 47% were fatalities, related mostly to maintenance area accidents and a few collisions at level crossings. With a completely elevated or protected system only the very rare catastrophic accident is possible, and with the Japanese and French experience, these will be at a rate of once in ≥ 25 years. Level crossings present a greater danger and mean that train speeds must be drastically reduced. The Chinese system still under construction now uses faster trains on existing tracks, but in sections where train speeds exceed 165 kph, all at-grade crossing facilities are closed and permanently removed.

Urban areas will feel the effect through a rearrangement of traffic patterns in terms of both time and location due to new train schedules; something that can lead to congestion. At

present these conditions do not exist as the railroad is well integrated in the urban area with passenger services usually located in the center of urban areas and freight services as centers within the urban fringe, with well established traffic patterns and traffic controls in place.

8) Construction Waste Management

At present Vietnam has a well established informal recycling industry, with virtually all dry construction wastes reused in some form or another. Clean fill, including construction demolition concrete waste as well as excavation material is in high demand particularly near the coast, since these areas, especially in the North Central and South Central Regions of the country are near sea level and as such flood prone. Thousands of tones of waste are generated every year and any amount that is clean fill is reused.

Historically construction waste generated in cities is managed by various decrees and laws. One of the more important is Directive No. 199/TTg 3/4/1997 on "Urgent measures to manage solid waste in urban and industrial areas" requiring all construction-related materials to be either reused immediately or taken to designated landfills for proper disposal. Waste stockpiling in unauthorized sites is not permitted. Therefore, the regulation and management practices for the handling and proper disposal of construction wastes is undertaken by the contractor as a standard procedure, since not only is it legally required but the contractor is often paid for this waste. Much of this issue will be carefully analyzed and addressed in the environmental assessments.

9) Risks: Landslide, Cave-Ins & Construction Accidents

In northern Vietnam, there are many faults that run from the northwest to the southeast. The larger rivers including the Red River flow to the Gulf of Bac Bo (Tonkin) along these faults. Destabilized by earthquakes and eroded by the rivers and rainfall, many large landslides occur along these fault lines in the northeast and northwest mountainous areas.

In central and southern Vietnam almost all the main rivers flow down to the sea in short (40–70km) precipitous channels along faults, but since seismic activity is weak and the valleys are relatively stable, the severity and frequency of landslides is low. In the mountainous areas in Vietnam's central highlands the land has become unstable, and landslides are quite common.

Under these geological conditions, railway and road operations in the Northwest and Northeast of Vietnam are regularly damaged and/or cut off by landslides. Examples of flashfloods and overflowing rivers are common in the Red River and Mekong River basins and their effects on selected roads are well known. In 2005 58 bridges, 125 culverts were destroyed and 430,678 m^2 of road surface subsided and/or peeled off and rendered unusable due to damage from landslides and flooding.

The other problem is flash flooding that affects slope stability leading to slope failures, mud flows and landslides. In the northern and the central mountainous areas a large percentage (43.4% of landslide volume in the north and 55.2% of this in the central) of the landslides are triggered by flashfloods. The central coastal where there are very dry coastal deserts, has severe but infrequent flash flooding. In 2005 floods claimed 24.3 million m3 of local road works land in 33 provinces for total loss of 484 billion VND. Nghe An Province had a biggest landslide volume of local roads accounting for 19% of the national total for 2005. These are all provinces that road and rail alignments must pass through.

The national railway passes through three high risk flood and landslide areas triggered by storms, typhoons and heavy rains. These areas and the type of problem encountered along the main line are shown in Table 2.1.2.

Table 2.1.2 Hazard Areas along Existing Rail Line

Location	Chainage (km)	Type of Problem
Vinh–Thu Loc	319–498	Flashflood and flood
Haoson–Ca Pass	1,220–1,269	Falling stones and landslides in rainy season
Yen Bai–Lao Cai	155–293	Fifteen well known flashflood, flood and landslide sites

Source: VITRANSS 2 consultant database

National highway No 32, 37 in Yen Bai Province had a biggest landslide volume accounting for 37% of the 2005 country-wide total.

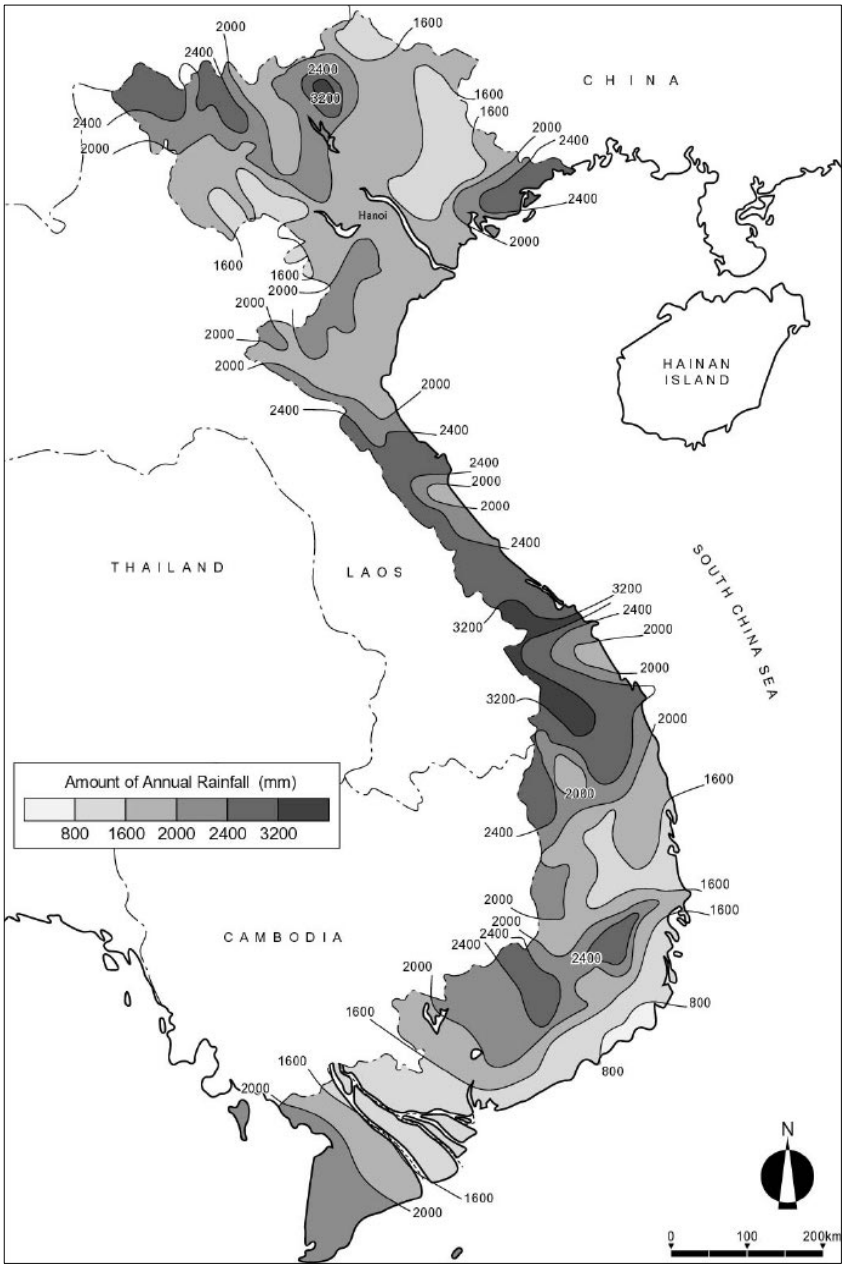
To conclude, the coastal provinces from the NE to SE through which both the proposed expressway and high speed rail line will pass have many landslide and flood prone sections, which need to be carefully considered during the design stage.

2.2 Natural Environment

1) Climate

Vietnam is located in the tropical monsoon area; the annual rainfall is about 1,940 mm. Three fourths of the total land area is covered by mountains therefore the rainfall is distributed unevenly from one area to another and varies with time. The long-term average annual rainfall varies greatly, in some areas the annual rainfall can reach 4,000 to 5,000mm, especially up to 8,000 mm in such as Bach Ma Mountain (Thua Thien Hue Province), but in Binh Thuan Province the annual rainfall reaches only 600–800 mm. The majority of the territory has a long-term average annual rainfall from 1,400 to 2,400 mm. (Figure 2.2.1). The variation of rainfall during the year affects the rainfall regime and is the main cause of droughts in the dry season and floods in the rainy season.

Figure 2.2.1 Distribution of Annual Rainfall in Vietnam



Source: Technical Report No. 11 Environment, The Study on the National Transport Development Strategy in the Socialist Republic of Vietnam (VITRANSS-2000)

Table 2.2.1 Monthly Rainfall in Vietnam, 2007

Name of Stations	Monthly Rainfall Amount (mm)												
	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Northern Mountainous Areas													
Lai Chau	4	27	11	139	491	479	780	304	188	4	49	0	2,476
Son La	4	17	9	166	267	176	290	174	169	69	11	1	1,353
Bai Chay	4	21	31	44	100	297	410	129	268	80	41	7	1,432
Tuyen Quang	2	32	17	120	288	163	231	175	208	20	14	24	1, 294
Red River Delta													
Ha Noi	3	25	29	98	118	211	286	330	388	145	5	21	1,659
Nam Dinh	6	45	32	43	175	60	217	162	179	125	10	33	1,087
North Central Coast													
Vinh	33	35	142	76	204	9	44	637	119	495	45	123	1,962
Hue	255	3	100	180	153	17	63	261	307	1544	907	603	4,393
South Central Coast													
Da Nang	153	0	58	55	156	7	24	152	253	1147	894	164	3,063
Qui Nhon	68	1	93	23	78	28	5	311	135	673	808	18	2,241
Nha Trang	23	3	40	27	157	49	17	51	168	483	543	4	1,565
Central Highlands													
Pleiku	0	0	31	49	306	209	444	522	258	327	168	0	2,314
Da Lat	0	0	98	85	338	147	206	530	394	208	148	2	2,156
South East Area													
Vung Tau	2	-	8	27	302	314	210	297	173	117	70	2	1,522
Mekong Delta													
Ca Mau	38	-	39	86	174	322	421	371	307	508	339	1	2,606

Sources: Statistical Year Book of Vietnam, 2007

According to statistic of the Research Centre of Meteorology and Climatology, average temperature in Vietnam is quite high, about 23.9^{0}C in 2007 (0,41^{o}C higher than ones in the period 1961–1990). Recent 10 recent years (1998–2007) is the hottest years in the history. Average temperature is obviously different between areas in the nation wide, such as: Ha Noi: 24.7^{o}C; Ho Chi Minh City: 27^{o}C; Sa Pa (Lao Cai) and Da Lat (Lam Dong): 17^{o}C.

Sunny hours distribute unevenly: 1,000 to 2,000 sunny hours in most area of the North and the Northern Central Highlands, Mekong River Delta and provinces from Khanh Hoa to Vung Tau; 2,000 to 2,500 sunny hours in the high mountainous areas of the North, in most areas in the Central Region, the Southern of Central Highlands and Ca Mau Province. Annual mean humidity in Vietnam is around 84%.

Climate is high various in Vietnam territories. The northern part (North mountain/Midland and the Red River Delta) is directly affected by two monsoon systems, the northeast (October–March) and the southwest monsoon (April to September). North-easterly winds bring dry and cold weather while south westerly winds cause both high humidity and temperature. During the latter period, storms typically occur as these coincide with the rainy season (Aug to Nov).

The climate in the northern central Vietnam (North Central Coast from Thanh Hoa to Thua Thien Hue) is transitional as this region is located between the northern and southern climatic zones which are segregated by the Hai Van pass. The rainy season coincides with the north easterly (September-December) winds and the dry season (November to April) with south westerly winds.

The southern part of Vietnam (Southeast Area and the Mekong River Delta) has two obvious seasons: rainy season (May to October), dry season (November to April). Climate is cool and temperate.

Table 2.2.2 Monthly Average Temperature in Vietnam, 2007

Name of Stations	Monthly Average Temperature (oC)												
	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Northern Mountainous Areas													
Lai Chau	17.4	19.2	22.8	24.0	25.6	27.0	26.3	26.9	25.6	24.4	19.6	19.7	23.2
Son La	14.8	19.6	21.9	22.1	24.1	25.8	25.1	24.9	23.6	21.5	16.7	17.4	21.5
Tuyen Quang	16.1	22.2	21.5	23.1	26.6	29.7	29.4	28.4	26.6	25.0	19.8	19.6	24.0
Bai Chay	16.2	20.1	20.5	22.4	26.4	29.2	29.3	28.5	26.8	25.4	20.5	20.0	23.8
Red River Delta													
Ha Noi	16.9	21.9	21.1	23.4	27.3	30.2	30.4	29.2	27.2	25.8	21.4	20.4	24.6
Nam Dinh	16.5	21.3	20.9	23.1	26.6	30.2	30.4	28.7	26.9	25.3	20.7	20.3	24.2
North Central Coast													
Vinh	17.2	22.1	22.5	24.0	27.2	31.2	31.1	29.2	27.4	25.0	20.7	21.1	24.9
Hue	19.3	22.8	24.7	25.0	26.8	29.2	29.2	28.0	26.7	24.7	21.6	22.3	25.0
South Central Coast													
Da Nang	21.3	23.7	25.4	26.4	28.1	29.8	29.4	28.8	27.8	26.0	23.2	23.9	26.2
Qui Nhon	23.5	24.5	26.4	27.1	28.9	29.7	29.7	29.3	28.9	27.1	24.5	24.8	27.0
Nha Trang	24.6	24.6	26.2	27.4	27.9	28.7	28.6	28.0	27.9	26.7	24.9	25.3	26.7
Central Highland													
Pleiku	19.5	21.1	23.3	24.2	23.8	24.0	22.6	22.2	22.9	21.7	19.9	19.8	22.1
Da Lat	16.3	16.7	18.0	19.0	19.5	19.4	18.8	18.3	18.9	18.0	16.7	16.8	18.0
South East Area													
Vung Tau	26.4	26.1	28.0	29.2	28.7	29.0	28.2	27.8	28.0	27.9	27.0	26.7	27.8
Mekong Delta													
Ca Mau	26.1	26.4	27.9	29.2	28.4	28.3	27.3	27.4	27.5	27.1	26.6	26.9	27.4

Source: Statistical Year Book of Vietnam, 2007

Table 2.2.3 Monthly Average Humidity in Vietnam, 2007

Name of Stations	Average humidity (%)												
	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual Av.
Northern Mountainous Areas													
Lai Chau	76	75	69	74	76	82	87	82	87	85	89	85	81
Son La	75	67	72	76	78	84	87	87	84	82	80	83	80
Tuyen Quang	77	80	87	83	80	78	82	85	84	83	79	83	82
Bai Chay	71	85	90	81	80	82	82	83	80	75	67	81	80
Red River Delta													
Ha Noi	69	81	88	79	75	77	78	81	81	77	67	77	78
Nam Dinh	76	87	92	84	83	78	78	85	84	83	73	85	82
North Central Coast													
Vinh	87	89	92	85	79	71	70	78	81	87	80	89	82
Hue	93	87	90	87	85	77	76	82	88	94	92	92	87
South Central Coast													
Da Nang	87	83	85	80	80	74	76	78	81	87	85	85	82
Qui Nhon	80	79	83	81	78	77	72	71	77	83	82	80	79
Nha Trang	78	76	80	80	81	78	78	80	81	84	83	79	80
Central Highland													
Pleiku	77	70	75	74	84	87	91	93	90	89	85	80	83
Da Lat	83	76	83	85	88	90	90	92	89	90	86	80	86
South East Area													
Vung Tau	73	76	76	74	81	78	80	81	81	81	77	77	78
Mekong Delta													
Ca Mau	80	79	79	77	84	85	87	86	86	87	82	79	83

Source: Statistical Year Book of Vietnam, 2007

Vietnam was hit 17 tropical low atmospheres and 30 storms during the period of 2004–2007 (Table 2.2.4). The highest frequency of typhoons occurs in the North and the South Central Coast, which mainly taken place between July to December. Tropical low atmosphere often occurs in the North and northern half of the central.

Table 2.2.4 Number of Storm and Tropical Low Atmosphere in Vietnam in 2004–2007

Year	No. of Tropical Low Atmosphere	Number of Storm in Vietnam												
		Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
2004	3	0	0	0	0	0	0	0	2	1	1	1	0	5
2005	4	0	0	1	0	0	0	1	3	2	1	0	0	8
2006	5	0	0	0	0	1	1	0	2	2	1	1	2	10
2007	5	0	0	0	0	0	0	1	2	1	1	2	0	7

Source: Research Centre of Meteorology and Climatology

The North and North Central Coast suffers the largest number of typhoons, accounting for about 67% of all typhoons annually occurring in Vietnam. The majority of typhoons hit the coast at the onset of rainy season (August-October). Most of the typhoons that usually hit this region are strong. In addition to the heavy rains and floods they bring, typhoons and low pressure systems cause landslides in mountain areas submerging the plains, damaging transport system and other infrastructures, agricultural land and livelihood.

The South Central Coast is also affected by severe typhoons, an average of 24% per annum. The typhoon season in this region as well as in the rest of the South is between October and November. In the Southern region, the occurrence of typhoons is not so frequent and average 9% a year.

It should be recognized that severe meteorological and natural phenomena (typhoon, storm, heavy rain, earthquake, etc.) can not be prevented. But it is possible to minimize the damages from natural disasters. The transport sector in particular must take the following measures:

(i) Technical improvement of 2 or 3 days on weather forecast, improvement of observation network with meteorological radars and rain gauges and technical development of short-range forecast using radar and rainfall data.
(ii) Establishment of meteorological communication network between the transport sector and agencies handling disaster prevention.
(iii) Preparation of a hazard map of dangerous areas and establishment of a monitoring system
(iv) Technical improvement of civil engineering skills for quick remedy and resumption of transport after the disaster.
(v) Enhancement of communication network on the information of weather forecast and natural disaster using mass communications

2) Landslides and Flood on Railway and Road

In northern Vietnam, there are many faults that run from NNW (north-northwest) to SSW (south-southwest). The main big rivers (including Red River) here flow down to the Gulf of Bac Bo along these faults. On account of these faults, there are many big landslides in the northern mountainous areas during heavy rainfall as indicated the following photos and in Figure 2.2.2.

In central and southern Vietnam almost all the main rivers also flow down to the sea along faults, but the activities of faults are weak and the scale of landslides is small. In the

mountainous areas in central Vietnam, however, the land has become unstable, a most conducive situation for landslide.

Figure 2.2.2 Landslide in Traffic Routes

Landslide in Cao Bang Province

Landslide from limestone mountain in Cao Bang

Source:

With these geological characteristics, transport accidents, especially landslides affecting railway and road, concentrically occur in northern Vietnam. Flashfloods and floods break out in the delta areas as Red River and Mekong River overflow. Detailed aspects on railway and road are as follows:

The national railway passes through three dangerous regions affected by flood and landslide brought by storms, typhoons and tropical heavy rain. These areas are:

(i) Vinh–Thu Loc (319–498km): Flashflood and flood

(ii) Haoson–Ca Pass area (1,220–1,269 km) in Khanh Hoa Province: Falling stones and landslides in rainy season

(iii) Yen Bai–Lao Cai (155–293 km): 15 dangerous sites of flashfloods, floods and landslides in rainy season.

58 bridges, 125 culverts were destroyed and 430,678 m^2 of road surface was subsided and peeled off caused by flood in year 2005.

National roads have many sections where flashfloods, floods and landslides regularly occur due to storms, typhoons and tropical heavy rain. The northern and the central mountainous areas are regularly damaged by flashfloods and landslides (43.4% of landslide volume in the north and 55.2% of this in the central). National highway No 32, 37 in Yen Bai Province had a biggest landslide volume accounting for 37% in 2005. (see Table 2.2.5).

Floods caused 24,208,650 m^3 of landslide of local roads (equivalent to 484 billion VND in loss) in 33 provinces in the whole country. Nghe An Province had a biggest landslide volume of local roads accounting for 19% in 2005. (see Table 2.2.6).

Table 2.2.5 Losses and Volume of Landslides in National Roads, 2005

National Road	Province	Volume (m^3)	Losses (Million VND)
2B, 2C	Vinh Phuc	140,000	2,800
39	Thai Binh	4,950	99
31, 279	Bac Giang	100,000	2,000
21	Nam Dinh	32,500	650
21	Ha Nam	1,500	30
14C, 24, 40	Bac Can	110,800	2,216
32, 37	Yen Bai	2,525,000	50,500
2C, 37	Tuyen Quang	66,800	1,336
34	Cao Bang	150,000	3,000
279, 4D, 70	Lao Cai	135,850	2,717
6, 12	Dien Bien	115,600	2,312
279, 4D,12	Lai Chau	113,800	2,276
No 18	Quang Ninh	5,750	115
37	Thai Nguyen	11,500	230
279, 4A, 4B, 31	Lang Son	277,500	5,550
32, 32B, 32 C	Phu Tho	297,400	5,948
12B, ATK, TSA	Hoa Binh	125,000	2,500
4G, 32B, 37, 43, 279	Son La	278,150	5,563
15, 47,,217	Thanh Hoa	575,000	11,500
15A, 48	Nghe An	273,700	5,474
49B	Hue	110,500	2,210
15, 8B	Ha Tinh	16,600	332
12A	Quang Binh	570,000	11,400
14B, 14D, 14E	Quang Nam	45,000	900
279, 4D, 12	Quang Tri	150,000	3,000
24	Quang Ngai	79,000	1,580
27	Lam Dong	60,000	1,200
14C, 24, 40	Kon Tum	125,000	2,500
1A, 27, 27B	Ninh Thuan	17,800	356
25	Phu Yen	150,000	3,000
19	Binh Dinh	80,000	1,600
Total		6,744,700	134,894

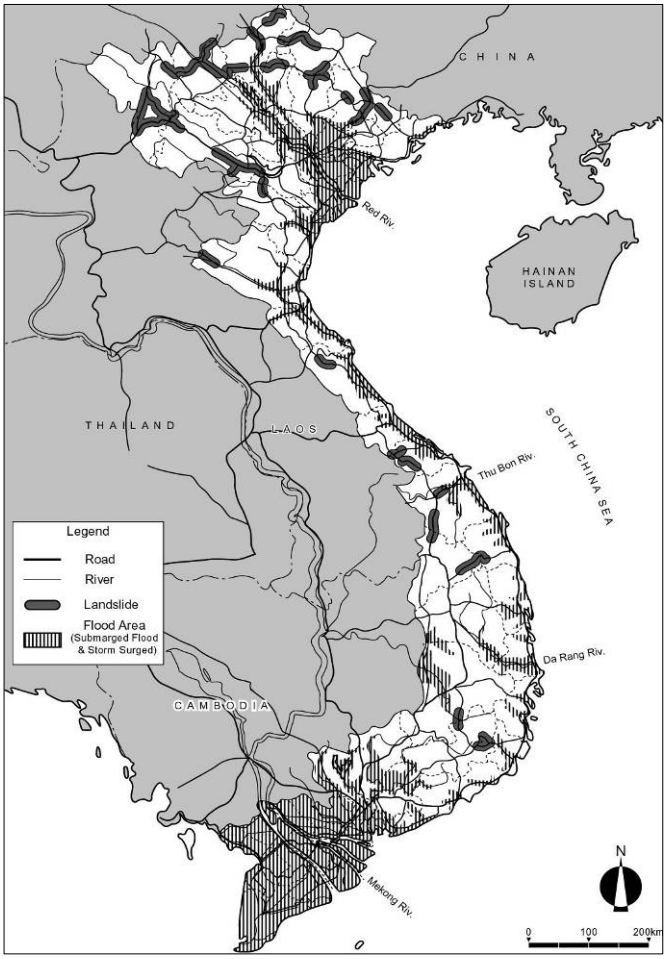
Source: Ministry of Transport- Department of Flood Prevention, 2005

Table 2.2.6 Losses and Volume of Landslides in Local Roads, 2005

Province	Volume (m^3)	Losses (Million VND)	Province	Volume (m^3)	Losses (Million VND)
Vinh Phuc	150,000	3,000	Son La	302,400	6,048
Thai Binh	299,650	5,993	Thanh Hoa	3,974,750	79,495
Bac Ninh	100,000	2,000	Nghe An	4,644,950	92,899
Ha Nam	25,000	500	Ha Tinh	16,600	332
Hai Duong	25,000	500	Quang Binh	550,000	11,000
Bac Can	300,000	6,000	Quang Tri	1,305,000	26,100
Yen Bai	1,650,000	33,000	Hue	350,000	7,000
Hai Phong	89,200	1,784	Khanh Hoa	947,200	18,944
Quang Ninh	119,850	2,397	Binh Dinh	1,882,000	37,640
Điện Biên	86,750	1,735	Quang Ngai	1,325,500	26,510
Lai Chau	108,750	2,175	Ninh Thuan	250,000	5,000
Lao Cai	2,487,700	49,754	Phu Yen	1,732,500	34,650
Thai Nguyen	60,850	1,217	Long An	386,450	7,729
Lang Son	22,500	450	Ben Tre	6,600	132
Phu Tho	297,400	5,948	Tien Giang	100,000	2,000
Hoa Binh	250,000	5,000	Can Tho	333,450	6,669
Tuyen Quang	28,600	572	Total	24,208,650	484,173

Source: Ministry of Transport- Department of Flood Prevention

Figure 2.2.3 Flood and Landslide-Prone Areas in Vietnam



Source: VITRANSS2 GIS Database

3) Seismic Conditions

Earthquake intensity is an important factor to consider in designing transport infrastructure. For transport engineering purposes, seismic force is estimated based on seismic acceleration on the ground surface when an earthquake strikes and on seismic coefficient method used universally. In Japan, the acceleration on the ground surface in case of a strong earthquake can be estimated by a measuring instrument installed at a fixed point (meteorological observation stations, earthquake observation stations, etc.). Analyzing the data obtained from observation points and structural damage, the relation between seismic coefficient and seismic acceleration on the ground surface gradually becomes clear.

Earthquake occurrence is strongly related to active deep faults especially to lateral strike slip faults. Earthquakes related to volcanic activity are moderate and occur in the off shore of centre part of Vietnam. Earthquakes in Vietnam are crustal ones with the depth less than 30km. Figure 2.2.3 shows earthquake epicentres in Viet Nam with MS>=4 (Seismic Magnitude). Here, large fault lines lie along the Dien Bien, Lai Chau, Son La, Red River, Chay River, Ca River, Ma River, Con River, Ca River ($109^{o}30'$E meridian) and the mountains in western Lai Chau Province. Earthquakes with a magnitude of 4.6–7.0 are frequently recorded in these areas. Railway sections from Hanoi to Lao Cai and Dong Dang and national roads such as Route 1A, 1B, 2, 4D, 6, 7, 8, 12, 15, 32, 70, and 279 are built on or slightly away from these high seismic intensity zones. On account of these large fault lines and earthquakes, the ground in these areas weakens and once heavy rain falls,

landslides occur in almost all parts of these areas. Hence, countermeasures should be taken to protect transport infrastructures, such as roads, railways, ports, and airports, from damage and to rehabilitate them.

Table 2.2.7 lists the location of earthquake epicentres and their seismic grades, Figure 2.2.4 show the earthquake epicentres in Vietnam and adjacent areas.

In period of 1900–2006 there were more than 450 earthquake events in Vietnam with magnitude 4.0 ≤ MS < 7 in which: 2 earthquakes with intensity 8-9, MS = 6.7–6.8 and more than 50 earthquakes with intensity I ≥ 7, MS ≥ 5 occurred in territory of Vietnam. Earthquakes in the territory occur only in crust of the Earth in the depths not exceeding 30km, Mmax <7.0. The largest panic events were reported of earthquakes of Ms = 6.7–6.8 occurred in the Northwest of Vietnam, at Dien Bien in 1935, 2001 and at Tuan Giao, 1983. They caused destruction of buildings and structures in the area of thousands square kilometres. 90% of Earthquakes have taken place in the northwester Vietnam. In another regions, there were no earthquake of magnitude larger than 5.5.

Table 2.2.7 Location of Earthquake Epicentres and their Seismic Grade

Province/District		Gr.	Province/District		Gr.
1. Ha Noi Capital			34. Kien Giang		
Ba Dinh dis.	Cong Vi pre.	7	Ha Tien ts.	Dong Ho pre.	5
Cau Giay dis.	Quan Hoa pre.	8	Rach Gia ts.	Vinh Thanh Van pre.	5
Dong Da dis.	Tho Quan pre.	7	An Bien dis.	Thu Ba to.	5
Hai Ba Trung dis.	Le Dai Hanh pre.	7	An Minh dis.	Thu Muoi Mot to.	5
Hoan Kiem dis.	Hang Trong pre.	7	Chau Thanh dis.	Minh Luong to.	5
Hoang Mai dis.	Phuong Mai pre.	8	Giong Rieng dis.	Giong Rieng to.	5
Long Bien dis.	Ngoc Thuy pre.	7	Go Quao dis.	Go Quao to.	5
Tay Ho dis.	Nhat Tan pre.	7	Hon Dat dis.	Hon dat to.	5
Thanh Xuan dis.	Thanh Xuan Bac	8	Kien Hai dis.	Dao	5
Dong Anh dis.	Dong Anh To.	7	Kien Luong dis.	Kien Luong to.	5
Gia Lam dis.	Trau Quy to.	7	Phu Quoc dis.	Duong Dong to.	5
Soc Son dis.	Soc Son to.	7	Tan Hiep dis.	Tan Hiep to.	5
Thanh Tri dis.	Van Dien to.	8	Vinh Thuan dis.	Vinh Thuan to.	5
Tu Liem dis.	Cau Dien to.	8	35. Kon Tum		
2. Ho Chi Minh City			Kon tum ts.	Thang Loi pre.	7
Dis. No1	Ben Nghe pre.	7	Dak Glei dis.	Dak Glei to.	7
Dis. No2	An Phu pre.	7	Dak Ha dis.	Dak Ha to.	7
Dis. No3	Pre. No4	7	Dak To dis.	Dak To to.	7
Dis. No4	Pre. No12	7	Kon Plong dis.	Kon Leng	7
Dis. No5	Pre. No8	7	Kon Ray dis.	Tan Lap to.	7
Dis. No6	Pre. No1	7	Ngoc Hoi dis.	Plei Kan to.	7
Dis. No7	Phu My pre.	7	Sa Thay dis.	Sa Thay to.	7
Dis. No8	Pre. No11	7	36. Lai Chau		
Dis. No9	Hiep Phu	7	Lai Chau ts.		7
Dis. No10	Pre. No14	7	Muong Te dis.	Muong Te to.	8
Dis. No11	Pre. No10	7	Phong Tho dis.	Phong Tho	7
Dis. No12	Tan Chanh Hiep pre.	7	Sin Ho dis.	Sin Ho to.	8
Binh Thach dis.	Pre. No14	7	Tam Duong dis.	Tam Duong to.	7
Go Vap dis.	Pre. No10	7	Than Uyen	Than Uyen to.	8
Phu Nhuan dis.	Pre. No11	7	37. Lang Son		
Tan Binh dis.	Pre. No4	7	Lang Son City	Vinh Trai pre.	7
Tan Phu dis.	Pre. No4	7	Bac Son dis.	Bac Son to.	5
Thu Duc dis.	Binh Tho pre.	7	Binh Gia dis.	Binh Gia to.	5
Binh Chanh dis.	An Lac to.	7	Cao Loc dis.	Cao Loc to.	7
Can Gio dis.	Can Gio to.	7	Chi Lang dis.	Dong Mo to.	5
Cu Chi dis.	Cu Chi to.	7	Dinh Lap dis.	Dinh Lap to.	7
Hoc Mon dis.	Hoc Mon to.	7	Huu Lung dis.	Huu Lung to.	7
Nha Be dis.	Nha Be to.	7	Loc Binh dis.	Loc Binh to.	7
3. Hai Phong City			Trang Dinh dis.	That Khe to.	7
Hong Bang dis.	Hoang Van Thu pre.	8	Van Lang dis.	Na Sam to.	7

Province/District		Gr.	Province/District		Gr.
Kien An dis.	Tran Thanh Ngo pre.	8	Van Quan dis.	Van Quan to.	6
Hai An Dis.	Tran Thanh Ngo pre.	8	38. Lao Cai		
Le Chan Dis.	Cat Dai pre.	8	Lao Cai ts.	Coc Luu pre.	8
Ngo Quyen Dis.	May To pre.	8	Cam Duong ts.	Pom Han pre.	7
Do Son ts.	Van Son pre.	7	Bac Ha dis.	Bac Ha to.	7
An Duong dis.	An Duong to.	8	Bao Thang dis.	Pho Lu to.	8
An Lao dis.	An Lao to.	8	Bao yen dis.	Pho Rang to.	8
Cat Hai dis.	Cat Ba to.		Bat Xat dis.	Bat Sat to.	8
Hai An dis.	Nui Doi to.	8	Muong Khuong dis.	Muong Khuong to.	6
Kien Thuy dis.	Nui Doi to.	8	Sa Pa dis.	Sa Pa to.	6
Thuy Nguyen dis.	Nui Deo to.	8	Van Ban dis.	Khanh Yen to.	7
Tien Lang dis.	Tien Lang to.	8	Si Ma Cai dis.	Si Ma Cai	6
Vinh Bao dis.	Vinh Bao to.	7	39. Lam Dong		
4. Da Nang City			Da Lat City	Pre. No3	5
Hai Chau Dis.	Hai Chau pre.	8	Bao Loc ts.	B'Lao pre.	5
Lien Chieu Dis.	Hoa Khanh pre.	7	Bao Lam dis.	Loc Thang to.	5
Ngu Hanh Son Dis.	Hoa Hai pre.	7	Cat Tien dis.	Dong Nai to.	6
Dis. Son Tra	An Dong Hai pre.	7	Di Linh dis.	Di Linh to.	5
Dis. Thanh Khe	Chinh Gian pre.	7	Da Huoai	Ma Da Gui to.	5
Hoa Vang dis.	Hoa Tho pre.	7	Da Teh dis.	Da Teh to.	5
Hoang Sa dis.	Dao	7	Don Duong dis.	Thanh My to.	6
5. Can Tho City			Duc Trong dis.	Lien Nghia to.	6
Binh Thuy dis.		7	Lam Ha dis.	Dinh Van to.	5
Cai Rang dis.		7	Lac Duong dis.	Lac Duong to.	5
Ninh Kieu dis.		7	40. Long An		
O Mon dis.		7	Tan An ts.	Pre. No1	7
Co Do dis.	Co Do to.	5	Ben Luc dis.	Ben Luc to.	7
Phong Dien dis.	Thanh An to.	8	Can Giuoc dis.	Can Giuoc to.	7
Thot Not dis.	Thot Not to.	7	Can Duoc dis.	Can Duoc to.	7
Vinh Thanh dis.	Thoi Lai to.	6	Chau Thanh dis.	Tam Vu to.	6
6.An Giang			Duc Hoa dis.	Hau Nghia to.	7
Long Xuyen City	My Binh pre.	7	Duc Hue dis.	Dong Thanh to.	7
Chau Doc ts.	Chau Phu A pre.	7	Moc Hoa dis.	Moc Hoa to.	5
An Phu dis.	An Phu to.	7	Tan Hung dis.	Tan Hung to.	5
Chau Phu dis.	Cai Dau to.	7	Tan Thanh dis.	Tan Thanh to.	5
Chau Thanh dis.	An Chau to.	7	Tan Tru dis.	Tan Tru to.	7
Cho Moi dis.	Cho Moi to.	7	Thanh Hoa dis.	Thanh Hoa to.	5
Phu Tan dis.	Cho Vam to.	6	Thu Thua dis.	Thu Thua to.	7
Tan Chau dis.		6	Vinh Hung dis.	Vinh Hung to.	5
Thoai Son dis.	Nui Saap to.	5	41. Nam Dinh		
Tri Ton dis.	Tri Ton to.	5	Nam Dinh City	Ngo Quyen pre.	8
Tinh Bien dis.	Nha Bang to.	6	Giao Thuy dis.	Ngo Dong to.	8
7.Ba Ria Vung Tau			Hai Hau dis.	Yen Dinh to.	8
Vung Tau City	Pre. No1	7	My Loc dis.	My Loc to.	8
Ba Ria ts.	Phuoc pre.	6	Nam Truc dis.	Nam Truc to.	8
Chau Duc dis.	Ngai Giao pre.	5	Nghia Hung dis.	Lieu De to.	8
Con Dao dis.	Con Dao	7	Truc Ninh dis.	Co Le to.	8
Dat Do dis.	Dat Do to.	6	Vu Ban dis.	Goi to.	8
Long Dien dis.	Long Dien to.	7	Xuan Truong dis.	Xuan Ngoc to.	8
Tan Thanh dis.	Phu My to.	6	Y Yen dis.	Lam to.	8
Xuyen Moc dis.	Phuoc Buu to.	5	42. Nghe An		
8.Bac Lieu			Vinh City	Le Mao pre.	8
Bac Lieu ts.	Pre. No3	5	Cua Lo ts.	Nghi Thuy pre.	8
Dong Hai dis.	Ganh Hao to.	6	Anh Son dis.	Anh Son to.	8
Gia Lai dis.	Gia Rai to.	5	Con Cuong dis.	Con Cuong to.	8
Hong Dan dis.	Ngan Dua to.	5	Dien Chau dis.	Dien Chau to.	7
Phuoc Long dis.	Phuoc Long to.	5	Do Luong dis.	Do Luong to.	8
Vinh Loi dis.	Hoa Binh to.	5	Hung Nguyen dis.	Hung Nguyen to.	8
9.Bac Giang			Ky Son dis.	Muong Xen to.	7
Bac Giang ts.	Tran Phu pre.	8	Nam Dan dis.	Nam Dam to.	8
Hiep Hoa dis.	Thang to.	7	Nghi Loc dis.	Quan Hanh to.	8
Lang Giang dis.	Voi to.	7	Nghia Dan dis.	Thai Hoa to.	6
Luc Nam dis.	Doi Ngo to.	8	Que Phong dis.	Kim Son to.	6

Province/District		Gr.	Province/District		Gr.
Luc Ngan dis.	Chu to.	7	Quy Chau dis.	Quy Chau to.	6
Tan Yen dis.	Cao Thuong to.	6	Quy Hop dis.	Quy Hop to.	6
Son Dong dis.	An Chau to.	7	Quynh Luu dis.	Cau Giat to.	6
Viet Yen dis.	Bich Dong to.	8	Tan Ky dis.	Tan Ky to.	7
Yen Dung dis.	Neo to.	8	Thanh Chuong dis.	Thanh Chuong to.	8
Yen The dis.	Cau Go to.	7	Tuong Duong dis.	Hoa Binh to.	7
10.Bac Can			Yen Thanh dis.	Yen Minh to.	7
Bac Can ts.	Phung Chi Kien pre.	7	43. Ninh Binh		
Ba Be dis.	Cho Ra to.	6	Ninh Binh ts.	Thanh Binh pre.	7
Bach Thong dis.	Phu Thong to.	7	Tam Diep Ts.	Bac Son pre.	7
Cho Don dis.	Bang Lung to.	5	Gia Vien dis.	Me to.	7
Cho Moi dis.	Cho Moi to.	7	Hoa Lu dis.	Hoa Lu to.	7
Na Ri dis.	Yen Lac to.	6	Kim Son dis.	Phat Diem to.	8
Pac Nam dis.	Boc Bo	6	Nho Quan dis.	Nho Quan to.	7
Ngan Son dis.	Ngan Son to.	7	Yen Khanh dis.	Yen Ninh to.	8
11. Bac Ninh			Yen Mo dis.	Yen Thinh to.	7
Bac Ninh ts.	Vu Ninh pre.	8	44. Ninh Thuan		
Gia Binh dis.	Gia Binh to.	8	Phan Rang-Thap Cham ts.	My Huong pre.	5
Luong Tai dis.	Thua to.	8	Bac Ai dis.	Bac Ai to.	6
Que Vo dis.	Pho Moi to.	8	Ninh Hai dis.	Khanh Hai to.	5
Thuan Thanh dis.	Ho to.	8	Ninh Phuoc dis.	Phuoc Dan to.	5
Tien Du dis.	Lim to.	8	Ninh Son dis.	Tan Son to.	6
Tu Son dis.	Tu Son to.	7	45. Phu Tho		
Yen Phong dis.	Cho to.	8	Viet Tri City	Tho Son pre.	8
12.Ben Tre			Phu Tho Ts.	Au Co pre.	8
Ben tre ts.	Pre. No8	5	Doan Hung dis.	Doan Hung to.	8
Ba Tri dis.	Ba Tri to.	6	Ha Hoa dis.	Ha Hoa to.	8
Binh Dai dis.	Binh Dai to.	7	Lam Thao dis.	Lam Thao to.	8
Chau Thanh dis.	Chau Thanh to.	5	Phu Ninh dis.	Phong Chau to.	8
Cho Lach dis.	Cho Lach to.	5	Song Thao dis.	Song Thao to.	8
Giong Chom dis.	Giong Tom to.	5	Tam Nong dis.	Hung Hoa to.	8
Mo Cay dis.	Mo Cay to.	5	Thanh Ba dis.	Thanh Ba to.	8
Thach Phu dis.	Thach Phu to.	5	Thanh Son dis.	Thanh Son to.	7
13.Binh Duong			Thanh Thuy dis.	Thanh Thuy to.	7
Thu Dau Mot to.sip	Hiep Thanh pre.	7	Yen Lap dis.	Yen Lap to.	7
Ben Cat dis.	My Phuoc to.	7	46. Phu Yen		
Dau Tieng dis.	Dau Tieng to.	7	Tuy Hoa Ts.	Pre. No1	7
Di An dis.	Di An to.	7	Dong Xuan dis.	La Hai to.	8
Phu Giao dis.	Phuoc Vinh to.	7	Phu Hoa dis.	Hoa My Dong	7
Tan Uyen dis.	Uyen Hung to.	6	Song Cau dis.	Song Cau to.	8
Thuan An dis.	Lai Thieu to.	7	Song Hinh dis.	Hai Rieng to.	7
14.Binh Dinh			Son Hoa dis.	Cung Son to.	7
Quy Nhon City	Le Loi pre.	7	Tuy An dis.	Chi Thanh to.	8
An Lao dis.	An Lao to.	8	Tuy Hoa dis.	Phu Lam to.	7
An Nhon dis.	Binh Dinh to.	8	47. Quang Binh		
Hoai An dis.	Tang Bat Ho to.	8	Dong Hoi City	Hai Dinh pre.	7
Hoai Nhon dis.	Bong Son to.	8	Bo Trach dis.	Hoan Lao to.	6
Phu Cat dis.	Ngo May to.	8	Le Thuy dis.	Kien Giang to.	6
Phu My dis.	Phu My to.	8	Minh Hoa dis.	Quy Dat to.	6
Tay Son dis.	Thu Phong to.	8	Quang Ninh dis.	Quan Hau to.	6
Tuy Phuoc dis.	Tuy Phuoc to.	8	Quang Trach dis.	Ba Don to.	6
Van Canh dis.	Van Canh to.	8	Tuyen Hoa dis.	Dong Le to.	6
Vinh Thach dis.	Vinh Thach to.	7	48. Quang Nam		
15.Binh Phuoc			Tam Ky Ts.	An Xuan pre.	7
Dong Xoai ts.	Tan Phu pre.	7	Hoi An Ts.	Minh An pre.	6
Binh Long dis.	An Loc to.	7	Bac Tra My dis.	Tra My to.	7
Bu Dang dis.	Duc Phong to.	6	Duy Xuyen dis.	Nam Phuoc to.	6
Bu Dop dis.	Loc Ninh to.	5	Dai Loc dis.	Ai Nghia to.	6
Chon Thanh dis.	Chon Thanh to.	7	Dien Ban dis.	Vinh Dien to.	6
Dong Phu dis.	Dong Phu to.	7	Dong Giang dis.	P Rao to.	7
Loc Ninh dis.	Loc Ninh to.	7	Hiep Duc dis.	Tan An to.	7
Phuoc Long dis.	Thac Mo to.	5	Nam Giang dis.	Thach My to.	6
16.Binh Thuan			Nam Tra My dis.	Tra Mai	7

Province/District		Gr.	Province/District		Gr.
Phan Thiet City	Duc Thang pre.	5	Nui Thanh dis.	Nui Thanh to.	7
Bac Binh dis.	Cho Lau to.	5	Phuoc Son dis.	Kham Duc to.	8
Duc Linh dis.	Vo Xu to.	6	Que Son dis.	Dong Phu to.	6
Ham Tan dis.	La Gi to.	7	Tay Giang dis.	Plang	7
Ham Thuan Bac dis.	Ma Lam to.	5	Thang Binh dis.	Ha Lam to.	6
Ham Thuan Nam dis.	Thuan Nam to.	6	Tien Phuoc dis.	Tien Ky to.	7
Phu Quy dis.	Phu Quy to.	7	49. Quang Ngai		
Tanh Linh dis.	Lac Tanh to.	6	Quang Ngai Ts.	Tran Hung Dao pre.	7
Tuy Phong dis.	Lien Huong to.	6	Ba To dis.	Ba To to.	8
17. Ca Mau			Binh Son dis.	Chau O to.	7
Ca Mau City	Pre. No5	5	Duc Pho dis.	Duc Pho to.	8
Cai Nuoc dis.	Cai Nuoc to.	5	Ly Son dis.	Ly Son to.	7
Dam Doi dis.	Dam Doi to.	5	Minh Long dis.	Long Hiep to.	6
Nam Can dis.	Nam Can to.	6	Mo Duc dis.	Mo Duc to.	6
Ngoc Hien dis.	Dam Doi to.	5	Nghia Hanh dis.	Cho Chua to.	7
Phu Tan dis.	Cai Doi to.	5	Son Ha dis.	Di Lang to.	6
Thoi Binh dis.	Thoi Binh to.	5	Son Tay dis.	Son Dung	6
Tran Van Thoi dis.	Tran Van Thoi to.	5	Son Tinh dis.	Son Tinh to.	8
U Minh	U Minh to.	5	Tay Tra dis.	Son Dung	7
18. Cao Bang			Tra Bong dis.	Tra Xuan to.	7
Cao Bang ts.	Hop Giang pre.	7	T Nghia dis.	La Ha to.	7
Bao Lam dis.	Bao Lam to.	6	50. Quang Ninh		
Bao Lac dis.	Bao Lac to.	6	Ha Long City	Hong Gai pre.	7
Ha Quang dis.	Ha Quang to.	7	Cam Pha Ts.	Cam Thanh pre.	7
Ha Lang dis.	Ha Lang to.	5	Mong Cai Ts.	Tran phu pre.	7
Hao An dis.	Nuoc Hai to.	7	Uong Bi Ts.	Trung Vuong pre.	8
Nguyen Binh dis.	Nguyen Binh to.	6	Ba Che dis.	Ba Che to.	8
Phuc Hoa dis.	Ta Lung to.	6	Binh Lieu dis.	Binh Lieu to.	6
Quang Yen dis.	Quang Yen to.	6	Co To dis.	Dao	5
Thach An dis.	Dong Khe to.	7	Dam Ha dis.	Dam Ha to.	7
Thong Nong dis.	Thong Nong to.	6	Dong Trieu dis.	Dong Trieu to.	8
Tra Linh dis.	Hung Quoc to.	6	Hai Ha dis.	Quang Ha to.	7
Trung Khanh dis.	Trung Khanh to.	5	Hoanh Bo dis.	Troi to.	8
19. Dac Lak			Tien Yen dis.	Tien Yen to.	7
Buon Ma Thuot City	Tu An dis.	5	Van Don dis.	Cai Rong to.	7
Buon Don dis.	Buon Don to.	5	Yen Hung dis.	Quang Yen to.	8
CM'gar dis.	Quang Phu to.	5	51. Quang Tri		
Ea H'leo dis.	Ea Drang to.	5	Dong Ha Ts.	Pre. No1	6
Ea Kar dis.	Ea Kar to.	5	Quang Tri Ts.	Pre. No1	6
Ea Sup dis.	Ea Sut to.	5	Cam Lo dis.	Cam Lo to.	6
Krong Ana dis.	Buon Trap to.	5	Da Krong dis.	Da Krong to.	7
Krong Bong dis.	Krong Kmar to.	6	Go Linh dis.	Gio Linh to.	6
Krong Buk dis.	Buon Ho to.	5	Hai Lang dis.	Hai Lang to.	6
Krong Nang dis.	Krong Nang to.	5	Huong Hoa dis.	Khe Sanh to.	7
Krong Pak dis.	Phuoc An to.	5	Trieu Phong dis.	Ai Tu to.	6
Lak dis.	Lien Son to.	6	Vinh Linh dis.	Ho Xa to.	6
M'Drak	Drak to.	7	52. Soc Trang		
20.Dak Nong			Soc Trang Ts.	Pre. No2	6
C Jut dis.	Ea T'Ling to.	5	Cu Lao Dung dis.	Vinh Chau to.	7
Dak Mil dis.	Dak Mil to.	5	Ke Sach dis.	Ke Sach to.	6
Dak Nong dis.	Gia Nghia to.	7	Long Phu dis.	Long Phu to.	6
Dak Rlap dis.	Kien Duc to.	6	My Tu dis.	Huynh Huu Nghia to.	5
Dak Song dis.	Dak Song to.	5	My Xuyen dis.	My Xuyen to.	5
Krong No dis.	Dak Man to.	5	Nga Nam dis.	Nga Nam to.	5
21.Dien Bien			Thanh Tri dis.	Phu Loc to.	5
Dien Bien Phu City	Him Lam to.	8	Vinh Chau	Vinh Chau to.	6
Lai Chau ts.	Na Lay to.	8	53. Son La		
Dien Bien dis.	Muong Thanh to.	8	Son La Ts.	Chieng Le pre.	8
Dien Bien Dong dis.	Dien Bien Dong to.	8	Bac Yen dis.	Bac Yen to.	7
Muong Lay dis.	Muong Lay to.	8	Mai Son dis.	Hat Lot to.	8
Muong Nhe dis.	Dien Bien Dong to.	8	Moc Chau dis.	Moc Chau to.	8
Tua Chua dis.	Tua Chua to.	8	Muong La dis.	Muong La to.	8
Tuan Giao dis.	Tuan Giao to.	8	Phu Yen dis.	Phu Yen to.	7

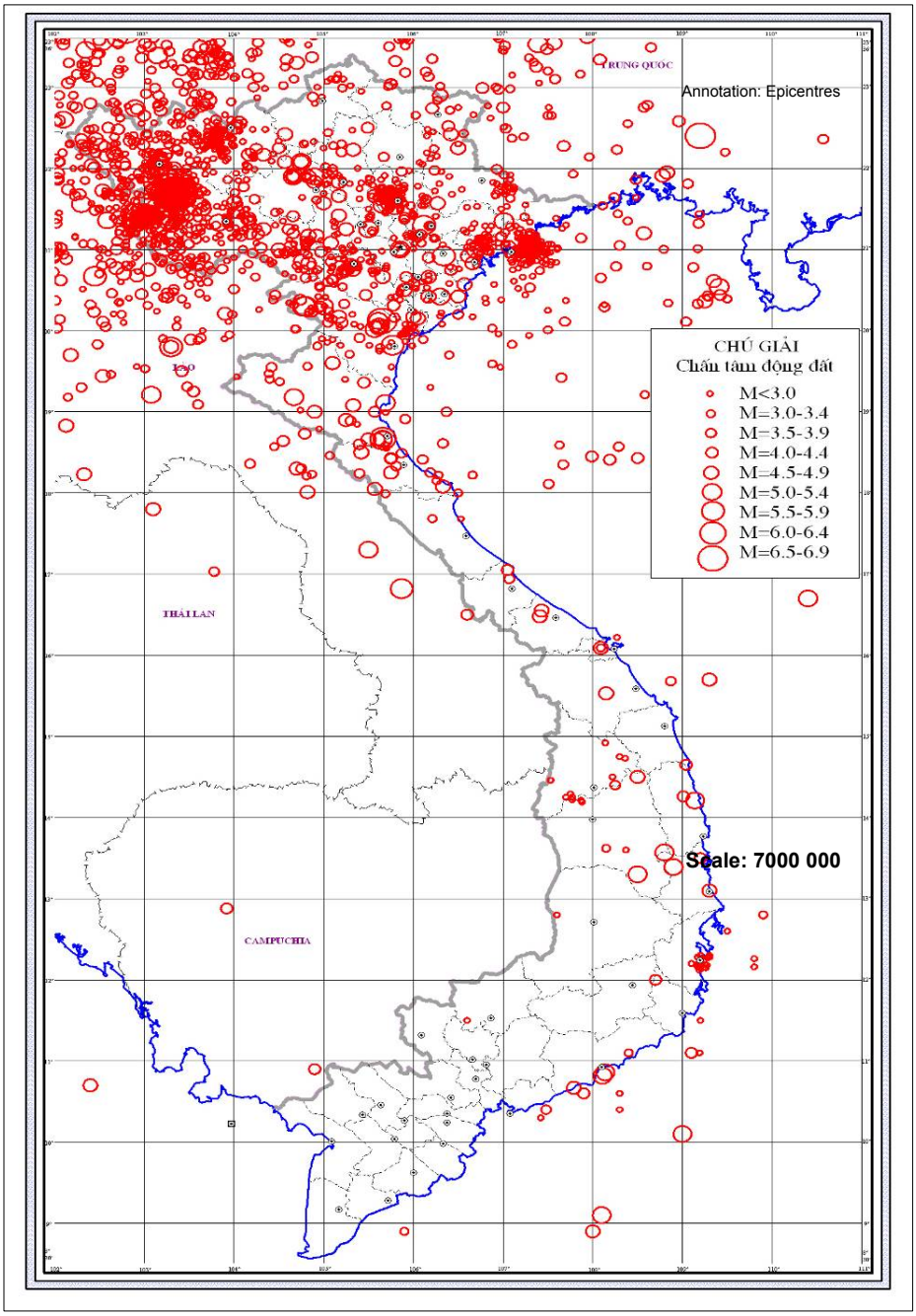
Province/District		Gr.	Province/District		Gr.
22.Dong Nai			Quynh Nhai dis.	Quynh Nhai to.	7
Bien Hoa City	Thanh Binh dis.	6	Song Ma dis.	Song Ma to.	8
Long Khanh ts.	Xuan Loc to.	6	Sop Cop dis.	Sop Cop to.	8
Cam My dis.	Trang Bom to.	5	Thuan Chau dis.	Thuan Chau to.	8
Dinh Quan dis.	Dinh Quan to.	6	Yen Chau dis.	Yen Chau to.	8
Long Thanh dis.	Long Thanh to.	6	54. Tay Ninh		
Nhon Trach dis.	Nhon Trach to.	6	Tay Ninh Ts.	Pre. No 2	7
Tan Phu dis.	Tan Phu to.	5	Ben Cau dis.	Ben Cau to.	7
Thong Nhat dis.	Dinh Quan to.	6	Chau Thanh dis.	Chau Thanh to.	7
Trang Bom dis.	Trang Bom to.	5	Duong Minh Chau dis.	Duong Minh Chau to.	7
Vinh Cuu dis.	Vinh An to.	5	Go Dau dis.	Go Dau to.	7
Xuan Loc dis.	Gia Lai to.	7	Hoa Thanh dis.	Hoa Thanh to.	7
23.Dong Thap			Tan Bien dis.	Tan Bien to.	7
Cao Lanh ts.	My Tho to.	6	Tan Chau dis.	Tan Chau to.	7
Sa Dec towtnship	Pre. No1	6	Trang Bang dis.	Trang Bang to.	7
Cao Lanh dis.	My Tho to.	6	55. Thai Binh		
Chau Thanh dis.	Cai Tau Ha to.	6	Thai Binh City	Le Hong Phong pre.	8
Hong Ngu dis.	Hong Ngu to.	6	Dong Hung dis.	Dong Hung to.	7
Lai Vung dis.	Lai Vung to.	7	Hung Ha dis.	Hung Ha to.	8
Lap Vo dis.	Lap Vo to.	7	Kien Xuong dis.	Kien Xuong to.	8
Tam Nong dis.	Tran Chim to.	5	Quynh Phu dis.	Quynh Coi to.	7
Tan Hong dis.	Sa Rai to.	5	Thai Thuy dis.	Diem Dien to.	7
Thanh Binh dis.	Thanh Binh to.	6	Tien Hai dis.	Tien Hai to.	7
Thap Muoi dis.	My An to.	5	Vu Thu dis.	Vu Thu to.	8
24.Gia Lai			56. Thai Nguyen		
Plei Ku City	Dien Hong to.	7	Thai Nguyen City	Trung Vuong pre.	7
An Khe ts.	An Khe to.	7	Song Cong Ts.	Tan Quang pre.	7
Ayun Pa dis.	Ayun Pa to.	7	Dai Tu dis.	Dai Tu to.	8
Chu Pah dis.	Phu Hoa to.	7	Dinh Hoa dis.	Cho Chu to.	6
Chu Prong dis.	Chu Prong to.	5	Dong Hy dis.	Chua Hang to.	7
Chu Se dis.	Chu Se to.	6	Pho Yen dis.	Ba Hang to.	7
Dak Doa dis.	Dak Doa to.	7	Phu Binh dis.	Uc Son to.	7
Dak Po dis.	Dak Po to.	7	Phu Luong dis.	Du to.	8
Duc Co dis.	Ch Ty to.	5	Vo Nhai dis.	Dinh Ca to.	6
Ia Grai dis.	Ia Kha to.	6	57. Thanh Hoa		
Ia Pa dis.	Kim Tan to.	7	Thanh Hoa City	Dien Bien pre.	7
K'Bang dis.	Kbang to.	7	Bim Son Ts.	Bac Son pre.	8
Kong Chro dis.	Kong Chro to.	7	Sam Son Ts.	Bac Son pre.	7
Krong Pa dis.	Phu Tuc to.	7	Ba Thuoc dis.	Canh Nang to.	8
Mang Yang dis.	Kon Dong to.	6	Cam Thuy dis.	Cam Thuy to.	8
25. Ha Giang			Dong Son dis.	Rung Thong to.	7
Ha Giang ts.	Tran Phu to.	7	Ha Trung dis.	Ha Trung to.	8
Bac Me dis.	Bac Me to.	6	Hau Loc dis.	Hau Loc to.	8
Bac Quang dis.	Viet Quang to.	6	Hoang Hoa dis.	But Son to.	8
Dong Van dis.	Dong Van to.	5	Lang Chanh dis.	Lang Chanh to.	8
Hoang Su Phi dis.	Vinh Quang to.	5	Muong Lat dis.	Muong Lat to.	8
Meo Vac dis.	Meo Vac to.	6	Nga Son dis.	Nga Son to.	8
Quang Binh dis.	Yen Binh	7	Ngoc Lac dis.	Ngoc Lac to.	8
Quan Ba dis.	Tam Son to.	6	Nhu Thanh dis.	Nhu Thanh to.	7
Vi Xuyen dis.	Vi Xuyen to.	6	Nhu Xuan dis.	Yen Cat to.	7
Xin Man dis.	Coc Pai to.	5	Nong Cong dis.	Nong Cong to.	8
Yen Minh dis.	Yen Minh to.	7	Quang Xuong dis.	Quang Xuong to.	7
26.Ha Nam			Quan Hoa dis.	Quan Hoa to.	8
Phu Ly ts.	Quang Trung pre.	8	Quan Son dis.	Quan Son to.	7
Binh Luc dis.	Binh My to.	8	Thach Thanh dis.	Kim Tan to.	8
Duy Tien dis.	Duy Tien to.	8	Tho Xuan dis.	Tho Xuan to.	7
Kim Bang dis.	Que to.	8	Thuong Xuan dis.	Thuong Xuan to.	7
Ly Nhan dis.	Vinh Tru to.	8	Thieu Hoa dis.	Van Ha to.	7
Thanh Liem dis.	Thanh Liem to.	8	Tinh Gia dis.	Tinh Gia to.	7
27.Ha Tay			Trieu Son dis.	Trieu Son to.	8
Ha Dong ts.	Nguyen Trai pre.	8	Vinh Loc dis.	Vinh Loc to.	8
Son Tay towwnship	Quang Trung pre.	8	Yen Dinh dis.	Quan Lao to.	7
Ba Vi dis.	Ba Vi to.	8	58. Thua Thien - Hue		

Province/District		Gr.	Province/District		Gr.
Chuong My dis.	Chuc Son to.	8	Inner City	Phu Hoi pre.	7
Dan Phuong dis.	Phung to.	8	A Luoi dis.	A Luoi to.	7
Hoai Duc dis.	Troi to.	8	Huong Thuy dis.	Phu Bai to.	6
My Duc dis.	Te Tieu to.	7	Huong Tra dis.	Tu Ha to.	7
Phu Xuyen dis.	Phu Xuan to.	8	Nam Dong dis.	Khe Tre to.	7
Phuc Tho dis.	Phuc Tho to.	8	Phu Loc dis.	Phu Loc to.	6
Quoc Oai dis.	Quoc Oai to.	8	Phu Vang dis.	Phu Vang to.	7
Thach that dis.	Lien Quan to.	8	Phong Dien dis.	Phong Dien to.	6
Thanh Oai dis.	Kim Bai to.	8	Quang Dien dis.	Sia to.	6
Thuong Tin dis.	Thuong Tin to.	8	59. Tien Giang		
Ung Hoa dis.	Van Dinh to.	8	My Tho City	Pre. No	5
28. Ha Tinh			Go Cong Ts.	Pre. No	7
Ha Tinh ts.	Bac Ha pre.	8	Cai Be dis.	Cai Be to.	5
Hong Linh ts.	Nam Hong pre.	8	Cai Lay dis.	Cai Lay to.	5
Can Loc dis.	Nghen to.	8	Chau Thanh dis.	Tan Hiep to.	6
Cam Xuyen dis.	TT.Cam Xuyen to.	8	Cho Gao dis.	Cho Gao to.	6
Duc Tho dis.	Duc Tho to.	8	Go Cong Dong dis.	Tan Hoa to.	7
Huong Khe dis.	Huong Khe to.	6	Go Cong Tay dis.	Vinh Binh to.	7
Huong Son dis.	. Pho Chau to.	7	Tan Phuoc dis.	My Phuoc to.	5
Ky Anh dis.	Ky Anh to.	8	60. Tra Vinh		
Nghi Xuan dis.	Nghi Xuan to.	8	Tra Vinh Ts.	Pre. No4	5
Thach Ha dis.	Cay to.	8	Cang Long dis.	Cang Long to.	6
Vu Quang dis.	Vu Quang to.	7	Cau Ke dis.	Cau Ke to.	7
29. Hai Duong			Cau Ngang dis.	Cau Ngang to.	6
Hai Duong City	Nguyen Trai pre.	8	Chau Thanh dis.	Chau Thanh to.	6
Binh Giang dis.	Ke Sat to.	7	Duyen Hai dis.	Duyen Hai to.	6
Cam Giang dis.	Lai Cach to.	8	Tieu Can dis.	Tieu Can to.	7
Chi Linh dis.	Sao Do to.	8	Tra Cu dis.	Tra Cu to.	7
Gia Loc dis.	Gia Loc to.	8	61. Tuyen Quang		
Kim Thanh dis.	Phu Thai to.	8	Tuyen Quang Ts.	Minh Son pre.	7
Kinh Mon dis.	An Lu to.	8	Chiem Hoa dis.	Vinh Loc to.	5
Nam Sach dis.	Nam Sach to.	8	Ham Yen dis.	Tan Yen to.	6
Ninh Giang dis.	Ninh Giang to.	7	Na Hang dis.	Na Hang to.	6
Thanh Ha dis.	Thanh Ha to.	8	Son Duong dis.	Son Duong to.	7
Thanh Mien dis.	Thanh Mien to.	7	Yen Son dis.	Yen Son to.	7
Tu Ky dis.	Tu Ky to.	8	62. Vinh Long		
30. Hau Giang			Vinh Long ts.	Pre. No	5
Vi Thanh ts.	Pre. No5	5	Binh Minh dis.	Cai Von to.	7
Chau Thanh dis.	Nga Sau to.	6	Long Ho dis.	Long Ho to.	5
Chau Thanh A dis.	Tan Thuan to.	5	Mang Thit dis.	Cai Nhum to.	5
Long My dis.	Long My to.	5	Tam Binh dis.	Tam Binh to.	6
Phung Hiep dis.	Phung Hiep to.	6	Tra On dis.	Tra On to.	6
Vi Thuy dis.	Nang Mau to.	5	Vung Liem dis.	Vung Liem to.	5
31. Hoa Binh			63. Vinh Phuc		
Hoa Binh ts.	Phuong Lam pre.	7	Phuc Yen ts.	Phuc Yen to.	7
Cao Phong dis.	Cao Phong to.	7	Vinh Yen ts.	Lien Bao pre.	7
Da Bac dis.	Da Bac to.	7	Binh Xuyen dis.	Huong Canh to.	7
Kim Boi dis.	Bo to.	6	Lap Thach dis.	Lap Thach to.	7
Ky Son dis.	Ky Son to.	7	Me Linh dis.	Phuc Yen to.	7
Lac Son dis.	Vu Ban to.	8	Tam Duong dis.	Tam Duong to.	7
Lac Thuy dis.	Chi Ne to.	7	Vinh Tuong dis.	Vinh Tuong to.	8
Luong Son dis.	Luong Son to.	7	Yen Lac dis.	Yen Lac to.	8
Mai Chau dis.	Mai Chau to.	8	64. Yen Bai		
Tan Lac dis.	Muong Khen to.	7	Yen Bai City	Nguyen Thai Hoc pre.	8
Yen Thuy dis.	Hang Tram to.	7	Nghia Lo Ts.	Trung Tam pre.	7
32. Hung Yen			Luc Yen dis.	Yen The to.	8
Hung yen ts.	Minh Khai pre.	8	Mu Cang Chai dis.	Mu Cang Chai to.	7
An Thi dis.	An Thi to.	7	Tram Tau dis.	Tram Tau to.	6
Khoai Chau dis.	Khoai Chau to.	8	Tran Yen dis.	Co Phuc to.	8
Kim Dong dis.	Luong Hoi to.	8	Van Chan dis.	TTNT. Lien Son	7
My Hao dis.	Ban Yen Nhan to.	7	Van Yen dis.	Mau A to.	8
Phu Cu dis.	Tran Cao to.	7	Yen Binh dis.	Yen Binh to.	8
Tien Lu dis.	Vuong to.	8			

Province/District		Gr.	Province/District		Gr.
Van Giang dis.	Van Giang to.	7			
Van Lam dis.	Nhu Quynh to.	7			
Yen My dis.	Yen My to.	7			
33. Khanh Hoa					
Nha Trang City	Tan Lap pre.	6			
Cam Ranh ts.	Ba Ngoi to.	5			
Dien Khanh dis.	Dien Khanh to.	6			
Khanh Son dis.	To Hap to.	6			
Khanh Vinh dis.	Khanh Vinh to.	5			
Ninh Hoa dis.	Ninh Hoa to.	6			
Truong Sa dis.	Dao	5			
Van Ninh dis.	Van Gia to.	5			

*) Gr. = Grade, to. = town, ts. = township, dis. = district, pre. = precinct
Source: Institute of Geophysics, 2007

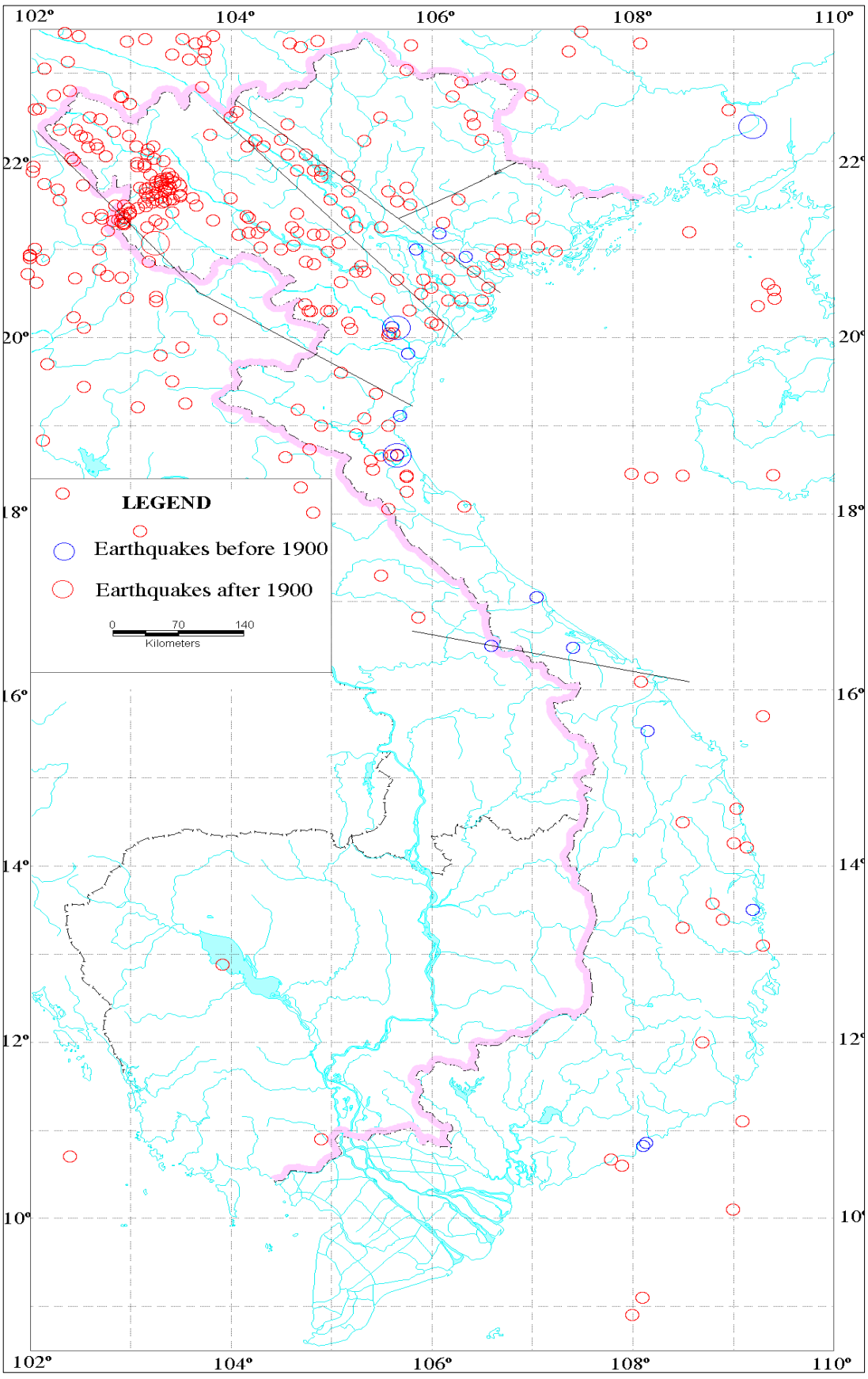
Figure 2.2.4 Earthquake Epicentres in Vietnam with MS>=4 (Magnitude Seismic)



Source: Institute of Geophysics, Viet Nam's Academy of Science and Technology (2007)

Figure 2.2.5 Map of Earthquake Epicentres in Vietnam and Adjacent Areas

(Scale: 1: 7,000,000)



Source: Institute of Geophysics, Viet Nam's Academy of Science and Technology (2007)

4) Forest Resources

Vietnam is tropical country having high biological diversity and is one of emergence countries of the world in term of biological diversity conservation. Forest resource of Vietnam is still very rich in the number of plant and wildlife species with various forest types: coastal mangrove forest, forest on fresh water marsh, broad-leaved evergreen forest, semi-deciduous forest on low land, limestone mountain forest, alpine evergreen forest and mixed pine forest. Up to now according to statistics Vietnam has over 7,000 high vascular tree species. As predicted by botanists in Vietnam there are at least 12,000 plant species of which about 2,300 species are already used by the people as food, , medicine, animal feed, timber, essential oil and others.

Up to the seventeenth century, Vietnam was covered with dense tropical forests which covered the deltas, the foot of mountains and low hills. The forests of Lim (ironwood), Huynh (Dalbergra bouruana gagu), De (hazel), etc. are all peak, or climatic, forests. At the end of the twentieth century, forest cover has diminished to only nine million hectares. Deforested land is 12 million ha. Forested land can only be found mostly in the Central Highland. Over the past decades the depletion of forest cover has increased sharply. Forest area was 14,272,000 ha in 1943 and fell to 9,184,283ha in 1987, accounting for just 28% of the total land area. According to statistics, forested lands annually decrease by 200,000, as a result of forest fire and shifting cultivation. In addition, a large forest area in the Central Highland and southeast has been converted to plantations of rubber, coffee, tea, and cotton in recent years. Forest cover has been reduced from 14.3 million ha (43.5%) in year 1943 to under 12 million (ha 38%) up to now.

Area of fired forest increased from 1.04 million ha in year 2000 to 2.08 million ha in 2006, especially in the North East, fired forest area account for 51% (1,069.8 ha), national growth rate of fired forest is 12.2% per year in the period 2000–2006 which is in urgent situation. However, it has been reduced in the South East and Red River Delta in this period (See more details in the Table 2.2.8). Destroyed forest area has decreased significantly from 3.54 million ha in 2000 to 2.85 million ha in 2006.

Table 2.2.8 Forest Area of Vietnam (Thousand ha)

Region	2000					2006					Growth rate (%) (2000-2006)				
	Total	Natural Forest	Planted Area	Destroyed Forest	Fired Forest	Total	Natural Forest	Planted Area	Destroyed Forest	Fired Forest	Total	Natural Forest	Planted Area	Destroyed Forest	Fired Forest
Red River Delta	110.5	55.0	55.5	0.21	0.03	130.4	58.2	72.2	0.01	0.02	2.8	0.9	4.5	-43.0	-3.8
North East	2,342.1	1,880.8	461.3	0.07	0.47	3,027.0	2,173.1	853.7	0.03	1.07	4.4	2.4	10.8	-10.6	14.7
North West	963.4	884.4	7.09	0.27	0.07	1,505.0	1,394.5	110.1	0.08	0.21	7.7	7.9	5.7	-18.1	21.1
North Central Coast	2,135.7	1,835.6	300.1	0.04	0.06	2,467.0	1,977.3	489.4	0.02	0.21	2.4	1.2	8.5	-14.1	24.4
South Central Coast	1,139.3	969.3	170.0	0.22	0.05	1,271.0	984.4	287.0	0.16	0.18	1.8	0.3	9.1	-5.0	22.5
Central Highlands	2,991.7	2,930.4	61.3	1.55	0.10	2,963.0	2,809.0	152.7	0.94	0.23	-0.2	-0.7	16.4	-8.1	15.5
South East	962.5	825.5	137	0.98	0.17	967.1	726.5	240.6	1.60	0.04	0.1	-2.1	9.8	8.4	-21.9
Mekong River Delta	270.4	63.2	207.2	0.21	0.10	334.3	53.8	280.5	0.02	0.11	3.6	-2.6	5.2	-31.8	2.5
Whole country	10,915.6	9,444.2	1,471.4	3.54	1.05	12,664.0	10,177.7	2,486.2	2.85	2.09	2.5	1.3	9.1	-3.5	12.2

Source: Statistical Yearbook of Vietnam

According to the Viet Nam's Forest Research Institute, Highland has the highest forest cover density accounting for 55% of total natural land areas that is much higher than nationally average forest cover density. Forest cover of the Northern- Mountainous, North

Central Coast, South Central Coast, South East, Mekong River Delta are as following: 36,3%; 43%; 38,5%; 20,8% and 8,5%.

Twenty eight percent of the population (approximately 24 million) living in and near forest depends on it. Most of them make product for their self-use and also use forest products as foodstuff, material to make house and furniture.

Rich forests locate mostly in provinces of Lam Dong, Dak Lak and Kon Tum (Highland), Yen Bai and Bac Kan (the Eastern–North), Thanh Hoa, Nghe An, Quang Binh (the Northern Central). Rich forest areas account for 29% of Viet Nam forest areas, Medium forest areas account for 16% and poor forest areas account for 41% of that. Some regions in Vietnam mainly in Highland and areas along to the Lao border have evergreen forests.

Mostly Planted forests in the North-East have roles of protecting and covering the areas that were treeless barren hills due to past mine exploiting industries. In the South Central Coast, Most planted forests are protective forests preventing sand erosion while in the South–East and Mekong River Delta, those are planted along the coast for industrial wood and paper producing.

Mr. Ho Chi Minh said that “Forest is gold. If we know how to conserve and use it well, it will be very precious. Destruction of the forest will lead to serious effects to both life and productivity.” Thus, the Government of Vietnam has made the effort to promote reforestation and worked to increase forest cover by 100,000 ha a year.

VITRANSS 2-proposed projects should thus include adequate measures to strengthen transport systems that would, for example, support the plantations in the Central Highland and the Southeast, while taking into consideration the forest preservation program of government.

5) Land Resources

According to Statistical Yearbook of Viet Nam 2006, total area of land use is 33,121,000 ha, in which:

(i) Farm land: 9,412,200 ha
(ii) Forestry land: 4,437,300 ha
(iii) Residential land: 602,700 ha
(iv) Specially used land: 1,401,000 ha

Vietnam can be divided into 8 agricultural-ecological regions namely: Red River Delta, North East, North West, North Central Coast, South Central Coast, South East, Mekong River Delta, and Red River Delta.

Mekong River Delta and Red River Delta population have high density, almost land areas (51.2% in Red R.D, 63.4% in Mekong R.D) is cultivated for food crop. The other regions have much less cultivation land areas (13.3% in North West and 15.3% in North East) but they are used with high frequency. Farm land per capita is 0.28ha on average in year 2006.

Most land area (56.1% in Central Highland, 55.4% in North Central Coast, 55.5% in North East) is used to grow forest.

Table 2.2.9 Existing Condition and Structure of Land in Vietnam in 2006 (103 ha)

Region	Total Area	Farm Land	Forestry Land	Specially Used Land	Residential Land
Red River Delta	1,486	760	123	231	117
North East	6,402	979	3,551	203	80
North West	3,753	500	1,774	42	33
North Central Coast	5,155	805	2,854	194	98
South Central Coast	3,317	584	1,460	194	54
Central Highlands	5,466	1,597	3,068	125	42
South East	3,481	1,612	1,252	194	71
Mekong River Delta	4,060	2,576	356	220	109
Whole country	33,121	9,412	14,437	1,401	603
Structure of Used Land (%)					
Red River Delta	100	51.2	8.3	15.5	7.8
North East	100	15.3	55.5	3.2	1.2
North West	100	13.3	47.3	1.1	0.9
North Central Coast	100	15.6	55.4	3.8	1.9
South Central Coast	100	17.6	44	5.8	1.6
Central Highlands	100	29.2	56.1	2.3	0.8
South East	100	46.3	36	5.6	2.1
Mekong River Delta	100	63.4	8.8	5.4	2.7
Whole country	100	28.4	46.3	4.2	1.8

Source: Statistical Yearbook of Viet Nam, 2006

6) Water Resources

Water resource includes surface and ground water. The total amount of surface water running through Vietnam land is 835 billion m^3/year a year on average including the 554.9 billion m^3 of water from neighboring countries (66.4%) and 280 billion m^3 generated domestically. In Vietnam river system, Mekong River has the biggest water amount with approximately of 520 billion m^3/year, the next is Hong–Thai Binh River with about of 137 m^3/year, as indicated in Table 2.2.10.

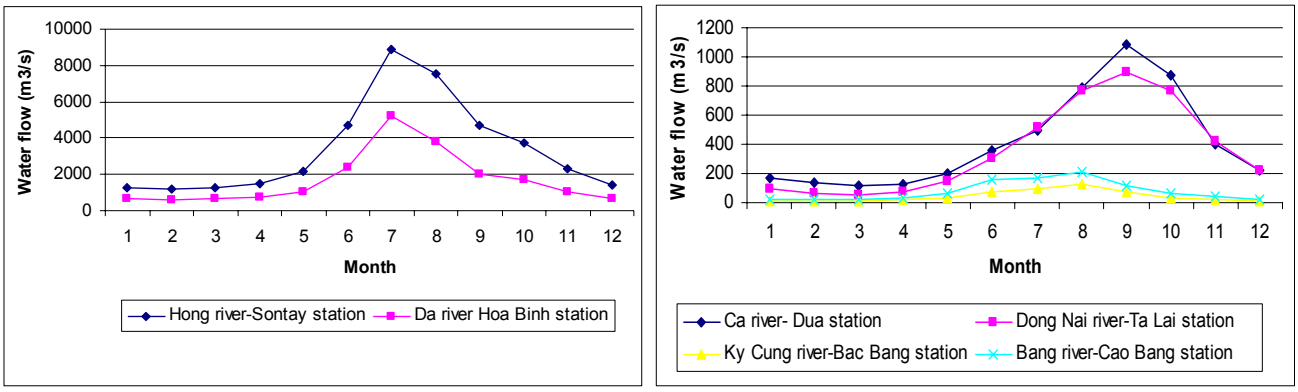
Table 2.2.10 Water Resource of Main Rivers in Vietnam (10^9 m^3)

River	Area (km^2)	Water Amount		Total
		Inside	Outside	
Bang-Ky Cung	12,880	7.22	1.70	8.92
Hong-Thai Binh	168,700	92.88	44.12	137.00
Ma - Chu	28,400	15.80	4.34	20.10
Ca	27,200	19.50	4.74	24.20
Gianh	4,680	8.14		8.14
Quang Tri	2,660	4.68		4.68
Huong	2,830	5.64		5.64
Thu Bon	10,496	19.30		19.30
Ve	1,260	2.36		2.36
Tra khuc	3,189	6.19		6.19
An Lao	1,466	1.64		1.64
Con	2,980	2.58		2.58
Ky Lo	1,920	1.45		1.45
Ba	13,800	10.36		10.36
Cai (Nha Trang)	1,900	1.90		1.90
Cai (Phan Rang)	3,000	1.72		1.72
Luy	1,910	0.82		0.82
Cai (Phan That)	1,050	0.49		0.49
Đong Nai	37,300	30.60		30.60
Me Kong	795,000	20.60	500.00	520.60
Total		253.87	554.90	808.69

Source: Institute of Meteorology and Hydrology

The distribution of water resource is highly variable both in terrain and time due to unevenly distributed monsoon rainfall and differential geomorphology. Figure 2.2.5 illustrates monthly average water flow of main rivers.

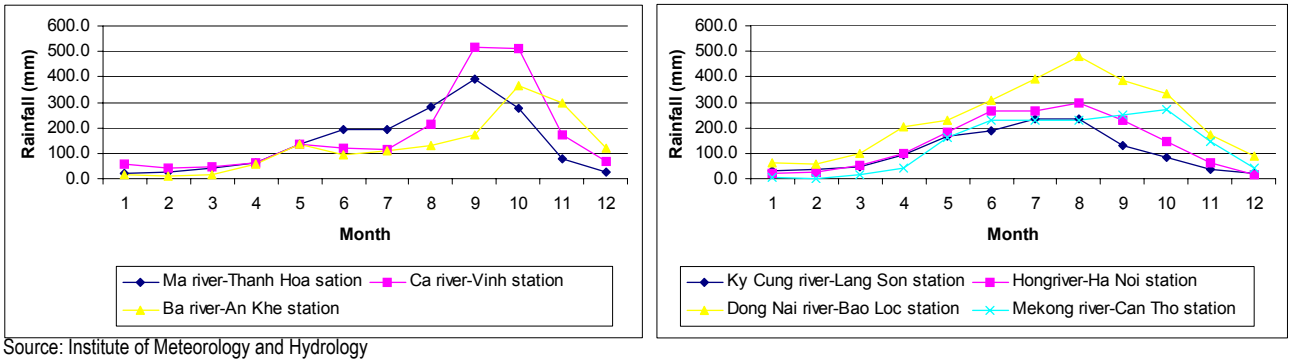
Figure 2.2.6 Monthly Average Water Flow of Main Rivers



Source: Institute of Geophysics, Viet Nam's Academy of Science and Technology (2007)

Highly variable rainfall, lack of reservoirs and infrastructures to mitigate flood are the leading factor causing flood and water shortage. Figure 2.2.6 illustrates monthly average rainfall patterns in several river basins and the close correlation between the rainfall distribution and that of runoff.

Figure 2.2.7 Monthly Average Rainfall



Source: Institute of Meteorology and Hydrology

About 70–75% of the annual total runoff is generated within flood season, 20–30% in dry season.

Table 2.2.11 Monthly Water Discharge in Main Rivers

River	Station	Period	Monthly Discharge (million m^3)				
			Max.	Min.	Driest Month	Max/yr (%)	Min/yr (%)
Bang-Ky Cung	Van Mich	1960-1976	300	24	Feb.	281.8	22
Red-Thai Binh	Son Tay	1986-2000	21,942	2940	Feb.	261.3	35
Ma	Cam Thuy	1995-2000	2,155	239	Mar.	260.4	29
Ca	Dua	1959-2000	2,659	295	Mar.	83.9	29
Gianh-Huong	Dong Tam	1961-1981	456	41	Apr.	363.3	26
Thu Bon	Nong Son	1977-2000	2,460	179	Apr.	361.1	26
Tra Khuc	Son Giang	1979-2000	1761	125	Apr.	304.1	18
Ba	Cung Son	1977-2000	2,187	131	Apr.	320.2	32
Cai	Thanh My	1977-2000	978	99	Apr.	248.3	14
Dong Nai	Ta Lai	1989-2000	2,201	120	Mar.	225.2	24
Xre-poc	Ban Don	1977-2000	1,497	162	Mar.		

Source: Institute of meteorology and hydrology, 2008
Note: Selected station is located in the largest basin area of the river.

Lack of water occurs in some mountainous districts of the North and Highland in dry season. Areas along the coast seriously lack fresh water due to brackish and aluminous river water.

Areas along to the coast especially Cu Long River Delta, Hong and Thai Binh Rivers have the valuable brackish water resource for socio-economic development.

Underground water is abundant with exploitable potential capacity nearly 60 billion m^3 per year. Vietnam also has plenty of mineral water sources and hot springs (about 400 sources), which has high quality and variety.

(1) Water Quality

The typical characteristic of river and stream flows in Vietnam is high in mud (sediment) ranging from100 g/m^3 to 500 g/m^3 per year on average meanwhile Hong River's mud is over 1,000 g/m^3. Brackish and aluminous water are mostly found in Mekong River Delta.

Untreated waste water from big cites, factories, industrial zones pollutes critically the rivers running through the big cities, industrial zones especially in Ha Noi, Ho Chi Minh and Viet Tri, Thai Nguyen.

(2) Reservoirs

Most dams and reservoirs in Vietnam has been constructed for multiple purposes, including flood control, irrigation, hydropower, water supply and other flow management. Most are more than 20–30 years old. There are about 3,600 reservoirs of various sizes, of which less than 15 percent are large or medium (capacity of over 1 mill.m^3 or a height of more than 10m). Siltation from degradation of watersheds is causing a decline in reservoir capacity – some with only 30% of the original capacity remaining.

Table 2.2.12 Major Reservoirs in Vietnam

Reservoirs	Catchment (km^2)	Volume ($10^6.m^3$)	Irrigated Area (ha)	Hydropower (MW)
Hoa Binh	51.700	9.450		1,920
Thac Ba	6.100	2.940		108
Tri An	14,600	2,760		420
Dau Tieng	2,700	1,580	72,000	
Thac Mo	2,200	1,370		150
Yaly	7,455	1,037		720
Phu Ninh	235	414	23,000	
Song Hinh	772	357		66
Ke Go	223	345	17,000	

Source: National profile on water resource, the Department of water resource management, 2002

(3) Lake

There are several major natural lakes in Vietnam, one of those is Ba Be Lake with a surface area of 4.5 km^2 and a volume of 90 million m^3. In addition, there are numerous other smaller lakes including urban lakes in Hanoi.

(4) Groundwater

The groundwater resources in Vietnam are abundant with the total potential exploitable reserves of the country's aquifers estimated at nearly 60 bill. m^3 per year. The availability varies from abundant resources in the Mekong River Delta to somewhat limited resources in the North Central Region. However, despite the abundance of groundwater reserves, only less than 5% of the total reserves are exploited, for the country as a whole. The

abstraction of groundwater also varies. For example, groundwater exploitation is difficult in the Northeast because the reserves are scattered and diverse. In the Central Highlands, on the other hand, groundwater is exploited heavily for irrigation of cash crops resulting in shortages of water in parts of this region. In the Red River and Mekong River Deltas groundwater is exploited beyond the recharge capacity around Hanoi and HCMC. This over exploitation is resulting in falling water tables further causing land subsidence and salinity intrusion, especially in the Mekong River Delta.

Mineral and thermal water resources are abundant in Vietnam, good in quality and varied in types having great value for different purposes such as balneological treatment, bottled mineral water, geothermal energy, extraction of CO_2 gas etc. According to investigation there are about 400 mineral and thermal water sources in the country, of which 287 sources have been exploited and reliable data exist.

Table 2.2.13 List of Mineral and Thermal Water Sources

Region	Number of Sources			
	Springs	Boreholes	Springs/Wells	Total
Northeast	83	1	3	87
Northwest	7	5	2	14
Red River Delta	1	15	1	17
North Central Coast	14	4	4	22
South Central Coast	30	4	22	56
Central Highlands	18	6		24
Northeast of Mekong	1	11	1	13
Mekong River Delta		54		54
Total	154	100	33	287

Source: Environmental Report of Vietnam 2006, The Current State of Water Environment in 3 River Basins: Cau, Nhue- Day and Dong Nai River Systems

7) Marine Resources

Vietnam's territory covers a large part of the sea with an immense continental shelf, a coastline 3,260 km long and two 100m deep gulfs of Thailand in the south and Tonkin in the north. Its islands are many with the largest being Cat Ba, Phu Quoc and Phu Quy. It also claims ownership over the group of outlying islands of Paracel and Spratly, the latter being claimed wholly or in part by other countries like China, Malaysia and the Philippines.

Typical biosystems like sand, dunes, marshes, estuaries, mangroves, coral reefs, and rock cliffs are mostly found along the coast and lagoons. Ha Long Bay, including Bai Tu Long, Lan Ha, and thousand of small islands, is one of the world's cultural heritage sites and a tourist center.

Its coral reefs are rich with a remarkable number of species. As fish haven, coastline protection and tourist site, Vietnam's coral reefs are extensively distributed from north to south, in particular, very extensive, structured and diverse in the south.

There are three kinds of river mouths along the coast - estuaries, deltas and lagoon river mouths. They are most numerous in the north from Mong Cai to Thanh Hoa and in the south from Vung Tau to Ha Tien and found at an average of every 20 km along the coastline as indicated in Figure 2.2.7.

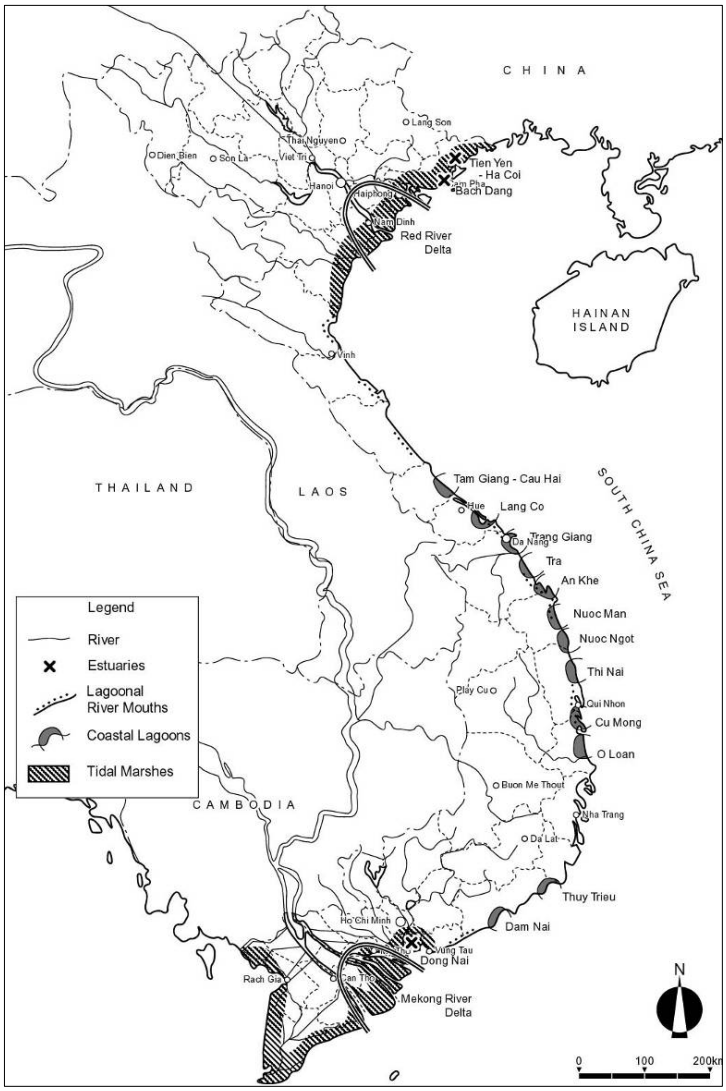
Typical coastal lagoons occupy 5% of coastline and are in the central region from Hue to Phan Rang (Ninh Thuan), where sand is abundant and tidal range is small (0.5–2.5 m). These lagoons, 280–21,600 ha in area, are enclosed by 2–25 m high sand barriers or dunes, and are connected to the sea through narrow inlets, which often vary in width and

location according to season. Coastal lagoons are productive ecosystems due to their high nutrient levels, which exceed those of the sea, even in dry season. Fish, shrimps and mollusks are abundant here.

The country's total area of tidal marsh covers about 300,000 ha, 70% of which has mangroves, with nearly 100 species, and sea grass. They are mainly distributed along the northern coast from Mong Cai in Quang Ninh to Thanh Hoa Province and in the south from Vung Tau to Kien Giang (see Table 2.2.14). In the central region, there are few tidal marshes. Nonvegetated tidal marshes are mainly found in the Red River and Mekong Delta, extending seaward from large mangrove stands.

Mangrove forests play an important role in coastal protection, land reclamation and as nursery for a large number of marine species. Along the coast they buffet the impact of waves, slow down erosion and provide a natural dike. They are also suitable habitats for marine resources, including species with a high commercial value such as Penaeid spp. shrimp and the mangrove crab, Scylla serrata. As mangrove density increases, so do fish and shellfish production in mangroves and adjacent waters.

Figure 2.2.8 Coastal Ecosystem of Vietnam



Source: Technical Report No. 11 Environment, The Study on the National Transport Development Strategy in the Socialist Republic of Vietnam (VITRANSS-2000)

Table 2.2.14 National Distribution of Tidal Marsh and Mangrove

Region	Area (ha)		
	Tidal Marsh	Natural Mangrove	Replanted Mangrove
Mong Cai–Thanh Hoa	74,520	46,400	4,200
Tanh Hoa–Vung Tau	18,000	14,300	
Vung Tau–Kien Giang	207,480	191,800	42,450

Source: "Biodiversity Action Plan for Vietnam" GSRV/GEFP, 1994

Over 60 species of fish, 146 of mollusks, 107 of crustaceans and many water birds and mammals inhabit tidal marshes. These area are also economically vital as they provide the spawning ground and nursery for numerous fish, prawns and mollusks. Table 2.2.15 compares the biodiversity of six important tidal marshes.

Table 2.2.15 Biodiversity Comparisons of Six Important Tidal Marshes

No. of Species	Duyen Hai	Ca Mau	Xuan Thuy	Tien Lang	Yen Hung	Tien Yen Ha Coi
Mangrove	105	46	8	6-7	45	23
Mollusk	55	52	38	26	30	24
Crustacean	19	30	30	28	32	30
Birds	33	50	40	23	32	36

Sources: "Biodiversity Action Plan for Vietnam" GSRV/GEFP, 1994

The environmental problems faced by lagoons include resource overexploitation, land reclamation for agriculture and aquaculture and water pollution. Most have been exploited in varying degrees to culture seaweed, fish and shrimp using traditional and extensive farming methods. The sandy soil however limits the potential for aquaculture.

8) Ecosystem and Biodiversity

(1) Ecosystem

Endowed with a diverse terrain, including submerged deltas, karsts limestone, long coast, high mountains, highland, wetland and large basin, Vietnam has many ecosystems in both terrestrial and aquatic natures.

Table 2.2.16 Major Ecosystem in Vietnam

Ecosystems	Biodiversity Characteristics
Terrestrial ecosystems	
Primary forests	High biodiversity, sustainable ecosystems
Secondary forests	Medium biodiversity, relatively sustainable ecosystems
Poor forests	Poor biodiversity, less sustainable ecosystems
Grasslands	Poor biodiversity, simple structured ecosystems
Mangrove forests	High biodiversity, less sustainable ecosystems
Coastal sand dunes	Poor biodiversity, less sustainable and fragile ecosystems
Lowland mountains	Medium biodiversity, fairly sustainable ecosystems
Rock mountain	Medium biodiversity, less sustainable ecosystems
Agricultural ecosystems	Poor biodiversity, less sustainable ecosystems
Urban areas and industrial parks	Poor biodiversity, less sustainable ecosystems
Aquatic ecosystems (wetlands and marine areas)	
Flowing water (rivers, streams)	Medium biodiversity, relatively sustainable ecosystems
Lakes, large water areas	Medium biodiversity, fairly sustainable ecosystems
Ponds, smaller water areas	Poor biodiversity, fragile ecosystems
Seasonal flooded areas	Poor biodiversity, fragile ecosystems
Blackish areas, estuaries	High biodiversity, fragile ecosystems
Coastal areas	High biodiversity, fragile ecosystems
marine areas (deep water)	Medium biodiversity, sustainable ecosystems
Underground water bodies, caves	Poor biodiversity, fragile ecosystems

Source: Biodiversity of Vietnam: characteristics and importance, 2004

(2) Biodiversity

Vietnam is in the tropical monsoon region and geographically diverse. This makes it favorable for many biological kingdoms to thrive in both numbers and species composition. However, during Vietnam's recent socio-economic development, its biodiversity has been also changing.

Species Diversity: According to Tre' de Grom Bridge (1992), Vietnam is one of the top 25 countries in term of biodiversity and has been estimated as home for between 20,000 to 30,000 plant species. Vietnam ranks 16 in world biodiversity index (with 6.5% of world species). Table 2.2.17 summaries data and records of species composition of plants and animals in Vietnam from literature.

Table 2.2.17 Diversity of Species Composition in Vietnam

Taxonomic Group	Species in Vietnam	Species in the World	Ratio (%) Vietnam/World
Micro algae			
Freshwater	1,438	15,000	9.6
Marine	537	19,000	2.8
Seaweeds, sea grasses			
Freshwater	AROUND 20	2,000	1
Marine	667	10,000	6.8
Vascular Plants	AROUND 11400		5
Moss	1,030	22,000	4.6
Fungi	826	50,000	1.6
Aquatic invertebrates			
Freshwater	794	80,000	1
Marine	AROUND 7,000	220,000	3.2
Soil invertebrates	AROUND 1,000	30,000	3.3
Parasite worms on livestock	161	1,600	10
Insects	7,750	250,000	3.1
Fishes		19,000	13
Freshwater	OVER 700		
Marine	2,458		
Reptiles	296	6,300	4.7
Marine reptiles	21		
Amphibians	162	4,184	3.8
Birds	840	9,040	9.3
Mammals	310	4,000	7.5
Marine mammals	25		

Source: VEPA, IEBR, NADAREP, Pham Binh Quyen, 2005

(a) Terrestrial Species Diversity

(i) **Flora:** In summary, studies and research on Vietnamese flora reveals 15,986 plant species (including 4,528 lower plants and 11,458 vascular plants) 10 per cent of these are endemic species.

(ii) **Fauna:** According to the most recent statistics, there are 307 species of roundworm (Nematoda), 161 tapeworm species, 200 earthworm species (Oligochaeta), 145 Arcatia species (Acartia), 113 springtail species (Collembolla), 7,750 insect species (Insecta), 260 reptiles species (Reptilia), 120 amphibian species (Amphibia), 840 bird species (Aves), 310 mammal species and sub-species.

Vietnam is considered one of the most ecologically diverse countries in the world with the richest level of species composition and highest degree of endemism of all the countries

with the Indo-Malayan region. The unique nature of Vietnamese natural ecosystem is exemplified by the occurrence of over 100 endemic bird species and sub-species and 78 endemic mammal species and sub-species (Vo Quy and Nguyen Cu, 1995). As an example, there are 25 primate species found in Vietnam, four species and sub-species are endemic to Vietnam, whilst three sub-species are only found in the forest areas of Vietnam and Lao and two sub-species are only found in the forests of Vietnam and Cambodia (Pham Nhat, 1999).

(b) Species Diversity in Wetland Ecosystems

Terrestrial freshwater basins in Vietnam possess a high degree of ecological diversity, including micro algae, fresh water seaweeds, wetland and seasonal wetland grasses, invertebrates and fishes.

(i) **Aquatic Species**

1,438 species in 259 genera and nine divisions. Current statistics record 794 species of invertebrates. In particular, 54 small crustaceans (Crutacea) and eight genera have only been recorded in Vietnam. In reference to two larger crustacean groups, shrimps and crabs, 59 species have been recorded with seven genera and 33 species (accounting for 55.9% of the total number of species) are newly described.

According to existing statistics (Ministry of Fishery, 1996, Dang Ngoc Thanh et al, 2002), the species composition of terrestrial freshwater fishes includes over 700 species and sub-species that belong to 228 genera, 57 families and 18 orders. For example the carp order has 276 species and sub-species belonging to 100 genera, four families and one sub-family are endemic to Vietnam. Most of the endemic species are found in river basins, streams and mountain areas.

(ii) **Species Diversity in Coastal and Marine Ecosystems**

Vietnamese marine ecosystems are characterized by tropical features and mixing of ocean currents. Marine ecosystems are however significantly different in the North and South but tend to demonstrate less endemism than observed in the nations terrestrial ecosystems (Dang Ngoc Thanh, 1996). Approximately 11,000 species (Table 2.2.18) find homes in over 20 different ecosystems in six marine biodiversity regions, Mong Cai–Do Son and Hai Van- Vung Tau marine regions have higher biodiversity than other regions. On the continental seafloor, there are nine water fluctuation areas that contain high biodiversity and large fish bases.

Research on resource dynamics provides a list of fish fauna found in Vietnamese waters including 2,458 species, which is 420 species more than the list recorded in 1985. Seven new marine mammal species have been also discovered recently (Aquatic resource Research Institute, 2005).

According to IUCN Red list of Endangered Species (IUCN, 2004), Vietnam has 289 globally endangered animal and plant species. Vietnam Red Data Book (MONRE) lists 1,056 threatened wildlife species at national level (Table 2.2.19). In comparison with records of the first version of Vietnam' Red Data Book (1996), the current number of species increased considerably, 1056 species against 721 species. This indicates the increasing trend of wildlife population in Vietnam and more species facing the risk of extinction. Many species remain in small population and are isolated in fragmented habitats. A typical example is the Javan Rhinos. Since being rediscovered in 1989 in Cat Loc area, the population of this species is estimated around six or seven individuals and there's no evidence of reproduction of this population (Pollet et al, 1999).

Table 2.2.18 Total Marine Species known in Vietnam

Taxonomic Group	Number of Species
Benthic animals	around 6,000
Molluscs	2,500
Bristle worms	700
Crustaceans	1,500
Echinoderms	350
Corals	617
Cephalopods	53
Fishes (about 130 commercial species)	2,458
Seaweeds	653
Zooplanktons	657
Mangrove plants	94
Marine shrimps	225
Seagrasses	14
Sea snakes	15
Marine mammals	25
Marine turtles	5
Seabirds	43
Others	approximately 224
Total	approximately 11,000

Sources: Do Van Khuong and Nguyen Chu Hoi (Proceedings of National workshop on environment and Fishery Resources protection, Hai Phong, January 14–15, 2005, Nguyen Huy Yet, 2005).

Table 2.2.19 Number of Endangered Species in Global and National Red Lists in Vietnam (List under categories critically endangered (CE), Vulnerable (VU), Endangered (EN))

	1992 -1998		2004	
	IUCN 1996, 1998	Vietnam Red Book 1992, 1996	IUCN	Vietnam Red Book
Mammals	38	78	41	94
Birds	47	83	41	76
Reptiles	12	43	24	39
Amphibians	1	11	15	14
Fishes	3	75	23	89
Invertebrates	0	75	0	105
Vascular Plants	125	337	145	605
Fungi		7		16
Algae		12		18
Total	226	721	289	1,056

Source: IUCN Red List (IUCN 1996, 1998, 2004), Vietnam Red data book.

(c) National Park, Nature Reserve and Historical, Environmental Reserve

There are 129 protected areas in Vietnam, in which: 27 are national parks; 60 are natural and habitat reservation areas, 37 are Cultural-historical-environmental reservation areas, 5 are world heritage sites.

National parks are protected areas that provide immense value to nature conservation, research, cultural heritage, and tourism. They should be located within a strictly protected area where all activities are prohibited. Within this protected area, there is a rehabilitation zone for regenerating forest plants and animals under threat of extinction and a recreational zone for showcasing to visitors the park's beautiful landscapes and inhabitants. National parks should be surrounded by buffer zones where production activities are restricted and

monitored by the park management board.

Nature reserves are protected areas meant to conserve plant and animal species. Here, research is acceptable while tourism and recreation are not encouraged. Culturally and environmentally protected areas contain historical and cultural monuments and items with aesthetic or environmental value and tourism and recreation potential.

Table 2.2.20 List of National Parks in Vietnam

No.	Name	Area (km^2)	Characteristic	Province
1	Ba Be	100.48	Lowland evergreen forests. The surface area of the lake fluctuates between 3 and 5km^2 between dry and wet season	Bac Kan
2	Ba Vi	69.86	The park has rich and diverse tropical and subtropical species of flora and fauna	Ha Tay
3	Bach Ma	22,000	This is one of the wettest places in Vietnam, rich in biodiversity, evergreen and montane forest	Thua Thien Hue
4	Bai Tu Long	15,783	Including 6,125ha of island land and 9,658ha of tidal land on Ba Mun, Tra Ngo Lon, Tra Ngo Nho, Sau Nam, Sau Dong, Dong Ma, and more than 20 other small islands. Diversity of 672 species of terrestrial plants and 178 aquatic floral species.	Quang Ninh
5	Ben En	166.34	Ben En has the mountainous terrain, various rivers and lakes on the mountain. Biological Diversity	Thanh Hoa
6	Bu Gia Map	22,000	Biological diversity	Binh Phuoc
7	Cat Ba	15,200	Mountainous terrain, diversity of flora and fauna	Hai Phong
8	Cat Tien	738.78	It protects one of the largest areas of lowland tropical rainforests left in Vietnam.	Binh Phuoc
9	Chu Mom Ray	56 620	Agro-ecological zone, lowland evergreen forest,	Kon Tum
10	Chu Yang Sin	589.47	Biological diversity	Dak Lak
11	Yok Don	115.54	Biological area, lowland forest	Dak Lak
12	Con Dao	150.43	Natural reserve area, including a part of the island and the surrounding, sea diverse ecosystem, many species of corals and especially the sea turtle	Ba Ria–Vung Tau
13	Cuc Phuong	25,000	The first national park, and the largest nature reserve, consists of verdant karst mountains and lush valleys. Diversity of flora and fauna.	Ninh Binh
14	Hoang Lien	19,739	Agro-ecological zone, lower montane evergreen forest	Lao Cai
15	Kon Ka Kinh	417.80	This is a priority zone for the protection of biodiversity of Vietnam as well as ASEAN. It is also a biological tourist site.	Gia Lai
16	Lo Go Sa Mat	187.65	Natural preservation	Tay Ninh
17	Mui Ca Mau	418.62	Natural preservation zone	Ca Mau
18	Nui Chua	29,865	Drain steep slope. Mixture of evergreen forest, semi-evergreen forest, deciduous forest. Nui Chua receives the lowest rainfall in the South-Central Viet Nam.	Ninh Thuan
19	Phong Nha-Ke Bang	857.54	This is one of the world's two largest limestone regions. It protects one of the world's two largest karst regions with several hundred caves and grottoes. Biodiversity of flora and fauna.	Quang Nam
20	Phu Quoc	314.22	Includes land and sea area, preservation zone, protecting oceanic species	Kien Giang
21	Phu Mat	911.13	Preservation zone, high slope	Nghe An
22	Tam Dao	36,883	The national park lies along a massif, which runs from north-west to south-east, and is isolated from other high-elevation areas by intervening areas of low elevation. There are several peaks over 1,300m in the national park, the highest of which is Mount Tam Dao Bac at 1,592m. The lowest point in the national park is c.100m.	Vinh Phuc, Thai Nguyen and Tuyen Quang
23	Tram Chim	75.88	This national park is created to protect several rare birds, especially sarus cran	Dong Thap
24	U Minh Thuong	8,053	U Minh Thuong is situated in an area of freshwater wetlands, comprising peatswamp forest, seasonally inundated grassland and open swamp. The core zone of U Minh Thuong is surrounded by a perimeter canal and dyke system, with a series of gates, which are used to manage the water level	Kien Giang
25	Vu Quang	55,029	Agro-ecological zone. An area of steep mountains and dense rainforest. It is a very wet, hot area, inhospitable climate. Diversity of several new species of deer and antelope	Ha Tinh
26	Xuan Son	150.48	the Xuan Son national park is one of 4 bio-diversity conservation sites in Vietnam, which have rich and rare fauna and flora of limestone mountain	Phu Tho
27	Xuan Thuy	7,100	The first Ramsar Site in Vietnam, The major habitats is estuaries, mangroves, mudflats, sandy flats and shrimp ponds.	Nam Dinh

Source: MONRE and FRD (Forest Protection Department (2006)

Table 2.2.21 List of Nature Conservation Areas in Vietnam

No.	Name of Nature Reserves	Area (km^2)	Province	No.	Name of Nature Reserves	Area (km^2)	Province
I. Nature Reserves				I. Nature Reserves			
1	Muong Nhe	182,000	Lai Chau	50	Mo Re-Bac Son	2,416	Lang Son
2	Nam Don	18,000	Son La	51	Tien Hai	12,500	Thai Binh
3	Sop Cop	27,886	Son La	52	Van Long	3,500	Ninh Binh
4	Xuan Nha	38,069	Son La	53	Tam Quy	500	Thanh Hoa
5	Phu Canh	5,647	Hoa Binh	54	Trap Kso	100	Dak Lak
6	Paco-Hang Kia	7,091	Hoa Binh	55	Ea Rai	50	Ninh Thuan
7	Thuong Tien	7,308	Hoa Binh	56	Rung kho Nui Chua	16,775	Bac Lieu
8	Bac Me	27,800	Ha Giang	57	San chim Bac Lieu	127	Can Tho
9	Du Gia	24,293	Ha Giang	58	Lung Ngoc Hoang	6,000	
10	Phong Quang	18,397	Ha Giang	59	Dat Mui-Bai Boi	4,461	Ca Mau
11	Tay Con Linh	40,344	Ha Giang	60	Vo Doi	3,394	
12	Cham Chu	51,187	Tuyen Quang	II. Cultural-historical-environmental reserve			
13	Nui Pia Oac	10,000	Cao Bang	1	Muong Phang	1,000	Lai Chau
14	Trung Khanh	3,000	Cao Bang	2	Dao ho song Da	3,000	Hoa Binh
15	Kim Hy	18,555	Bac Kan	3	Kim Binh	1,937	Tuyen Quang
16	Huu Lien	10,640	Lang Son	4	Tan Trao	6,633	Tuyen Quang
17	Khe Ro	5,675	Bac Giang	5	Pac Bo	2,784	Cao Bang
18	Tay Yen Tu	16,466	Bac Giang	6	All inslands of Thac Ba	5,000	Yen Bai
19	Ky Thuong	17,640	Quang Ninh	7	Ai Chi Lang	1,000	Lang Son
20	Yen Tu	3,040	Thanh Hoa	8	Hang Phuoc Hoang	6,000	Thai Nguyen
21	Hon Me	500	Thanh Hoa	9	Nui Coc lake	6,000	Thai Nguyen
22	Pu Hu	35,089	Thanh Hoa	10	Cam Son lake	15,000	Bac Giang
23	Pu Luong	17,662	Thanh Hoa	11	Yen The	1,883	Bac Giang
24	Xuan Lien	23,610	Nghe An	12	Bai Chay	562	Quang Ninh
25	Pu Hoat	67,934	Nghe An	13	All islands of Ha Long Bay	1,000	Quang Ninh
26	Pu Huong	50,075	Ha Tinh	14	Den Hung	285	Phu Tho
27	Ke Go	24,801	Quang Tri	15	Huong Son	4,355	Ha Tay
28	Dakrong	40,526	Thua Thien Hue	16	Con Son Kiep Bac	1,477	Hai Duong
29	Phong Dien	41,548	Quang Nam	17	Do Son	267	Hai Phong
30	Cu Lao Cham	1,535	Quang Nam	18	Hoa Lu	5,624	Ninh Binh
31	Song Thanh	93,249	Da Nang	19	Den Ba Trieu	300	Thanh Hoa
32	Ba Na-Nui Chua	8,838	Da Nang	20	Lam son	300	Thanh Hoa
33	Ban dao Son Tra	4,370	Phu Yen	21	Ngoc Trao	300	Thanh Hoa
34	Krong Trai	22,290	Kon Tum	22	Nui Chung	600	Nghe An
35	Ngoc Linh Kontum	41,424	Kon Tum	23	Vuc Mau	24,842	Nghe An
36	Kon Cha Rang	24,000	Gia Lai	24	Bac Hai Van	15,547	Thua Thien Hue
37	Easo	22,000	Dak Lak	25	Ngu Hanh Son	400	Quang Nam
38	Nam Ca	24,555	Dak Lak	26	Nui Thanh	1,500	Quang Nam
39	Nam Nung	10,849	Dak Lak	27	Nam Hai Van	10,850	Da Nang
40	Ta Dung	18,893	Dak Lak	28	Ba To	500	Binh Dinh
41	Bidoup-Nui Ba	72,573	Lam Dong	29	Ghenh Rang	2,616	Binh Dinh
42	Nui Dai Binh	5,000	Lam Dong	30	Deo Ca Hon Nua	8,876	Phu Yen
43	Nui Ong	25,468	Binh Thuan	31	Ho Lac	12,744	Dak Lak
44	Ta Kou	17,823	Binh Thuan	32	Rung Thong Da Lat	32,051	Lam Dong
45	Phuoc Binh	7,400	Ninh Thuan	33	Chien khu Boi Loi	2,000	Tay Ninh
46	Binh Chau Phuoc Buu	11,293	Ba Ria-Vung Tau	34	Duong Minh Chau	5,000	Tay Ninh
47	Thanh Phu	4,510	Ben Tre	35	Nui Ba Den	2,000	Tay Ninh
48	Nui Cam	1,500	An Giang	36	Nui Ba Ra	940	Phuoc Long
49	Na Hang	41,930	Tuyen Quang	37	Hon Chong	3,495	Kien Giang

Source: Forest Protection Department, 2008

There are 5 world heritage sites in Vietnam.

(1) Complex of Hue Monuments

Established as the capital of unified Viet Nam in 1802, Hue was not only the political but also the cultural and religious centre under the Nguyen dynasty until 1945. The Perfume River winds its way through the Capital City, the Imperial City, the Forbidden Purple City and the Inner City, giving this unique feudal capital a setting of great natural beauty.

(2) Ha Long Bay

Ha Long Bay, in the Gulf of Tonkin, includes some 1,600 islands and islets, forming a spectacular seascape of limestone pillars. Because of their precipitous nature, most of the islands are uninhabited and unaffected by a human presence. The site's outstanding scenic beauty is complemented by its great biological interest.

(3) Hoi An Ancient Town

Hoi An Ancient Town is an exceptionally well-preserved example of a South-East Asian trading port dating from the 15th to the 19th century. Its buildings and its street plan reflect the influences, both indigenous and foreign, that have combined to produce this unique heritage site.

(4) My Son Sanctuary

Between the 4th and 13th centuries a unique culture which owed its spiritual origins to Indian Hinduism developed on the coast of contemporary Vietnam. This is graphically illustrated by the remains of a series of impressive tower-temples located in a dramatic site that was the religious and political capital of the Champa Kingdom for most of its existence.

(5) Phong Nha–Ke Bang

The karst formation of Phong Nha-Ke Bang National Park has evolved since the Palaeozoic (some 400 million years ago) and so is the oldest major karst area in Asia. Subject to massive tectonic changes, the park’s karst landscape is extremely complex with many geomorphic features of considerable significance. The vast area, extending to the border of the Lao People’s Democratic Republic, contains spectacular formations including 65km of caves and underground rivers.

9) Environment in Urban Areas and Industrial Zones

Although urbanization and industrialization in Vietnam remain low with only two towns having more than 1 million populations each, the environment in cities and industrial zones is already affected. In future should there be no adequate countermeasures to reverse the situation and with the forecast rapid growth in urbanization and industrialization, the environmental degradation will become worse.

These are the cities of Hanoi, Ho Chi Minh City, Hai Phong, and Danang, and the industrial zones of Lao Cai (appetite mine), Lam Thao (basic chemicals, fertilizers, paper, and battery factories), Viet Tri (electric plant and paper, textile and basic chemicals factories), Thai Nguyen (steel plant), Bac Giang (nitrogen fertilizer factory), Quang Ninh (coal mine), Pha Lai (thermoelectric plant), Bien Hoa (machinery, food processing, battery, chemical and metallurgical plants), and Vung Tau (oil mine and gas plant).

Water contamination is the most serious issue. Water in Hanoi, Ho Chi Minh City and Hai Phong is highly polluted. Wastewater from factories and residential areas discharge directly

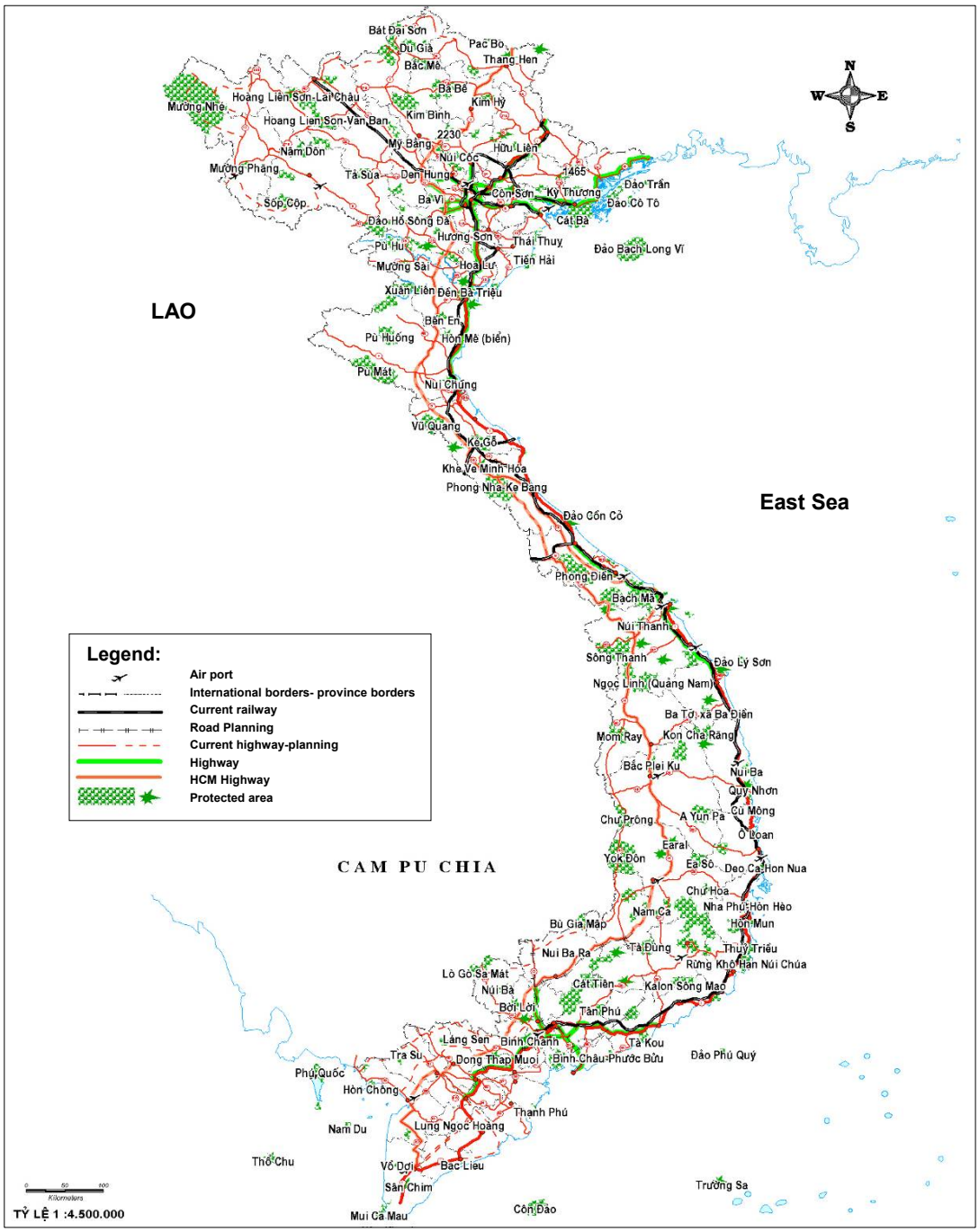
to water bodies (river, lake and sea) as Vietnam has no wastewater treatment plants. In the rainy season, the cities' drainage systems are overloaded, flooding the cities with a mixture of wastewater and rainwater.

Table 2.2.22 World Heritage Sites in Vietnam

No.	Name	Year Established	Characteristics	Location
1	Complex Of Hue Monuments	1993	Cultural	Thua Thien Hue
2	Ha Long Bay	1994	Natural	Quang Ninh
3	Hoi An Ancient Town	1999	Cultural	Quang Nam
4	My Son Sanctuary	1999	Cultural	Quang Nam
5	Phong Nha - Ke Bang	2003	Natural	Quang Binh

Source: Viet Nam National Administration of Tourism, 2007

Figure 2.2.9 Map of Protected Area in Vietnam



Source: TERI, Integrating Environmental Protection Measures in the transportation Development Master Plan, 2006, ***Appendix 1***

Solid waste in cities is another pollutant. Two pilot factories were built in Hanoi and Ho Chi Minh City for composting but their capacities are very small.

Air (dust and toxic gas) and noise pollution are very common in urban areas and industrial zones where the rate of motorization has increased. Besides vehicle emission, which mainly causes air pollution, Vietnamese cities, like Hanoi and Ho Chi Minh, are faced with many transport problems that contribute significantly to the degradation of air quality. Major transportation issues causing problems are:

(i) Inspection and maintenance system of vehicles are not satisfactory;
(ii) There is no proper traffic control system to ensure a smooth traffic flow and the traffic signal system is not complete;
(iii) Traffic congestion occurs frequently due to the rapid increase of motorbikes;
(iv) Mass transit system is poor and inadequate;
(v) Roads cannot accommodate actual traffic flow;
(vi) Transport terminals function poorly; and
(vii) There is no comprehensive urban transport system.

10) Environment in Rural Areas

A majority of the population (approx. 80%) lives in rural areas. About 89% of this is made up of Kinh lowland Vietnamese and Muong people who occupy the two great agricultural deltas and the narrow coastal strip. The remaining 11% of the population is made up of more than 50 different cultural ethnic communities living in communes in the mountains.

Almost all of these communes are isolated; only narrow foot trails connect them. To upgrade the lives of these ethnic communities it is necessary to improve rural roads connecting main roads (provincial and national roads) and commune roads to at least to allow for small trucks to pass.

Another threat to the environment is the number of new “economic zones” being established in the heart of the country, seriously affecting some of the most critical areas in Vietnam. The frequent use of forest fires to clear forests for resettlement has greatly reduced the evergreen forest cover of lower mountains.

Then too the rural population has recently faced a serious problem: Potable water supply can only be available to 30% of the people. Sanitation is likewise very poor too, especially in the Mekong River Delta. Highly infectious diseases frequently and continuously occur.

11) Natural Hazards and Environmental Disasters

Geographic position and topographic condition form special climate characteristic resulting to serious and diversified disasters in Vietnam. Natural disaster occurs almost round year in Vietnam. There are typical disasters in each season and particular characters in each region. Vietnam suffers from many kinds of disasters, such as: floods, storms, tropical depression, storm surge, inundation, whirlwind, flash floods, river bank and coastline erosion, hail rain, drought, landslide, forest fire.

In the late 1990s and in the early 2000s, global climatic change has brought about a remarkable increase in disaster events. Like many countries in the world, Vietnam has been faced with tremendous losses in human lives and properties as a result of devastating natural hazards. In the past 10 years, big disaster events have continuously occurred in Vietnam, badly affecting all regions in the country.

Table 2.2.23 Relative Disaster Frequency in Vietnam (High Medium and Low)

High	Medium	Low
Flood, Inundation	Hail rain	Earthquake
Typhoon, tropical depression	Landslide	Accident (technology)
Flash flood	Forest fire	Frost
Tornado	Salt water intrusion	
Drought		

Source: National Report on disaster reduction in Vietnam, for the World Conference on disaster Reduction, Kobe-Hyogo, Japan, 18-22 January 2005

Storms: Storms and tropical low pressures occurred in the country in 2004 and in the first 7 months of 2005 have led to serious loss and damage to both human lives and properties. (Table 2.2.24)

Table 2.2.24 Total Damage and Loss caused by Storm and Tropical Low Pressures in 2004 and 7 Early Months in 2005

	2004	Up to 7/2005
Storm	2	2
Tropical low pressures	2	
Number of dead people	232	3
Number of house affected	>4,200	233
Ship wreaks	>200	25
Agriculture damage (ha)	>483,000	5,725
Economic damage (billion dong)	>900	335

Source: National steering committee on Flood and Storm Prevention and Control

In September 2005, Storm No.6 struck Vietnam, directly impacting Nam Dinh, Hai Phong, Thanh Hoa and Ha Tinh Province. The total damage and loss caused by Storm No.6 is estimated about VND350 billion, of which the biggest share in Nam Dinh Province with a total damage of 131 VND billion.

Table 2.2.25 Damages Caused by Storm No.6

Damages Caused by Storm	
Number of dead people	6
Number of dead people/lostpeople	6
Number of collapsed and destroyed house	3,595
Area of flooded and damaged paddy and secondary crops	132,173 ha

Source: National steering committee on Flood and Storm Prevention and Control

(1) Floods

In 2004 and the first 7 months of 2005, floods occurred in many places and caused huge damage and loss of human lives and properties.

In particular, in September 2005 serious flash floods occurred in Van Chan and Tram Tau district, Yen Bai Province.

(2) Whirl Winds

In the last few years, whirlwinds have become common with higher frequency intensity, causing huge damage and loss of human lives and property and destroying natural resources and environment.

(3) Coastal Erosion, Land Subsidence and Landslide

Landslide, land collapse, erosion and land subsidence are natural phenomena, which are

complicated and difficult to control. These continue to occurrepeatedly at many places over the whole country.

Landslide happened on September, 13th 2004 in Lao Cai Province burying 22 people causing an economic damage of VND680 million. A serious landslide took place on 9th June 2005 in Binh Lieu district, Quang Ninh Province as a consequence of a heavy rain, 11 people were killed. A landslide happened in Trung Chai commune (Sa Pa, Lao Cai Province) on June 24th, 2005 that killed 2 people and injured 1 people.

Figure 2.2.10 Map of Hazard Zones in Vietnam

Source: National Report on disaster reduction in Vietnam, for the World Conference on disaster Reduction, Kobe-Hyogo, Japan, 18–22 January 2005

12) International Conventions and Agreements

Table 2.2.26 International Conventions and Agreements Ratified by Vietnam

Title, Year of Adoption	Date of Ratification
IAEA's Convention on Early Notification of a Nuclear Accident, 1986	29/12/1987
IAEA's Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, 1986	29/12/1987
Convention concerning the protection of the World cultural and Natural heritage, 1972	19/10/1982
Agreement on the Network of Aquaculture Centres in Asia and the Pacific, 1988	2/2/1989
Convention on wetlands of international importance especially as waterfowl habitat Ramsar, 1971 Protocol to Amend the Convention on Wetlands of International Importance especially as Waterfowl Habitat, 1982	20/9/1989
International Convention for the Prevention of Pollution from Ships, 1973 as modified by the Protocol of 1978 (MARPOL 73/78)	29/8/1991
Convention on international trade in endangered species of wild fauna and flora (CITES)	20/1/1994
The Montreal Protocol on Substances that deplete the Ozone Layer, 1987	26/1/1994
Vienna convention for the protection of the zone layer, 1985	26/4/1994
United Nations Convention on the Law of the Sea, 1982	25/7/1994
United nations framework convention on climate change, 1992	16/11/1994
Convention on biological diversity	16/11/1994
Basel convention on the control of Tran boundary movements of hazardous wastes and their disposal	13/3/1995
International declaration on cleaner production	22/9/1999
Convention on international civil aviation, Chicago, 1944	
Agreement for the Establishment of the Asia-Pacific Fishery Commission, 1948	
Convention on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction, 1972	

Source:
International Conventions and Agreements in review process
International Convention on Civil Liability for Oil Pollution Damage, 1969
International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties, 1969
International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage, 1971
Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, London, 1972
Convention on the Conservation of Migratory Species of Wild Animals, 1979
Agreement on the Conservation of Nature and Natural Resources, 1985
International Convention on Oil Pollution Preparedness, Response, and Co-operation (OPRC), London, 1990

2.3 Pollution

1) Air Pollution

Major pollutant sources causing air environment pollution in Vietnam include: industrial activities, transport activities, building activities and household activities.

Like other developing countries, Vietnam is facing increasing air pollution problems, especially in large cities. Accompanied with the rapid economic growth, the transportation development in Vietnam, particularly road construction and transport activities, has created a great deal of uncontrolled air pollution that worsened air quality. Before 1980, 80–90% of urban people used bicycles, but at present 90% of urban peoples uses motorcycles. Emissions from transportation have become a major source of air pollution in urban areas, particularly in large cities such as Ha Noi, Ho Chi Minh City, Hai Phong and Da Nang.

In Hanoi, authorities repeaed regulation that each person can only register for one motorcycle in 14/12/2005 after three years of implementation (from 13/02/2003). Then the number of motorcycle has sharply increased. From late 2006 to June 2007 22,300 new motorcycles and 21,000 new cars were registered. The total number of cars in Hanoi now reached 193,000 and motorcycles 1,930,000. Apart from that, thousand of new police vehicles were registered. On the other hand, there is 530km length of inner road and around 1000km length of outer road networks. Thus every km road length in Hanoi, in average, loads 540 cars and 5,900 motorcycles (Xuan Tung, 2007).

Ho Chi Minh City has the largest vehicle fleet in the entire Viet Nam. In October 2002, 2,225,000 motorcycles and 189,000 motor vehicles were officially registered in Ho Chi Minh city. Many of the trucks and buses are old, and use obsolete technology. Most of the motorcycles, cars, and vans are relatively new, but tend to use old technology and have no pollution control devices. The public transport (bus) network of the city only meets 3% of the total demand, while 97% is met by others with motorbikes (56%), bicycles (30%), cars (3%), and foot (8%) (Viet Nam Register, 2002). Transportation infrastructure is poor; the density of traffic system is 0.81 km/km^2 (standards 4–6 km/km^2); and average traffic speed is only 4– 5 km/h.

The larger number of on-road vehicles with poor maintenance is the major source of toxic air pollutants such as particulate matter, CO, volatile organic compounds (VOCs), CO, SO_2, NOx and others. According to environmental experts, air pollution in urban area from transport activities accounts for 70%. The dense traffic flow and frequent traffic jam make air pollution more serious.

According to State of the Environment Vietnam report (MONRE, 2005), most of the urban areas in the country have been polluted by dust. In many places, dust pollutant reached alarming level. The dust concentration in large cities such as Hanoi, Hai Phong, Ho Chi Minh City and Da Nang is 2–3 time higher than Vietnam standard (0.2 mg/m^3), especially at road junctions, dust concentration is 4–5 time higher than Vietnam standard, in which, 80% of dust in the air is from street dust.

Conversely, sources of SO_2 concentration are mainly from industrial and handicraft activities (95% total emission ton/year), the emission from traffic activities is not significant (1–2%) and from domestic activities is 1%. However, the average concentration level is still lower than standard.

Daily average CO and NOx concentrations in the ambient air environment in the large cities

like Hanoi, Hai Phong, Da Nang and Ho Chi Minh are still lower than standard. However, at some busy traffic junctions CO and NOx concentrations has exceeded standard.

Air quality in rural area remains good, it is not affected by transport activities, only in some craft villages where air is polluted by smoke from kilns using coal and wood for fuel, which discharges dust and toxic gases such as CO, NO, NO_2 and SO_2

2) Noise Pollution and Vibration

As mentioned above, vehicle number in Vietnam streets are mainly motorcycles, driver's irresponsible and indiscriminate honking is huge problem in urban center area like Hanoi and Ho Chi Minh City. People use horn everywhere and at every moment. In most developed countries, a car's or motorbike's horn is used only in case of an emergency, and drivers often use their turn signals to let other drivers know when they are turning or switching lanes. In Viet Nam, however, many people abuse the use of their horns. For instance, people who are stopped at a red light are always honking until it turns green.

The noise level due to traffic and transportation in many urban areas at day time are higher than Vietnam standard for residential area (75dBA, TCVN 5949 -1998) that ranges within 75–78 dBA and in some large streets within 80–85 dBA.

Vibration from transport activities and road network construction was well known; however, until now there are no data on vibration state in Vietnam.

3) Water Pollution

Water environment is divided into two types: inland water environment and marine water environment.

Inland water includes surface and ground water sources, currently, pollution of surface and ground water are increasing seriously, particularly in river basins and small rivers, canals in urban area. Waste water from households, factories, hospitals, agricultures etc. is discharged mostly without treatment into water bodies, this heavily pollutes the environment. Water quality monitoring along major rives like Cam River (Hai Phong), Huong River (Hue), Sai Gon River (Ho Chi Minh City) shows that the concentration of BOD5 and N-NH4+ has exceeded standards by 1.5 to 3 times.

According to Current state of Environment Report of Vietnam, lakes, ponds, canals and small rivers in inner parts of big cities like Hanoi, Ho Chi Minh City, Hai Phong and Hue, which receive and transport waste water from industrial and residential areas are seriously polluted with 5–10 times higher than standard (for surface water of category B–TCVN 5942– 995). Most lakes in inner part of cities are suffering from eutrophication.

Transport activities such as boats, ships that run along rivers seem to discharge illegally oil and solid waste into river. Dredging the riverbed contaminates water by heavy metal and bacterium in sediment. Construction of bridge, road and port also pollutes water due to construction activities.

The uncontrolled and indiscriminate exploitation of ground water in coastal zone has led to salinization of ground water in many places. Ground water has also been polluted by improper technical burial of infected domestic fowls.

Marine water environment still remains within allowable standards, except for some coastal estuaries where concentrated densely populated urban residential areas, industrial factories and sea port exits. In addition to this, the development of water transportation and

the potential discharge of solid and liquid wastes illegally may pollute water environment. Also transport of liquid goods by sea such as crude oil, refined oil may potentially pollute the environment incase of spillage accidents. Operation of ship yard and port also discharges a larger amount of solid and liquid waste in to sea.

Table 2.3.1 Amount of Waste Generated from Maritime Transportation

No.	Enterprise	Type of Waste	Amount (ton/year)
1	Ship yards (30 yards in country)	Solid Waste	18,000
		Liquid Waste	> 1,000
2	Ports (9 ports)	Solid Waste	6,800

Source: MONRE, 2005, State of the Environment Report of Vietnam, P 21

4) Solid Waste Management

Solid wastes are mainly from domestic and industrial sources (Table 2.3.2), only few discharged from transport activities.

Table 2.3.2 Solid Waste from Industrial Zone at Key Economic Regions

Locations	Total (ton/year)	Locations	Total (ton/year)
Ha Noi	97, 030	Ho Chi Minh City	130, 380
Hai Phong	28, 470	Dong Nai	24, 935
Hai Duong	20, 417	Binh Duong	23,400
Quang Ninh	11, 855	Ba Ria–Vung Tau	29,700
Grand Total	157, 773	Grand Total	208, 415

Source: MONRE, 2005, State of the Environment Report of Vietnam, P 39

In most urban areas, domestic waste account for 60–70% of the total urban solid waste. In some cities, up to 90% of solid waste is from domestic sources. And the amount of domestic solid waste generated from urban areas has tendency to increase gradually by 10–16% per year.

Table 2.3.3 Generation of Solid Waste

Sources	Total	Urban	Rural
Municipal waste (ton/year)	12, 800,00	6,400,00	6,400
Industrial hazardous waste (ton/year)	128,400	125,00	2,400
Industrial non-hazardous waste (ton/year)	2,510,00	1,740,000	770,000
Average collection rate (%)	-	71	20
Generation rate (kg/person/day)	-	0.8	0.3

Source: MONRE, 2005, State of the Environment Report of Vietnam, P 38

Solid waste from transport activities are mainly at bus, train station and airport. The solid waste from these sources are collected and treated as domestic waste. The major problem raising concerns in management solid waste from transport activities is the discharge solid waste along railway.

Everyday, there are 4 trains from North to South and 50 local trains with 25,000 passengers and thousands of staff working in the train. If each person discharges 0.2kg solid waste everyday, 25,000 passengers will discharge around 5 tons solid waste/day. Especially, since 1998, railway department provides processed food for passengers, which has increased the amount of total solid waste discharged.

3 FRAMEWORK FOR ENVIRONMENTAL PROTECTION

3.1 Environmental Law and Institution

The basic law pertaining to environmental protection as stipulated by the national constitution of Vietnam is known as the Law on Environmental Protection (LEP). The LEP was first enacted in 1993 and later revised in 2005 to become the latest new applicable law, which became effective since July 2006. This LEP (2005) elaborates on required environmental protection policies and activities and the relevant environmental measures and resources required for realizing the objective of environmental protection including the pertinent rights and obligations of organizations, households and individuals.

Vietnam Environment Administration (VEA) under the Ministry of Natural Resources and Environment (MONRE) is responsible for applying the Law on Environmental Protection (LEP) at the national level, as well as ensuring efficiency at all levels. At the provincial level, Department of Natural Resources and Environment (DONRE) on behalf of MONRE is responsible for operating and enforcing the LEP (2005).

Moreover, concerned to transport sector to which this VITRANSS 2 belongs, according to Decree 51/2008/ND-CP by the Prime Minister on regulation functions, duties, powers and organizational structure of the Ministry of Transport (MOT), the powers, duties and responsibilities of MOT with respect to environmental management of transport sector are enumerated as follows:

(i) Organizing review council for strategic environment assessment and environmental impact assessment reports of projects that are subject to the approval within the competence of MOT.

(ii) Provisions for certification standard for environmental facilities of road, railway transport, inland waterway, maritime and aviation (except transport of troops, the Police used for the purpose of defense and security); including leadership in supervising, certifying environmental standards for cars and other motor vehicles;

(iii) Coordinate with the MONRE, other ministries, ministerial-level agencies and government agencies concerned and the relevant provincial People's Committee to direct, guide and supervise the implementation of legislation on environmental protection and other provisions of law relating to the construction of transport sector infrastructure and transport operations; monitor and supervise the implementation of the provisions of the LEP in the field under the jurisdiction of the MOT

In this respect Department for Environment under the MOT is the agency responsible for the implementation of environmental protection measures in transportation sector.

3.2 Environmental Assessment Framework

The Chapter 3 of LEP (2005) clearly divides environmental assessment process into two distinct categories, namely SEA (Strategic Environmental Assessment) and EIA (Environmental Impact Assessment). Still, IEE (Initial Environmental Examination) as defined in the former LEP (1993) has been eliminated as category of environmental assessment and could be regarded as incorporated into SEA for plans and EIA for projects. The Section 1 of Chapter 3 (Article 14 to 17) of LEP (2005) deals with SEA aspects while Section 2 (Article 18 to 27) deals with EIA aspects. In particular Article 14 of Section 1 defines policies, programs and plans that are subjected to mandatory SEA as follows:

(i) National socio-economic development strategies, planning and plans.

(ii) Sectoral development strategies, planning and plans of national scale.

(iii) Socio-economic development strategies, planning and plans of regions, provinces and cities directly under the jurisdiction of Central Government

(iv) Land use planning; forest protection and development; other natural resource exploitation and use at least at inter-provincial and inter-regional levels.

(v) Focal economic zone development planning.

(vi) Integrated river basin planning at inter-provincial level.

Regarding EIA, Article 18 of Section 2 defines projects subjected to EIA as follows:

(i) Projects of national importance;

(ii) Projects that use part of land of, or are likely to cause adverse impact to, natural reserves, national parks, historical-cultural relics, natural heritage and famed beauty spots that are designated;

(iii) Projects that are likely to impose risks of adverse impacts on water resources of river basins, coastal areas and protected ecosystem areas;

(iv) Projects on infrastructure development in economic areas, industrial parks, hi-tech parks, export processing zones and craft village clusters;

(v) Projects on new urban center and centered residential area development;

(vi) Projects on large-scale groundwater and other natural resources exploitation and use;

(vii) Other projects that may impose potential risks of adversely environmental impacts.

Moreover, when implementing SEA and EIA studies particular attention has to be paid to Government Decree No. 80/2006/CP, enacted in August 2006, on detailed regulations and guidelines for Implementation of some Articles of LEP (2005). This Decree regulates the responsibilities, time limitation, administrative schedules for approval of SEA and EIA reports.

In addition, the Circular 08/2006/TT-BTNMT first enacted in September 2006 by the Ministry of Natural Resource and Environment (MONRE) and later updated as Circular number 05/2008/TT-BTNMT in December 2008 is also very relevant for the conduct of SEA and EIA Studies. This Circular by MONRE in overall provides guidance on the conduct, elaboration and appraisal of SEA, EIA reports and also elaboration, registration and certification of commitment on environmental protection by project proponents/owners. Moreover, this Circular in its Appendix 1 provides the organizational structure and required contents of SEA reports.

3.3 Relevant Environmental Standards

The relevant and applicable national environmental standards of Vietnam and hence to be taken into due consideration in the strategic planning, design as well as operation of transport sector (land, water and air) facilities as appropriate are identified by this environmental sector study as listed below. Some of these environmental standards are updated very recently in 2008. In total 13 environmental standards are identified as relevant to transport sector as of August 2009. The standard values with relevant pertinent information as appropriate are given in ***Appendix 3A***.

(a) **TCVN 5937:2005:** Air quality-Ambient air quality standards

(b) **TCVN 5938:2005:** Air quality-Maximum allowable concentration of hazardous substances in ambient air.

(c) **TCVN 5939:2005:** Air quality-Industrial emission standards for Inorganic substances and dusts

(d) **TCVN 5940:2005:** Air quality-Industrial emission standards for Organic substances

(e) **TCVN 6438:2005:** Air quality-Road vehicle emission standards

(f) **TCVN 5950:1995:** Noise standards for vehicles

(g) **TCVN 5951:1995:** Permitted vibration

(h) **TCVN 5949:1999:** Maximum permitted noise level for residential and public area

(i) **QCVN 08:2008/BTNMT:** National technical regulation on surface water quality

(j) **QCVN 09: 2008/BTNMT:** National Technical regulation on underground water quality

(k) **QCVN 14: 2008/BTNMT:** National technical regulation on domestic wastewater

(l) **QCVN 10: 2008/BTNMT:** National technical regulation on coastal water quality

(m) **QCVN 15: 2008/BTNMT:** National technical regulation on the pesticide residues in the soils

3.4 Administration of Project Implementation

1) Institutional Aspects of Project Implementation

Only resettlement and land acquisition have special procedures and arrangements that need to be well understood and followed during any projects where land and assets are to be expropriated by the state. The other social effects are governed by the standard regulations on heath, safety, waste management and enforcement (fines).

For land acquisition and resettlement (Much of the information and text on Resettlement in Vietnam is taken with permission from materials prepared by Susan Novak, principally involving ADB projects. She is a Social Sector Consultant with extensive experience in Vietnam susan.novak1@gmail.com) the proponent will form a management team or a project management unit as soon as the preliminary RP (An RP is complete only after the data compiled as part of the inventory of losses (IOL) for all affected household has been checked via a Detailed Measurement Survey (DMS) and the RP is revised.) has completed. That unit will then ensure that under the direction of the Provincial Peoples' Committee (PPC), Provincial Resettlement Committees (PRCs) are established for each province, and the District Compensation, Assistance and Resettlement Boards (CARBs) and Commune Resettlement Taskforces (RTs) are formed. The PRC, CARBs and RTs will be responsible to a project management unit for preparation of the final Resettlement Plans (RPs). This hierarchy is complex and will need to be carefully identified and structured such that each province can make its own social environment decisions (Most provinces have identified their own entitlement framework and compensation rates.), and will be consistent regardless of which of the Ministry's five sub agencies is the proponent, namely the Vietnam Roads Administration (VRA), VINARAIL, VINAMARINE, Civil Aviation Administration of Vietnam (CAAV) or Vietnam's Inland Waters Administration (VIWA).

Following approval, the CARBs with assistance from the RTs will be responsible for implementation of the RPs, under guidance and direction of the PMU, which will still take instructions from the PPCs, PRCs. Representatives of the Women's Union, and/or the Farmers' Association, will participate actively in the resettlement program.

The institutional arrangements to carry out and manage the implementation of future VITRANSS 2 resettlement plan(s) will require the involvement of agencies at the national, provincial, district and commune levels. The following section of this report sets out the roles and responsibilities of different parties for compensation, resettlement and assistance activities. The proposed institutional arrangements are based on the provisions of Decree No.197 ND-CP and the experience of the VITRANSS 2 consultant in preparing and implementing resettlement programs.

(1) The Executing Agencies: VRA, VINARAIL, CAAV, VIANMARINE or VIWA

For each project, the Executing Agency will be one of the five Units of the Ministry of Transport, i.e. VRA, VINARAIL, CAAV, VIANMARINE or VIWA, and will be responsible for approving project documents, hiring consultants (the PMUs), providing funds and for the overall implementation and coordination of the project(s), including land acquisition and resettlement activities with the PMUs.

(2) Project Management Unit

For most development projects a Project Management Unit (PMU) is established and acts as the representative of the proponent on all aspects of implementation and ongoing management of a Project, including land acquisition and resettlement. It works closely with the PPC. In Vietnam, PMUs for large projects often retain some social safeguards expertise to handle the resettlement issues arising.

(3) The Provincial People's Committee (PPC)

The PPC is the principal authority at the provincial level for decision making regarding the implementation of the RP for any of the projects proposed. The primary responsibilities at the provincial level include: (i) review and approval of the RP; (ii) establishment of compensation prices; and, (iii) oversight of preparation and implementation of the resettlement program at the district level.

(4) District People's Committee (DPC)

The DPC is responsible for managing and overseeing: (i) the conduct of the DMS; (ii) replacement land allocation and development of resettlement schemes; and, (iii) ensuring notification of APs and public information programs.

(5) Commune People's Committee (CPC)

The CPCs' primary responsibility is to: (i) informing APs and other stakeholders about the resettlement program, its policies and activities; (ii) payment of compensation and allowances; (iii) coordinate with other relevant district relevant agencies in resolution of AP grievances and complaints; and, (iv) land clearance in preparation of civil works.

(6) Provincial Department Involved in Social Environment Management

Being the proponent at the provincial level, the PDOT or the project PMU, acting on behalf of the proponent and can, if instructed, lead all social impact analyses, including land acquisition and resettlement planning. However, several other provincial departments also have responsibilities for resettlement, assistance and compensation actions, as set out in Decree No. 197 ND-CP. These include the:

(a) **Department of Finance (DOF):** which develops reviews and appraises proposals for compensation prices, allowance rates and the costs of other forms of assistance prior to submitting them to the PPC for approval; and, manages and monitors the disbursal of funds for the resettlement program;

(b) **Department of Natural Resources and Environment (DONRE):** Guides the establishment of compensation prices of affected land resources;

(c) **Department of Planning and Investment (DPI):** Guide and review the planning and implementation of the resettlement program;

(d) **Department of Construction (DOC):** Evaluates the prices and allowance rates for APs' affected assets, and participates in finding relocation sites; and,

(e) **Provincial department of the MOLISA:** guide the compensation process.

2) Land Acquisition and Resettlement

The legal and policy framework for resettlement and compensation is defined by the relevant policies and laws of the Government of Viet Nam (GOV), provincial, district and

commune-level rules, including the constitution (1992) which confirms the right of citizens to own and protect the ownership of a house. In addition, the GOV has enacted a 10 laws, decrees and regulations that constitute the legal framework for land acquisition, compensation and resettlement, the most important being The Land Law No.13/2003/QH11.

Under the 2003 Land Law, the State exercises the right to assign and lease land to land users, including individual, households and organizations. In the case of assigned land, the State delegates to the PPCs the authority to grant land use rights certificates to land users. With respect to land acquisition, resettlement and compensation, the Land Law makes all necessary provisions. In addition there are a further five decrees/circulars that elaborate on compensation, land pricing and the use of ODA social environment guidelines. These five are:

(i) Decree No. 197/2004/ND-CP

(ii) Circular 116/2004/TT-BTC (guiding Decree 197)

(iii) Decree No. 17/2006/ND-CP

(iv) Decree No. 123/2007/ND-CP (re land pricing), replaces 188/2004, and

(v) Decree No. 17/2001/ND-CP

There are a further 10 legal instruments relevant for social environmental management starting with the Construction Law No. 16, 2003/QH11 and Decrees 172/1999/ND-CP relevant to protection and preservation of cultural property.

Three decrees and decisions deal directly with social environment and the transport sector issues. They include:

(i) Decree No. 172/1999/ND-CP, establishing that Affected People within the Right Of Way are entitled to compensation for land and assets expropriated;

(ii) Decree No. 171/1999/ND-CP, addressing issues of informal settlers that have encroached into the safety corridors of waterways;

(iii) Decision 3037/QD-BGTVT, 2003, on procedures for compensation and relocation of people affected by site clearance.

In 2007 the provinces and cities were give permission to establish compensation rates and prepare their own compensation plans using Decree Amendment 123/2007/ND-CP as a basis for estimate costs. Thus this approach would apply to airport and port projects that are in one province but not to large inter-provincial works such as the expressway network.

3) Land Use

The 2003 Land Law defines how, who and when and where Land use zoning takes place, but in general it is project-driven. This however is complicated by the fact that most urban areas have marginally enforced land use plans per se, and that is why one can find a bakery or flower shop beside a welding or air conditioner repair facility. In relation to the road and rail activities being planned, noise and existing use concerns will trigger conditions in the Land Use Act as well as Decree 91/CP 1994 dictating what documentation is needed and where the alignments are permitted to go in the urban space. Urban land use planning control is administered by the Ministry of Construction for all cities with a population of ≥ 350,000 and by the Provincial People's Committee for

all others. However in the case of the large scale road and rail projects, the planning approvals will come from the Chief Architects Office of the MOC, in close consultation with MOT.

Most of the provincial capitals through which the rail and road alignments would have to pass have general urban plans, which broadly highlight land use zoning restrictions and as such control where the alignments would go. Therefore these plans represent the boundaries for transport development projects and must be consulted when detailed design begins and a detailed Land use application prepared.

While such urban plans contain details and are well intentioned, their implementation has a very spotty record as illustrated in the example in the first paragraph, are very common.

For any of the proposed VITRANSS 2 projects urban planning approvals will be required and must start with the MOC's Chief Architect Office and the PPC Planning Department. For projects that will be inter-provincial, such as the road and rail links, all control will rest with the MOC in Hanoi, who will likely establish a project planning committee made up of key provincial representatives.

Unfortunately rural areas have no such planning controls, other than the provisions in the environmental assessment which will address planning concerns, in terms of proposed uses conflicting with what is on the ground, protected areas and degradation of the biophysical, socio-cultural and human environment. Theoretically the DPCs and CPCs have this authority, but rarely use it for projects of this type.

4) Traffic and Public Facilities

Vietnam has three pieces of legislation which together encompass most of the regulatory requirements associated with traffic and public safety in the context of the social environment. The three documents are:

(i) Decree No.36-Cp On The 29th Of May 1995 Of The Government On Ensuring Traffic Order And Safety On Roads And In Urban Centres; and,

(ii) Regulation accompanying Decree 36-CP (1995) Regulation On Traffic Order And Safety On Roads And In Urban Centres and

(iii) Law No. 25/2001/QH10 prescribing rules of the road for all road transport activities (http//vbqpp13.moj.gov.vn/law/en/2001_to_2010/200106/2001062)

Law No. 25/2001/QH10 defines the specific limits and requirements for all road users and specifically in the context of this report, Chapter III- Road Traffic and Drivers, Chapter IV Basic Safety, Chapter IV Driving Rules are of special relevance. Land-Law website: http//vbqpp13.moj.gov.vn/law/en/2001_to_2010/200106/2001062

English translation of the other Decree and Regulation can be found at the following link: http://coombs.anu.edu.au/~vern/luat/english/Gov-36CP-traffic.txt

Decree 36C (1996) and its accompanying regulation provides the framework for safe road operations, including setting speed limits by class of road. When designing the road, engineers must use Vietnam's design specifications defined for each class of road, ensuring the correct match between design, expected traffic volumes, design speed, resulting in a safe road design.

Of interest is that erection of traffic signs, vehicle inspection, fining and enforcement,

and urban traffic control that is controlled by the Ministry of the Interior (the police force), not those designing the roadway.

Traffic and public facilities as defined in the JICA guideline includes not only road and rail projects but also ports and airport projects, and refer to the need to define the impact of the newly operating facility on schools, hospitals and traffic movement. Most of these effects during the construction and operational period of a road, rail line, port or airport are addressed in the environmental assessment document, including the description of mitigation and monitoring measures in the report Environmental Management Plan, leaving only a few items for the social assessment. For example traffic volume will generate air and noise pollution impacts, and these impacts will be carefully examined in the EIA documentation.

The most obvious social environment effects of traffic is the safety and traffic congestion problem for people and facilities near the project being built and all those using the new facility. A second and potentially more serious impact is the traffic diversion effect, where due to the new road, traffic volumes along the old road(s), railway station, port or airport are significantly reduced thereby causing serious and permanent economic loss to roadside businesses. The opposite is equally bad where traffic flow increases significantly, leading to serious congestion, localized air pollution and noise, resulting in lost business.

A well prepared EIA should cover these aspects and the social environment mitigation measures can be extracted directly from this document.

Traffic management and public safety play an important role in any road planning project and Vietnam's Decree 36C and Law 25/2001 and its regulation provide solid guidelines. As with so many other legal requirements the big issue is always enforcement and available staff and budget. Decree 36C applies to all road traffic, so port and airport access planning must also work within those boundaries and consult with the Ministry of the Interior, the DOT and PPC.

5) Construction Waste Management

Construction waste consists of two general categories, (a) the clean fill materials such as clean demolition waste, excess excavation materials, and felled trees, and (b) waste byproducts from equipment use and workers, namely waste oils, sewage and garbage as well as hazardous materials coming from demolitions, e.g. tainted cargo storage areas from old port storage facilities or contaminated railway ballast material. Vietnam has many of the requisite regulations that control the management and disposal of construction wastes. Key among them is:

(i) Directive No.199/TTg dated 3/4/1997 on "Urgent measures to manage solid waste in urban and industrial areas";

(ii) Circular No.1350/TT-KCM issued in 1995 by the MOSTE giving instruction to implement the Governmental Decree No.02-CP dated 5/1/1995 defining the commodities and services banned from commercial business and the commodities and services allowed for commercial business under certain conditions on the domestic market"; and,

(iii) Decision No.155/1999/QD-TTg dated 16/7/1999 by the Prime Minister promulgating Regulation on hazardous waste management.

The current system of legal documentation is still inconsistent and inadequate, with large gaps in the legal instruments, instructive documents, and especially a system of National Standards (TCVN) on solid waste. Having legal documents addressing closely related issues but in different units, sometimes overlapping and even conflicting with each other, coupled with a low level of staffing is seriously hampering the work of environmental protection and waste management.

At the municipal level, Vietnam has established waste collection and management agencies or urban environment companies (URENCOs) for every larger urban center throughout the country. They are managed by the MOT or its PDOTs and are responsible for the collection and proper disposal of all urban residential and commercial wastes. Unfortunately the management and disposal of construction project wastes is unspecified, since depending on the type of waste, it is controlled either the National Environmental protection Agency (NEPA), MOH, or possibly other agencies. Once a disposal site is identified and a delivery is planned, NEPA has jurisdiction. For this reason the inclusion of detailed discussions on waste disposal in the environmental assessment documents accompanying the project design will be of great importance and will form the basis of any waste monitoring and appropriate management (as defined in the environmental management plan) in solving both biophysical and any social environment issues.

The road and rail development programs will generate the greatest amounts of waste. For example the need to reconstruct at least rail 100 rail bridges will mean many tons of concrete waste. The need to double track or build new rail tunnels for 24 or km will also generate large volumes of excavation material, including ballast (Used ballast materials are often significantly contaminated with waste, and fine materials. Machinery that cleans the ballast on situ generates much of the dust and other particles for treatment and disposal). These wastes will need careful planning and disposal/reuse.

A further indirect but a very serious waste issue in urban areas is dust from earth and construction materials spilled onto access and haul roads but never cleaned up. This is a rapidly growing problem in Hanoi and HCMC, despite having specific clauses in the regulation, requiring the contractors to clean all ‘construction’ roads. Reference: http://www.nea.gov.vn/html/VEM_2004/23-30_Eng.pdf

6) Landslides, Cave-Ins and Flooding

The annex to the 2006 Environmental Protection Law specifies that all new roads of Class II or higher and any new rail projects require full EIAs. EIA field studies include identification of any landslide and unstable slope conditions, coupled with appropriate preventative or mitigation measures. Therefore it is primarily the environmental legislation that indirectly requires proponents to identify and provide adequate measures to avoid or mitigate landslides and to properly deal with flood-prone areas, since landslides are classified as an environmental impact. Social environment studies must therefore extract this information from the EIAs.

The locations of landslide areas have remained the same since the 2000 VITRNASS report (VITRANSS 1. 2000. Technical Report No.5) was prepared, with most danger areas focused in the NE, NW and Red River Delta area.

Flood areas are well known as well since most legal documents related to disaster management deal with flooding. The base documents are the Law on Water Resources

(1998), Environmental Protection Law (2007), the Ordinance on Dikes, Ordinance on Flood and Storm control, and the Ordinance on Management and Utilization of Hydraulic Structures. Of these the Water Resources Law is most relevant. It establishes the basic policies, principles and framework for the planning, exploitation, utilization, conservation, protection, regulation and management of all water resources, with due regard for land and other related natural resources and the environment in general;

Under the law, there are various associated ordinances, the most important being the Ordinance on Prevention and Control of Floods and Storms (March 1996) in force before the law was promulgated and clarified in 1998 by Decree No 32–CP which specifies the procedures needed to implement the Ordinance. Decree 32 further elaborates the legal aspects mention in the 1996 Ordinance.

7) Construction Safety

The following material was extracted from a 2006 US HCMC Commercial Service Review of Vietnam's Occupational Health and Safety Legal Framework, and edited by the VITRANSS 2 consulting team.

The Ministry of Health (MOH) and the Ministry of Labor, Invalids and Social Affairs (MOLISA) enforce Vietnam's occupational safety and health laws. Safety inspections are conducted by MOLISA and the provincial labor offices. Section 186 and 187 of the Labor Code authorizes labor inspectors to audit workplaces without advance notice and can require the employer to supply reports and documents relevant to the inspection.

As of the end of 2006 the Government of Vietnam has six important legal documents concerning occupational safety and health. They are:

(i) The Vietnam Constitution articles 29, 39, 56, and 61, describing labor protection, public health protection and environmental protection;

(ii) The Law on Public Health Protection (1989) Articles 1, 4, 9, 10, 12, 14 and 18 defining the rights and obligations of citizens, public organizations, and enterprises in state and private sectors in ensuring occupational safety and health at the workplace;

(iii) The Ordinance on Labor Protection (1991) and the Labor Code (1995). Chapter IX of the Labor Code , including 14 articles concerning occupational safety and health; and;

(iv) The Law on Companies (1990) and the Law on Public Business (1995) include provisions concerning occupational safety, health and environmental protection.

Under Section 95(1) of the Labor Code (1995), employers must ensuring occupational safety and health of their workers, always striving to improving working conditions. Workers may leave a jobsite with hazardous conditions until improvements are made, without risking loss of employment.

Within this framework proponents/executing agencies and their contractors are responsible for implementing these regulations on the jobsites. For example for an airport project the CAAV and its contractors would be required to ensure worker and worksite safety, perform inspections and immediately rectify non-compliance issues and record each such event.

Due a lack of inspectors, and contractors feeling little pressure to comply, violations of the legal framework is common and periodically brought to the public's attention when serious accidents are publicized.

4 ENVIRONMENTAL CONSIDERATIONS

4.1 Strategic Environmental Assessment (SEA)

Strategic Environmental Assessment (SEA) was conducted for the relevant transport development sectors on sub-sector basis for the overall transport development strategy of the VITRNASS 2 up to the year 2030. The relevant transport sectors considered for the SEA are in total seven in numbers, namely, Road Sub-sector, North-South Expressway Sector, Railway Sub-sector, High-speed Railway Sector, Port and Shipping Sub-sector, Inland Water Transport Sub-sector and Civil Aviation Sub-Sector. The term sector is used for North-South Expressway and High-speed railway in consideration to their strategic significance as large-scale national projects to link the two major urban centers of Hanoi and Ho Chi Minh City (HCMC), though in essence all are sub-sectors of transport development strategy. SEA for each of these sub-sectors is dealt with below on sub-sector basis. This is followed with overall concluding remarks and public consultation aspects of SEA.

1) Road Sub-Sector

The significant environmental and social issues to be taken into due consideration and the relevant mitigation measures concerned to the development of road sub-sector are described below on an itemized basis.

(1) Land Acquisition, Resettlement and Other Social Issues

Most road construction, improvement and widening works would require significant land acquisition and also resettlement of households and businesses including temporary disturbance to business during construction works especially in developed and urban areas. The due process well established in Vietnam that has already been followed with ongoing similar works includes public consultation, RAP (resettlement action plan) formulation, implementation and monitoring along with EIA during detailed project planning and design. In fact the North-South Expressway would involve very significant land acquisition and resettlement requirement since it would mostly be constructed on a new alignment on lands with various current uses including agriculture.

According to Vietnam Road transport development to 2020 and Orienting to 2030 it is estimated total land used to develop national road in 2020 is about 57,392 ha, in which: road level I: 3,686 ha; road level II: 4,456 ha; road level III: 36.040 ha; road level IV: 13,028 ha. Land to construct expressway system (towards Decision 1734/QD-TTg issued on December 01st 2008 about Plan in developing expressway of Vietnam to 2020 and vision after 2020) is about 41,104 ha (in which: occupied by in used road and under construction is about 2,916 ha, the additional area is about 38,188 ha; agriculture land acquisition is about 24,167 ha). The total land for national road and expressway system is estimated 98,496 ha, in which agriculture land acquisition for North-South expressway is around 24,167 ha. Of the total land acquisition of road transport of 98,496 ha the North-South Expressway possess a very significant requirement of about 42%. As could be anticipated land acquisition for road transport is a very difficult and contentious issue that has to be well planned and executed with due process of public consultation with project affected persons (PAPs) and the relevant RAP aspects as mentioned above. As the basic step in new road development plan every effort shall be made to study alternative alignments to select optimal alignment so as to minimize resettlement requirement and also acquisition of productive lands like agricultural lands.

Regarding RAP implementation, resettlement and relocation should be planned and executed

very carefully during detailed project planning and design to mitigate adverse effects on the PAPs. In this respect, all efforts have to be made to achieve improvement in living condition of people affected, with particular attention on poor and vulnerable and other socially disadvantaged people like ethnic minorities. In all cases of RAP implementation the minimum requirement should be to achieve future living condition of the resettled people to be at least the same as their living condition prior to resettlement. In other words no decline in living condition of the PAPs should occur consequent to the involuntary resettlement.

Apart from the most significant issue of involuntary resettlement other social issues related to road development project includes split of communities and the resultant lack or inconvenience to access social services and social institutions like schools, hospitals and others. All these issues shall be addressed along with RAP formulation, as social impact assessment of the project during detailed planning and design of project and amicable mitigation measures agreeable to the affected people has to be carried out.

(2) Effect on Ecosystem

There are 129 protected areas in Viet Nam composed of 27 National Parks, 60 Nature Reserves areas, 37 Cultural-historical-environmental reservation areas and 5 World Heritage sites. Those National Parks and Nature Reserves have been reserved to protect natural and ecological resources, preserve scientific value as species diversity of flora and fauna including preservation of rare, endangered and endemic species, protection of watersheds, facilitation of eco-tourism, environmental education, preservation of local community life and others. The National Parks, Nature Reserves are distributed in the Northeast, Northwest, North Delta, North-Central area, South-Central area, Central-highland area, Southeast area and Cuu Long (Me Kong) Delta. Expropriating some portions of such National Parks and Nature Reserves in particular for ROW (right of way) of new routes are inevitable. This may result in split of national parks and nature reserves thereby affecting their functional ecological purpose and value. Hence any inevitable routing of ROW through such areas of Nature Reserves, National Parks should be planned very carefully to minimize the length of ROW to the optimum possible extent. In particular under no circumstance, an ROW should bisect right through the middle of such an area and every effort shall be made to direct the ROW along or nearby the property boundary of Nature Reserves and National Parks. Moreover in order to minimize potential interference and also safety of fauna (from traffic accidents) dedicated ROW as underground or overhead passage across such areas shall be provided. The list of Nature Reserves, National Parks and Cultural-historical-environmental reservation areas need to be protected consequent to the provision of road development are listed below in Table 4.1.1 as the initial SEA step for planning the provision of required mitigation measures in later detailed engineering of the road development plans.

In particular, rerouting of NH 20 (Dau Giay–Lien Khuong) in the South that passes though Tan Phu, a proposed protected area, and NH279 in the North that passes through Tay Yen Tu, a Nature Reserve area, is recommended so as to avoid these areas. These two road developments are incorporated in the list of road improvement projects of VITRANSS 2 Master Plan (2020).

Table 4.1.1 Potentially Affected Nature Reserves, National Parks and Cultural-Historical-Environmental Reservation Areas

No.	Protection Area	Classification	Area (ha)	Routes Passage Through	Region
The North					
1	Ba Be	National Park	100.48	National Road No. 279	Bac Kan
2	Cuc Phuong	National Park	25,000	HCM-12b	HCM-Thanh Hoa–Ninh Binh
3	Hoang Lien Son–Lai Chau	Proposed Nature Reserve	19,739	4D	Lai Chau
4	Hoang Lien Son–Lai Chau	Proposed Nature Reserve	19,739	National Road No. 279	Lai Chau
5	Kim Hy	Nature Reserve	18,555	National Road No. 279	Bac Kan
6	Muong Nhe	Nature Reserve	182,000	Border Corridor	Dien Bien–Lai Chau
7	Muong Sai	Proposed Nature Reserve	10,000	National Road No. 217	Thanh Hoa
8	Na Hang	Nature Reserve	41,930	National Road No. 279	Tuyen Quang
9	Pia Oac Mountain	Nature Reserve	10,000	National Road No. 34	Cao Bang
10	Phong Dien	Nature Reserve	41,548	National Road No. 49	Quang Nam
11	Phong Nha–Ke Bang	National Park	857.54	HCM- National Road No. 15	Quang Binh
12	Phong Quang	Nature Reserve	18,397	4C	Ha Giang
13	Pu Luong	Nature Reserve	17,662	National Road No. 15	Thanh Hoa–Hoa Binh
14	Tan Trao	Cultural, historical, and environmental preserve area	6,633	HCM Road	Tuyen Quang
15	Tay Con Linh	Nature Reserve	40,344	National Road No. 2- Hai Duong	Ha Giang
16	Tay Yen Tu	Nature Reserve	16,466	National Road No. 31–National Road No. 279	Bac Giang
17	Xuan Nha	Nature Reserve	38,099	National Road No. 43	Son La
The South					
1	Ngoan Muc Mountain pass	Proposed Protection Area	2,000	National Road No. 20	Ninh Thuan, Lam Đong
2	North Plei Ku	Proposed Protection Area	12,941	HCM	Gia Lai
3	Chu Prong	Proposed Protection Area	50,104	14C	Gia Lai
4	Krong Trai	Nature Reserve	20927.81	National Road No. 25	Tuy Hoa
5	Chu Mom Ray	National Park	56,620	National Road No. 14C	Kon Tum
6	Nam Ca	Nature Reserve	24,555	HCM	Dac Nong
7	Ngoc Linh	Nature Reserve	41,424	National Road No. 19	Kon Tum
8	Thanh River	Nature Reserve	93,249	National Road No. 19-D	Quang Nam
9	Ta Đung	Nature Reserve	18,893	National Road No. 28	Dac Lac
10	Yok Đon	National Park	115.54	14C	Dac Lac
11	Tan Phu	Proposed Protection Area	13.967	NH 20 (Dau Giay–Lien Khuong)	Dong Nai

(3) Effect Due to Natural Disasters of Land Slide and Flooding

(a) Land Slide

Northeast, Northwest and the Central mountain regions of Vietnam have weak geology and hence prone to frequent landslide. Road transport in these regions is frequently obstructed due to landslide. In 2005, 58 bridges and 125 culverts were destroyed due to landslide. Moreover, 430,678 m^2 surface of road area was either settled or sheared off because of landslides and flooding. Accordingly, landslide along major routes like national and provincial roads has been a frequent occurrence that needs due structural mitigation measures.

Potential landslide prone areas in the road transportation routes are many as given below. Landslide prone area of national road No.4 system includes four sections as Tinh Tuc–Cao Bang to Bao, Dinh Lap to Dong Dang, Quang Ba to Thanh Thuy, Xin Man to Phong Tho (Lai Chau). In case of national road No. 279 system it includes sections as Chi Lang to Binh Gia, Na Ri to Ngan Son, Na Hang to Bac Giang, Quynh Nhai to Dien Bien Phu City and Tay Trang border gate. In case of national road No. 6 it includes Mai Chau to Hat Lot and Thuan Chau to

Lai Chau. For national road No. 12 it includes Lai Chau to Dien Bien Phu City, for National Road No. 1 it includes Lang Son to Met (there is high mountain range at Chi Lang frontier), for National Road No. 7 it includes West of Hoa Binh to Nam Can, for National Road No. 15 (Ho Chi Minh Road) it includes Khe Ve to Khe Gat, for National Road No. 14 it includes intersection with National Road No. 49, to A Sa and from Kham Duc to the south of Dak Glei, for National Road No. 14B it includes Thach My to Tay Ha Nha, for National Road No. 24 it includes East of Kon Tum to West of Ba To and for National Road No. 27 it includes Lien Son to Bac Phu Son and Da Lat to Ninh Son (Da Nhim Hydroelectric area).

Typical structural measures of slope stabilization include slope netting, provision of set-back distance in the form of allowance for potential rock-fall and failed slope earth retention area in-between road curb and land slope base, talus reinforcement and also provision of deep-rooted vegetation based slope stabilization systems such as vetivier plantation on slopes. In particular, deep-rooted vetivier plant based slope stabilization is widely used recently in many road projects in Vietnam and hence its use has to be given due consideration (as the nearest natural means) in the design of slope stabilization systems.

(b) Flooding

There are two major flood prone lowland areas in Vietnam the Cuu Long (Me Kong) Delta region in the South and Red River Delta in the North. In addition virtually the entire eastern coastal area is flood prone lowland area. Accordingly, potentially flood prone road routes include the central coastal area from Tinh Gia to Giat Bridge, from Nghe An to Phan Thiet and large river valleys. Flood prone routes in the northern Red River valley area include National Road No. 70 and No. 2 (also the Lo River valley area of National Road No. 2). Moreover, the road routes in the central river valleys of Ma, Chu, and La rivers, namely, National Road No. 1A, No. 45, No. 47 and also the National Road No. 14B in Bon River valley area are flood prone.

The most significant flood prone road route of Cuu Long (Me Kong) and Red River deltas are as follows:

(a) **Cuu Long River Delta:** National Road No. 1A, N1, N2 and National Roads No. 50, 62, 30, 59, 57, 60, 61, 63, 81, 91

(b) **Red River Delta:** National Road No. 5, 10, expressway Hanoi–Hai Phong, National Road No. 1A

Many road projects of VITRANSS 2 Master Plan (2020) inevitably pass though flood prone areas such as NH 1 A Bypass (Thanh Hoa), NH1A Bypass (Ha Tinh), NH1A Bypass (Phan Thiet), NH1A Bypass (Duc Pho–Quang Ngai), NH 37 Bypass (Nam Sach), NH 60 Bypass (Ham Luong–Ben Tre–Mo Cay), NH 38 Bypass (Hoa Mac), NH1 Dong Ha–Quang Tri widening, NH14 Dong Xoai–Chon Thanh widening, NH51 Dong Nai–Vung Tau widening, NH6 Ba La–Xuan Mai widening and NH 20 (Dau Giay–Lien Khuong) improvement.

It is vital to raise the level of road base above design flood level with embankments so as to ensure their functionality as vital means of access during floods including their use for evacuation of flood affected people. Moreover, it is also required to take into consideration as far as practical potential rise in sea level in deciding the base level of road surface, in particular for those road routes along coastal areas. Still, raising the major road base levels has to be planned with the required surface water drainage and culvert systems so that the road infrastructure on raised embankments does not interfere with the natural drainage pattern and not to become a causative factor for flooding (inundation). These design mitigation measures shall be given due consideration in a very comprehensive manner in detailed planning and design of roads in flood

prone areas.

(4) Ambient Air Quality and Green House Gas Emission

In general increased future demand for road transportation consequent to future economic development, in overall, will result in increase in both air pollutants and green house gas (CO_2) emissions. Still, the rate of such increase could only be controlled with effective road development to minimize the distance of travel between origin and destination and also to control traffic jams, a major cause of increase in air pollution. This effective road development in combination with other more energy efficient transport modes like improved railway and waterway transportation (as planned by the overall transport development strategy of this VITRANSS 2) would optimize and limit the rate of increase of both air pollutants and green house gas emission consequent to increased overall energy efficiency in overall transport, including road transport.

Estimation on the overall air pollutant emission and green house gas emission only due to the development of road transport sector in the year 2030, the target year of transport development strategy of VITRANSS 2, was made under the assumption of 3 scenarios. The 3 scenarios considered are no project scenario, in which no development plan is assumed, base network scenario in which only all committed road development projects are assumed to be provided and the maximum scenario in which the entire transport development strategy of VITRNASS 2 including the entire road development strategy until the year 2030 are assumed to be realized by 2030. The results of analysis is shown in Table 4.1.2, which clearly indicates the maximum scenario results in lowest emission of both air pollutants and green house gas and hence has the highest relative energy efficiency for road transport. The basic assumptions and conditions used in the estimation of airp pollutants and green house gas emission are summarized in ***Appendix 4A***.

Table 4.1.2 Estimate Total Air Pollutant Emission of Road Transport Sector (ton/year) 2030 for Scenarios

No.	Scenario	CO_2	NOx	HC	PM	CO
1	Do nothing Scenario	21,454,325.6	323,651.2	873,258.8	20,314.4	2,314,804.6
2	Base Network	14,492,683.0	218,221.7	596,472.0	13,797.1	1,674,523.4
3	Do Maximum Scenario	9,495,489.6	174,042.5	443,604.5	12,436.2	1,602,785.0

Since air pollutants and green house gases are emitted consequent to vehicle operation, promotion of low emission (high gas mileage) vehicles such as hybrids, substitution of vehicular fuel with cleaner alternatives such as natural gas (CNG, LPG) along with a well established periodic maintenance inspection system for vehicles in use would contribute to reduction in emission of air pollutants and green house gas, and hence better ambient environmental quality. In this regard, upgrading the vehicle emission standards of Vietnam to EURO 4 would contribute to quick phasing out of old and malfunctioning vehicles off the road.

(5) Noise Nuisance in Road Transport

In general road is the noisiest surface means of transportation and reported to account for about 70% of overall noise nuisance (water transport and railway account for 10% and 20% respectively). Accordingly noise nuisance control is very important in both planning and subsequent vehicle operational management on roads. The noise observation survey result in most national, provincial, district roads in Vietnam is on average 75–78 dB. Still, noise level at some major streets in big cities like Ho Chi Minh City, Hanoi, Haiphong, and Danang is reported to be higher than 90 dBA, well over the standard for mixed areas. (TCVN 5949–1999–Maximum permitted noise level for mixed areas with residential, commercial and other activities near a

typical road is 75 dBA). The main reason for high noise level in urban areas are many that include high transport flow, traffic jam, lack of driver awareness resulting in negligence to follow traffic rules and unnecessary and frequent use of horn, lack of uniformly distributive traffic directional flow and use of old and non-road travel worthy vehicles.

Accordingly, improving road traffic awareness of drivers, in particular to limit the use of horn only in case of emergency, along with strict implementation of vehicle inspection system to phase out old non-road worthy vehicles and also to crack down on illegal vehicle modifications such as muffler alterations should contribute to a lot to not only reduction in road traffic noise level at source but also in reduction of air pollutants and green house gas emissions.

Conventional design noise dispersion mitigation measures of new and widening of road projects include tree plantation along side of road boundaries that would also mitigate air pollution at-least due to SPM (suspended particulate matter/dust), provision of set back distance to the extent possible between road and property boundaries as a buffer zone (most preferably as land use planning with due consideration to road traffic noise mitigation for new developments) and provision of noise retaining barriers.

In particular for expressways that would have dedicated ROW with vehicular flow at high-speed and hence high potential to generate high noise and vibration, provision of noise retaining barriers and buffer zones between the highway and nearest residential and other human habited developments is widely practiced and shall be given due attention in planning and design of expressway projects.

(6) Effect of Climate Change and Rise in Sea Level

According to the Marine Resources and Environment Investigation and Management Department of MONRE (Ministry of Natural Resources and Environment), in Vietnam, seawater level due to global warming is predicted to increase in the range of 15 to 90 cm by 2070. In such scenario, the affected areas would include Ca Mau, Kien Giang, Ba Ria–Vung Tau, Thanh Hoa, Nam Dinh, and Thai Binh. Moreover, in the event of worst-case scenario with rise in seawater up to 1 m, 23% of population will lose their land for living.

The effect due to potential future rise in sea level on road infrastructure would be very significant since road infrastructure, including the North-South Expressway, is also concentrated in the heavily populated lowland coastal regions including Cuu Long (Me Kong) and Red River deltas. Potential adverse effects on roads would obviously be serious and long-term. In this respect it is advisable to set the design criteria of new major road developments in lowland coastal areas with a minimum base elevation level of more than 1m above sea level. Such criteria shall be applied at-least for major national strategic road infrastructure projects like the North-South Expressway to facilitate their long-term sustainability.

(7) Pollution and Waste Management

No significant long-term water pollution or solid waste management issue and soil pollution is anticipated consequent to the vehicle movement on roads. The most significant aspect would be proper management of all solid and liquid wastes arising form construction activities that has to be managed properly with due construction planning and management during the implementation of construction works integrally as EHS (environment, health and safety) management and monitoring. This aspect shall be dealt with in detail in relevant EHS management and monitoring of project based EIA.

(8) Road Traffic Safety

Traffic safety is still a very significant issue and the major cause of high accident rate. Lack of awareness among drivers and also pedestrians to obey traffic signals and laws is widely prevalent such as not respecting traffic lights, unnecessary and frequent use of horns and others. So it is imperative to enhance the awareness of drivers in particular with educational campaign (using mass media like radio and TV also as education and campaign tools) and strict enforcement of traffic laws along with high penalty for violations. In fact this issue has already been widely recognized and recently a traffic safety improvement master plan was made. Prompt implementation of the plan to enhance traffic safety is very important along with new road and expressway development projects so as to fully realize the benefit of socio-economic development.

(9) Historical and Cultural Aspects

The basic road network in Vietnam in the past was built with very narrow rights of ways. This permitted culturally important structures such as pagodas, churches and public facilities such as schools, post office and cemeteries to be located close to the road edge. So any road improvement project would probably involve road widening as basic requirement, which in turn would have potential adverse effects on historical and cultural relics. Sadly, many such important historical and cultural relics were simply destroyed in the recent past when road development projects were carried out with little regard for the loss of historical and cultural heritage.

In this respect it is very important to take into due consideration in the planning of road alignments, first of all, the minimization of loss of important historical and cultural relics. As the basic requirement all due attention has to be given to identify important historical and cultural relics and every effort shall be made to relocate important relics elsewhere when such relocation is inevitable for road improvement and new road development plans. Moreover, during construction works care must be taken in areas with potentially high archeological significance so that construction works would not cause inadvertent destruction of any buried treasures. Construction contractors shall be instructed to follow due protocol in carrying out excavation works in areas with potential archeological significance.

2) North-South Expressway Sector

The significant environmental and social issues to be taken into due consideration and the relevant mitigation measures are described below on an itemized basis. Moreover, most social and environmental issues are quite similar to the road sub-sector as described above, since this is also a road sector project though of very significant national strategic importance to link the two major urban centers of Hanoi and Ho Chi Minh. Accordingly, repetitions are minimized to the extent possible and focus is made on specific and very important social and environmental aspects.

(1) Land Acquisition, Resettlement and Other Social Issues

North-South Expressway would involve very significant land acquisition and resettlement requirement since it would mostly be constructed on a new alignment on lands with various current uses including agriculture as also noted under similar item 1 of Road Sub-Sector of above. The expressway development strategy is slated for implementation on intermediate link basis of linking 2 major nearest urban areas like Danang and Hue. So during the detailed planning and implementation of the relevant intermediate sector of North-South Highway all efforts shall be made to select alignment so as to minimize resettlement requirement (in developed areas) and also to minimize the requirement of productive agricultural lands (in rural areas). Other concerned issues of public consultation and RAP for PAPs (project affected persons) are very similar to the one described above under Road Sub-sector and need to be duly followed during detailed project planning and design of each relevant intermediate links. The minimum target of RAP implementation will be no decline in living condition of the PAPs should occur consequent to the involuntary resettlement.

Moreover, since the Expressway would be from 4 up to 6 to 8 lanes on dedicated ROW it has high potential to cause split of communities thereby inconveniencing access to various public facilities and services like schools and hospitals. Accordingly due cross-accesses across the Expressway preferably in the form of underneath bypass with ease of access to cross the Expressway shall be an integral component of project design.

(2) Effect on Ecosystem

There are 129 protected areas in Viet Nam composed of 27 National Parks, 60 Nature Reserves areas, 37 Cultural-historical-environmental reservation areas and 5 World Heritage sites as also noted under similar item 2 of Road Sub-sector of above. Overlaying protected area in Vietnam with the VITRANSS 2 Expressway network shows that the planned alignments will run through the following Nature Reserves, National Parks and other cultural-historical-environmental reservation areas as shown in Table 4.1.3.

Expropriating at least some portions of the above National Parks and Nature Reserves for ROW (right of way) of the Expressway might be inevitable. This may result in split of national parks and nature reserves thereby affecting their functional ecological purpose and value. Hence any inevitable routing of ROW of expressway through the above mentioned (Table 4.1.3) Nature Reserves, National Parks should be planned very carefully to minimize the length of ROW to the optimum possible extent. In particular under no circumstance, ROW should bisect right through the middle of such an area and every effort shall be made to direct the ROW along or nearby the property boundary of Nature Reserves and National Parks. Moreover in order to minimize potential interference and also safety of fauna (from traffic accidents) since expressway will be on dedicated ROW, as far as possible underground passage within such nature reserve area shall be provided. If it is impractical due to some reason like flooding problem, then overhead passage across such areas shall be provided (on-grade passage shall not be permitted). These underground or overhead passages not only protect fauna from accidental risk but also minimize (entirely eliminates in case of underground passage) at least the required land surface area for Expressways.

Table 4.1.3 Nature Reserves, National Parks and Cultural-Historical-Environmental Reservation Areas Located along Expressway Routes

No.	Section	Protection Areas	Classification
I. Primary Arterial Network			
a.	NS backbone		
1.	Ha Tinh–Quang Tri	Nui Chung	Cultural-historical-environmental reserve
2.	Hue–Da Nang	Bach Ma	National Park
3.	Hue–Da Nang	Nam Hai Van	Cultural-historical-environmental reserve
4.	Hue–Da Nang	Bac Hai Van	Cultural-historical-environmental reserve
5.	Phan Thiet–Gia Rai	Ta Kou	Nature Reserve
II. Secondary Arterial Network			
1.	Doan Hung–Hoa Lac–Pho Chau	Nui Coc	Nature Reserve
2.	Dong Ha–Lao Bao	Phong Dien	Nature Reserve
3.	Da Nang–Ngoc Hoi	Song Thanh	Nature Reserve
4.	Da Nang–Ngoc Hoi	Ngoc Linh	Nature Reserve
5.	Dak To–Kon Tum	Nam Ca	Proposed protection area

(3) Effect due to Natural Disasters of Land Slide and Flooding

Most sections of North-South Expressway pass through flood prone area due to storm, tidal effect and river inundation except for sections such as Phap Van–Cam Lo and Nha Trang–Ho Chi Minh City. In particular the Central Vietnam area and the Cuu Long (Me Kong) Delta in the South are highly flood prone. Also, the topography of the central area from Quang Binh to Ninh Thuan has narrow width and the rivers are short in length with steep slope and hence the area is susceptible to flash floods. Moreover, Phap Van–Ha Tinh in the North area, which has big river system is also flood prone. Still, effective drainage and non-interference with natural drainage pattern which should be possible in the design considering the fact that the Expressway will have dedicated ROW (that could be raised to desired level) should mitigate flooding problem.

(4) Ambient Air Quality and Green House Gas Emission

In general increased future demand for road transportation consequent to future economic development, in overall, will result in increase in both air pollutants and green house gas (CO_2) emissions. Still, the rate of such increase could only be controlled with effective road development to minimize the distance of travel between origin and destination and also to control traffic jams, a major source of increase in air pollution. This effective road development in combination with other more energy efficient transport modes like improved railway and waterway transportation (as planned by the overall transport development strategy of this VITRANSS 2) would optimize and limit the rate of increase of both air pollutants and green house gas emission consequent to increased overall energy efficiency in overall transport, including road transport. In this respect the North-South Expressway would play a very significant role in minimizing the distance and travel time between Northern and Southern parts of Vietnam thereby contributing to increased overall energy efficiency of road transport and hence to reduced overall emission of air pollutants and green house gases. This is evident from Table 4.1.2 in which the maximum scenario that included the entire development of North-South Expressway resulted in lowest emission of both air pollutants and green house gases in road transport.

(5) Effect of Climate Change and Rise in Sea Level

As also noted in the similar Item 6 under road sub-sector of above, according to the Marine Resources and Environment Investigation and Management Department of MONRE (Ministry of Natural Resources and Environment), in Vietnam, seawater level due to global warming is

predicted to increase in the range of 15 to 90 cm by 2070. In such scenario, the affected areas would include Ca Mau, Kien Giang, Ba Ria–Vung Tau, Thanh Hoa, Nam Dinh, and Thai Binh. Moreover, in the event of worst-case scenario with rise in seawater up to 1 m, 23% of population will lose their land for living.

The effect due to potential future rise in sea level on road infrastructure would be very significant since road infrastructure, including this North-South Expressway, is also concentrated in the heavily populated lowland coastal regions including Cuu Long (Me Kong) and Red River deltas. Potential adverse effects due to potential rise in sea level on this strategically very important North-South Expressway could obviously be serious and long-term. In this respect it is strongly recommended to set the design criteria to have a minimum base elevation level of more than 1 m above sea level in order to facilitate long-term sustainability of this strategically important expressway link between northern and southern parts of Vietnam.

(6) Pollution and Waste Management

No significant long-term water pollution or solid waste management issue and soil pollution is anticipated consequent to the direct vehicle movement on Expressways. Still waste management at rest stop stations and the restaurants toilets and others, which will be integral part Expressway system, must be well executed to mitigate potential water (toilet and restaurant wastewater) and solid waste (principally food related waste and its putrefaction effects) pollution. Moreover, during construction of the Expressways, proper management of all solid and liquid wastes arising form construction related activities is very important and has to be done with due construction planning and management integrally as EHS (environment, health and safety) management and monitoring. This aspect shall be dealt with in detail by the relevant EHS management and monitoring of project based EIA.

(7) Expressway Traffic Safety

Traffic safety is still a very significant issue and the major cause of high accident rate. Lack of awareness among drivers and also pedestrians to obey traffic laws is still widely prevalent. The importance of traffic safety in expressways does not require over emphasis to ensure its effective and efficient operational use. Lack of traffic safety would evidently lead to expressways to become “death-ways”. All vehicles have to follow the basic safety requirement such as no tailgating, obey the speed limits, proper use of signals during changing of lanes including no frequent changing of lanes for the purpose of just speeding and others. Moreover, no unauthorized entrance of pedestrians and vendors into expressways need to be strictly enforced. In order to realize these educational campaign and awareness of drivers and population in general (using mass media like radio, TV also as effective tools), due training of traffic police and other expressway management personnel is necessary and continuously done on regular basis in combination with strict enforcement of traffic laws along with high penalty for traffic violations. In fact this issue has already been widely recognized and recently a traffic safety improvement master plan was made. Prompt implementation of the plan to enhance traffic safety is very important along with both expressway and also new road development projects so as to fully realize the benefit of socio-economic development.

The basic road network in Vietnam in the past was built with very narrow rights of ways. This permitted culturally important structures such as pagodas, churches and public facilities such as schools, post office and cemeteries to be located close to the road edge. So any road improvement project would probably involve road widening as basic requirement, which in turn would have potential adverse effects on historical and cultural relics. Sadly, many such important historical and cultural relics were simply destroyed in the recent past when road development

projects, including expressways, were carried out with little regard for the loss of historical and cultural heritage.

In this respect it is very important to take into due consideration in the planning of expressways alignments, first of all, the minimization of loss of important historical and cultural relics by selecting alignments to be located away from such important cultural treasures. As the basic requirement all due attention has to be given to identify important historical and cultural relics and every effort shall be made to relocate important relics elsewhere when such relocation is inevitable for expressway development plans. Moreover, during construction works care must be taken in areas with potentially high archeological significance so that construction works would not cause inadvertent destruction of any buried treasures. Construction contractors shall be instructed to follow due protocol in carrying out excavation works in areas with potential archeological significance.

3) Railway Sub-sector

The significant environmental and social issues to be taken into due consideration and the relevant mitigation measures are described below on an itemized basis. Moreover, most social issues are quite similar to the road sub-sector of Item 1) as described above since Vietnam has considerable railway network (all with single track and a lot of bottle necks like on grade road crossings), and the proposed strategic plan is to basically improve the existing railway network and also to construct a new rail line the one to link Vung Tau with the existing major Ho Chi Minh City (HCMC)–Hanoi rail system and also the provision of new line to extend existing HCMC–Hanoi line to further south to link the major Me Kong (Cuu Long) Delta urban center Can Tho. Similar to roads railway also requires ROW (right of way) and hence the land acquisition and other social effects are quite similar.

(1) Land Acquisition, Resettlement and Other Social Issues

Most railway improvement work in the exiting single track like replacement of rails, strengthening of ballast base, separation of grade with road crossings would not require any significant land acquisition or resettlement requirement. However, double tracking to increase the frequency of services, which would be mostly required near urban areas as well and also the provision of new tracks like the one to link Vung Tau with HCMC–Hanoi rail line (the new line will be a branch-off from Trang Bom) to would involve significant land acquisition and resettlement requirement. Double tracking would require widening of ROW similar to road widening work. There are very close developed areas like commercial and housings in the urban rail line areas like Hanoi and HCMC. So land acquisition and resettlement requirement, in particular in urban areas, for double tracking would be a very contentious issue that would also include temporary disturbance to business during construction works. The due process well established in Vietnam that has already been followed with ongoing similar works includes public consultation, RAP (resettlement action plan) formulation, implementation and monitoring along with EIA during detailed project planning and design. In fact the proposed new rail lines between Trang Bom and Vung Tau and in particular the highly agriculturally developed and populated areas for the new line to link HCMC with Can Tho in Me Kong Delta would involve very significant land acquisition and resettlement requirement.

Concerning railway improvement with double tracking in highly urbanized and congested areas like those around HCMC and Hanoi, the required additional terrestrial land space for the second new track could be eliminated (at least partly) by accommodating the new track within the space of existing track with the provision of the second tract above the existing tract on viaduct or putting it underground below the existing track (in tunnel), though it would involve higher cost of

construction. Still, this higher cost must be compared with land acquisition, resettlement and other cost and also the time consuming difficult negotiations with PAPs including selection of alternative sites for resettlement and others. So at times such higher construction cost option might be the cheapest option as well. These alternatives have to be duly considered during detailed planning and engineering design of railway improvement.

As could be anticipated land acquisition for railway improvement and new line provisions is a very difficult and contentious issue that has to be well planned and executed with due process of public consultation with project affected persons (PAPs) and the relevant RAP aspects as mentioned above. As the basic step in new railway development plan every effort shall be made to study alternative alignments to select optimal alignment so as to minimize resettlement requirement and also acquisition of productive lands like agricultural lands, in particular in the highly agriculturally developed areas for the new rail line to link HCMC with Can Tho (located in Me Kong/Cuu Long Delta).

Regarding RAP implementation, resettlement and relocation should be planned and executed very carefully during detailed project planning and design to mitigate adverse effects on the PAPs. In this respect, all efforts have to be made to achieve improvement in living condition of people affected, with particular attention on poor and vulnerable and other socially disadvantaged people like ethnic minorities. In all cases of RAP implementation the minimum requirement should be “no decline in living condition of the PAPs should occur consequent to the involuntary resettlement”.

Apart from the most significant issue of involuntary resettlement other social issues related to at least for new railway development project includes split of communities and the resultant lack or inconvenience to access social services and social institutions like schools, hospitals and others. All these issues shall be addressed along with RAP formulation, as social impact assessment of the project during detailed planning and design of project and amicable mitigation measures agreeable to the affected people has to be carried out. Most split of community issue could be eliminated by avoiding on grade road crossing, with the rail line passing either overhead or underneath the road along with the provision of safe cross-access across the railway line, which would also enhance the overall safety of the train operation in addition to elimination of grade crossing signaling and other management requirement.

(2) Effect on Ecosystem

Rail transport network in Hong (Red River) Delta includes Hanoi–Lang Son alignment passing through Bac Ninh (NE line) and Hanoi–Lao Cai alignment passing through Vinh Phuc and Phu Tho (NW line) both being cross-boarder links to China. There are also 2 other branch lines to Hai Phong and Ha Long. Hong Delta is mostly industrial and urban area, especially the NE sector. Moreover, all these existing rail lines have long operational history and hence their improvement is not expected cause any significant adverse effects on surrounding protected and other nature reserve areas of ecological importance. The longest northern sector of Hanoi–Ho Chi Minh City (HCMC) line passes through Ha Nam, Nam Dinh, Ninh Binh, the terrain of which is plain and has no interference with any ecologically significant areas to cause any adverse effects due to their improvement works.

The (north-central) portion of the Hanoi–HCMC railway line that goes through Northern Central provinces from Thanh Hoa Province to Thua Thien–Hue Province is narrow coastal plains containing mountains, hills, mountain passes, and submerged and settled areas in the flooding season. Still, improvement of this stretch of lines is not expected to interfere with ecologically significant areas.

The south-central portion of Hanoi- HCMC railway line goes through those narrow coastal plains containing mountains, hills, and mountain passes. In this segment of the line, there are many submerged and settled areas in the flooding season. This railway lines also runs across densely populated towns and cities. Still, with due attention it should be possible to eliminate interference with ecologically significant coastal nature reserve areas consequent to rail way improvement works.

The railway network in the Central Plateau region is underdeveloped. There was previously a railway line linking Da Lat with Thap Cham that consisted of a saw-toothed wheel section passing mountainous areas. However, this railway line was seriously damaged during the war with USA and the saw-toothed wheel section was removed. At the present, seven kilometers of the line from Da Lat to Trai Mat has been restored to serve tourism. The restoration of these railway lines in future might affect the forests, fauna and flora along the lines. Accordingly, due attention has to be paid to minimize interference with natural forestry ecosystem in determining the alignment of any future restoration of this railways since this area has high ecological value with high forest cover on a national basis. The biodiversity of this forested area is still high and hence the nature reserve zones and important riverine forests in this area require continuous protection.

The proposed new railway line linking HCMC with Vung Tau (with new section from Trang Bom to Vung Tau) city will go through industrial zones those will be established the next numerous years and there is no ecologically significant areas.

The proposed new railway line connecting HCMC with Can Tho City would go through human effected agricultural areas interposed with residential villages. Accordingly, no significant effect on important natural ecological system is anticipated even though effect on human modified agricultural lands may be significant.

(3) Effect due to Natural Disasters of Land Slide and Flooding

The Vietnamese railway system runs through 3 major regions, namely, North, Central, and South areas and would remain so even after some new line developments like HCMC–Vung Tau (Trang Bom–Vung Tau) and HCMC–Can Tho. In northern Vietnam, there are many faults that run from northwest to the southwest. Destabilized by earthquakes and eroded by rivers and rainfall, many landslides occur along these fault lines in the northeastern and northwestern mountainous areas. In central and southern Vietnam, almost all the main rivers flow down to the sea in short (40–70 km) precipitous channels along faults, but since seismic activity is weak and the valleys are relatively stable, the severity and frequency of landslides is low. In the mountainous areas in Vietnam's central highlands, the land has become unstable, and landslides are quite common.

With these geological conditions, railway (and also road) operations in the northwest and northeast of Vietnam are regularly damaged and/or cut off by landslides. The other problem is flash flooding that affects slope stability leading to slope failures, mud flows, and landslides. The central coast, where there are very dry coastal deserts, has severe but infrequent flash flooding. In particular, the existing national railway passes through three areas with high risk from flood and landslide triggered by storms, typhoons, and heavy rains. These areas are: (i) Vinh–Thu Loc (179 km); (ii) Haoson–Ca Pass (49 km); and (iii) Yen Bai–Lao Cai (138 km). Railway improvement works in such areas should focus on slope stabilization, raising of design rail bed elevation and other possible technical mitigation measures to cope with such natural disasters of landslide and flooding.

The proposed 2 new section linking HCMC with Vung Tau and Can Tho is also mostly located in

lowland flood prone areas. It is vital to raise the level of rail bed base above design flood level with embankments so as to ensure their functionality as vital means of access during floods. Moreover, it is also required to take into consideration as far as practical potential rise in sea level in deciding the base level of these lowland (and near coast) rail lines. Still, raising the rail base levels has to be planned with the required surface water drainage and culvert systems so that the railways on raised embankments does not interfere with the natural drainage pattern and not to become a causative factor for flooding (inundation). These design mitigation measures shall be given due consideration in a very comprehensive manner in detailed planning and design of these new rail links around HCMC located in flood prone areas.

(4) Ambient Air Quality and Green House Gas Emission

In general increased future demand for rail transportation, in overall, will result in increase in both air pollutants and green house gas (CO_2) emissions in comparison ot the existing condition. Still, the rate of such increase is low in comparison to road transport since railways are comparatively more energy efficient mode of transportation than roads. As long as diesel is used as fuel, local air pollution would be prevalent though its effect is not expected to be that significant. Moreover, future electrification of railways shall be duly considered for both facilitation improved energy efficiency and also to mitigate local air pollution and to shift toward cleaner energy use on the assumption that in future electricity generation with clean energy sources like solar and wind would increase in proportion in Vietnam as well. In overall, considering the available option of future electrification and also relative high energy efficiency in fuel use potential adverse effects by improved railways even with diesel as fuel is considered as not that significant with respect to both ambient air pollution and green house gas emission. In fact increased modal shift from road transport to railways (both passengers and cargo) due to improved railways to the extent possible would contribute to overall reduction in the emission of air pollutants and green house gas emission.

(5) Noise Nuisance in Railways

In general noise nuisance in rail transport is intermittent and not continuous due to relatively low frequency of train passage with no “traffic congestion” and infrequent requirement to use horn. With improved railways the noise effect could also be reduced with the use of improved rail tracks with long lengths, improved carriages along with improved design and construction of upgraded rail system. In effect all possible means of improved design and operation of rail system is recommended to reduce to the extent possible potential noise nuisance.

(6) Effect of Climate Change and Rise in Sea Level

As also noted in the similar Item 6 under road sub-sector (and also Expressway sector) of above, according to the Marine Resources and Environment Investigation and Management Department of MONRE (Ministry of Natural Resources and Environment), in Vietnam, seawater level due to global warming is predicted to increase in the range of 15 to 90 cm by 2070. In such scenario, the affected areas would include Ca Mau, Kien Giang, Ba Ria–Vung Tau, Thanh Hoa, Nam Dinh, and Thai Binh. Moreover, in the event of worst-case scenario with rise in seawater up to 1 m, 23% of population will lose their land for living.

The effect due to potential future rise in sea level on railway infrastructure located along and nearby the lowland of the eastern coast (both existing and the planned 2 lines to link HCMC with Vung Tau and Can Tho), which includes the strategically important existing railway system linking Hanoi with HCMC that traverses mostly along the eastern coast, could obviously be serious and long-term. In this respect it is strongly recommended to set the design criteria to have a minimum base rail elevation level of more than 1m above sea level at least for the 2

planned new links located in and near coastal lowlands, namely, Trang Bom to Vung Tau (HCMC–Vung Tau) line and HCMC to Can Tho line, in order to facilitate their long-term sustainability. The possibility of raising the base rail level to at least 1m above sea level is recommended to be taken into due consideration in upgrading the coastal lowland portions of the existing strategically important Hanoi to HCMC railway as well.

(7) Pollution and Waste Management

The most significant long-term water pollution and solid waste management issue (including somewhat potential soil pollution along the railway tracks) is the requirement for proper management of wastes generated by passengers, especially by those long distance passengers both in trains and railway stations. The current management of passenger-generated waste is regarded as inadequate since wastes from toilets in trains are directly disposed on to tracks, which is unsanitary and also important public health issue. In this respect VNR as the responsible agency for railways is recommended to improve not just the provision of cafeteria and meals service on long distance trains but also the management of wastes generated consequent to passengers both in railway stations and trains. It is strongly recommended to discontinue the practice of direct disposal of human waste on to the railway tracks as the highest priority. Moreover, during construction of both the improvement of existing railway lines and new ones, proper management of all solid and liquid wastes arising from construction related activities is very important and has to be done with due construction planning and management integrally as EHS (environment, health and safety) management and monitoring. This aspect shall be dealt with in detail by the relevant EHS management and monitoring of project based EIA.

(8) Safety in Railway Operation

Safety in railway operation is very important that includes safety of direct train operation as well as other interferences like safety in level crossings with roads and other pedestrian crossways (in particular, on-grade road crossing). Accordingly, improvement of existing railways including double tracking as required will obviously have due focus on enhancement operational safety that would include eliminating all on-grade road crossings at-least in urban and developed areas like HCMC, Hanoi and others along with modernization of train signaling system. In addition operational safety training oriented human development aspects to be given due consideration by VNR for its staffs with improved service level with increased frequency of train service since increased frequency of service would also increase the probability of train accidents.

(9) Historical and Cultural Aspects

There is a possibility for culturally important structures such as pagodas, churches and public facilities being located close to the existing railway lines. So this aspect has to be given due consideration in planning railway improvement works, in particular double tracking work that would require expansion of ROW to accommodate the new track. Still, as also noted under item 1 of above on land acquisition and resettlement aspects, provision of the additional track overhead in viaduct or underground in tunnels is always an available option to protect any existing important cultural asset as well, which would minimize if not entirely eliminate the requirement of additional terrestrial land space for the new track (and hence to protect the important cultural asset). Also the alignment of the planned new rail routes (HCMC to Vung Tau and HCMC to Can Tho) should be selected so that important cultural and historical assets are not affected. Moreover, during construction works care must be taken in areas with potentially high archeological significance (such areas may exist especially along the HCMC to Can Tho route) so that construction works would not cause inadvertent destruction of any buried

treasures. Construction contractors shall be instructed to follow due protocol in carrying out excavation works in areas with potential archeological significance.

4) North-South High-Speed Railway Sector

Principally due to its extremely high investment cost the North-South High-speed railway, referred to as NSHSR (North-South High-Speed Railway), linking Hanoi with HCMC is not considered as a financially viable option until the year 2030, the target time frame of this transport development strategy. Still, NSHSR is a highly strategically significant project plan and should be a viable option in the long-term (at least after 2030) and hence studied on a preliminary basis in component of overall transport development strategy. Accordingly, SEA for this NSHSR is also conduced on a preliminary basis. The significant environmental and social issues to be taken into due consideration and the relevant mitigation measures in planning the NSHSR are described below on an itemized basis. Also it is noted that social and environmental issues of this NSHSR are quite similar to the North-South Expressway Sector as described above under item 2), since this is also very significant national strategic important project to link the two major urban centers of Hanoi and Ho Chi Minh City (HCMC) through quite similar geographical terrains as the North-South Expressway. Moreover, both would require dedicated ROW, though the requirement of dedication would be much higher for NSHSR in order to facilitate safe high-speed train travel with no interruptions (obstructions).

The preliminary NSHSR system planning consists of railway planning and station planning, in which there are two major alternative proposals with different overall rail alignment and train speed. The first one is to construct a completely new and straighter line with design speed of 300 km/h and total rail length of 1,550 km (first option). The second proposal is to construct several high-speed sections mostly in parallel with the existing railway sections with due straightening as required so as to arrive at conditions necessary and suitable for high-speed transportation (second option). In this option (second preliminary proposal), the total length is 1,600 km and the design speed of the high-speed sections would be limited to 200 km/h (in consideration to the relative lack of straightness of the line as well). However, link lines, electric power supply systems and other important auxiliary requirements for high-speed train service have not been studied in this preliminary planning.

Major characteristics of high-speed railway system are: (i) often operating at high speed range, (ii) utilizing numerous elevated or underground (and also tunnel as crossings in case of significant mountainous areas both to maintain the straightness of train track line and also to avoid significant change in base elevation of the line) substructures (dedicated ROW) in order to avoid interference with other transport modes as well as to ensure operation safety, high speed and good maintenance, and (iii) use of electric power for operation. Because of these characteristics, the impacts of high-speed railway on environment are somewhat different from those of conventional railway but still quite similar to North-South Expressways as noted above.

(1) Land Acquisition, Resettlement and Other Social Issues

NHSR would involve very significant land acquisition and resettlement requirement since it would mostly be constructed on a new alignment (first option for 300 km/h) or at-least mostly on expanded alignment along existing railway (second option for 20 km/h) lands with various current uses including agriculture, quite similar to the North-South Expressway Sector as dealt with under similar item 1 of Item 2), Moreover, since the objective is high-speed rail service, selection of alignment will have to focus on minimizing the rail alignment distance to the possible optimum as well as far as practical for both options. Nevertheless, during the detailed alternative planning study of both options, all efforts shall be made to select the sections of overall alignment

so as to minimize resettlement requirement (in developed areas) and also to minimize the requirement of productive agricultural lands (in rural areas) to the extent possible still without compromising the requirement on the limit of curvature for safe high speed train service. The requirement of fully dedicated overhead or underground train lines (ROW) to avoid any interference with all other surface transport mode (especially in developed urban areas) would in fact facilitate in at least minimizing the required terrestrial land surface area. In any case comparing both options, the second option to provide the NHSHR parallel to existing railway would inevitably pass through more developed areas and hence should require more resettlement requirement than the first option, which would pass through more rural undeveloped areas and also more flexible with respect to alignment modification and hence to minimize resettlement requirement. Other concerned issues of public consultation and RAP for PAPs (project affected persons) are very similar to the one described above under Road Sub-sector and need to be duly followed once the NSHSR option (first one or the second one) is selected and during detailed project planning and design of each relevant intermediate links of NSHSR. The minimum target of RAP implementation will be "no decline in living condition of the PAPs should occur consequent to the involuntary resettlement".

Moreover, irrespective of the option selected as also pointed out above, in order to ensure safe high-speed train operation, the NSHSR will have fully dedicated ROW and hence may have potential to cause split of communities thereby inconveniencing access to various public facilities and services like schools and hospitals. Still it is expected that elevated sections will be suitably provided in such developed areas requiring cross-access by inhabitants in order to ensure that no pedestrian would ever attempt to illegally cross the rail line, very important safety concern of high-speed train operation. Accordingly due cross-accesses in the form of underneath bypass with ease (and safe) access to cross the NSHSR could be easily provided an integral component of project design so as to mitigate spilt of community oriented adverse effect.

(2) Effect on Ecosystem

There are 129 protected areas in Viet Nam composed of 27 National Parks, 60 Nature Reserves areas, 37 Cultural-historical-environmental reservation areas and 5 World Heritage sites as also noted under similar item 2 of Road Sub-sector of above. Moreover, Table 4.1.3 under the similar item of Expressway Sector provides the list of nature reserve, national park and other cultural-historical-environmental reservation areas potentially affected by the North-South Expressway. At-least the 5 protected areas of the first section on Primary Arterial Network (Nui Chung, Bach Ma, Nam Hai Van, Bac Hai Van and Ta Kou) in the above Table 4.1.3 would be potentially affected by the NSHSR irrespective of the option selected. Moreover, the following protected forest areas would also be probably affected by the NSHSR. They are Cuc Phuong forest (Ninh Binh), Ben En forest (Thanh Hoa) and Vu Quang forest (Ha Tinh).

Expropriating at least some portions of the above National Parks and Nature Reserves for ROW (right of way) of the NSHSR might be inevitable. This may result in split of national parks and nature reserves thereby affecting their functional ecological purpose and value. Hence any inevitable routing of ROW of NSHSR through the above mentioned Nature Reserves, National Parks should be planned very carefully to minimize the length of ROW to the optimum possible extent. In particular under no circumstance, ROW should bisect right through the middle of such an area and every effort shall be made to direct the ROW along or nearby the property boundary of Nature Reserves and National Parks. Moreover in order to minimize potential interference and also safety of fauna (from traffic accidents) since NSHSR will be on fully dedicated ROW, as far as possible underground passage within such nature reserve area shall be provided. If it is impractical due to some reason like flooding problem, then overhead passage across such

areas shall be provided (on-grade passage shall not be permitted). These underground or overhead passages not only protect fauna from accidental risk from high-speed trains but also minimize (entirely eliminates in case of underground passage) at least the required land surface area for ROW of NSHSR. Moreover, if necessary reduction of speed of trains through these areas along with no use of horns shall be considered if noise and vibration is still an issue for the protection of fauna in any particular protected or nature reserve area.

(3) Effect due to Flooding, Land Slide and Ground Subsidence

The option 2 of NSHSR parallel to existing railways have more potential to pass though at least relatively more flood prone areas while option 1 on new alignment could be planned more flexibly to avoid as far as possible such areas. Also the central mountainous region is landslide prone. Still, due technical mitigation measures are possible for either options in particular considering the requirement of fully dedicated new ROW that could be raised to the desired level either on overhead viaduct or embankment to mitigate flooding and also due land slide mitigation measures like slope stabilization, ground leveling will be integral part of engineering design of ROW (for either option). The flood mitigation measures shall also ensure non-interference with natural drainage pattern.

Moreover, either option would require very significant tunneling work, in particular along the central mountainous areas (most significantly the segment between Danag and Hue across Hai Van Pass is a highly constrained tunneling area). In this respect the tunneling work length of option 1 will be more than twice that of option 2 (more than 200 km in total for option 1 against about 100 km for option 2) as could be expected since option 1 would be on new more linear alignment to facilitate higher speed of 300 km/h (for option2 it is 200 km/h). These tunneling works have to be well planned and executed with due safety consideration to mitigate potential earth collapse, landslide, rock falls, ground subsidence and other land failure disasters that may result in very serious consequence.

(4) Effect on Geographic Features

Due to the requirement of specific ROW with no interference with other transport modes and other activities to facilitate uninterrupted safe high-speed service mostly in overhead viaducts and raised embankments, the effect on landscape and geographic feature of NSHSR would be very significant since it would be a highly visible (easily recognizable) long continuous structure. This effect should be more prominent for option 1 of new alignment that would traverse through more undeveloped rural area than the option 2 that would be most parallel to the existing railway line. This impact could not be mitigated in practical sense and all effort should be made to blend the structural feature of this long linear NSHSR line to be in compatible and harmoniously blend with the natural surroundings environment to the extent possible in detailed engineering design.

(5) Ambient Air Quality and Green House Gas Emission

In general increased future total (net) transportation consequent to future economic development, in overall, will result in increase in both air pollutants and green house gas (CO_2) emissions in comparison to existing condition as long as carbon remains as the major source of energy for electricity generation as well. Nevertheless, since NSHSR will use electricity due to its obvious high-energy intensity and efficiency requirement at least there is no local air pollution issue due to direct train operation (air pollution is emitted in the power plants that generate electricity for the NSHSR operation and hence could be effectively controlled with proper sitting of power plants). Still, the rate of increase in air pollutant and green house gas emission could only be controlled with effective total transport development to minimize the distance of travel between origin and destination and also to control traffic jams of road transport, a major source of air pollution. The

effective long-term development of more energy efficient surface transport mode of NSHSR, including improved conventional railway and waterway transportation (as planned by the overall transport development strategy of this VITRANSS 2) would optimize and limit the rate of increase of both air pollutants and green house gas emission consequent to increased overall energy efficiency in overall transport, including road transport. In particular the long-term contribution of NSHSR in limiting the future demand for air travel, the least energy efficient transport mode and hence its contribution for reducing the growth in green house gas emission, is very significant. Still the high investment cost of NSHSR along with the requirement of stable uninterrupted electric power requirement is important constraints of the development of NSHSR at least in the near future. Still, in long-term NSHSR would play a very significant role in minimizing the distance and travel time between Northern and Southern parts of Vietnam thereby contributing to improvement in travel convenience and overall energy efficiency (reduction in green house gas emission) and also total elimination of local emission of air pollutants.

(6) Noise Nuisance in NSHSR Operation

In general noise nuisance in NSHSR (rail transport in general) is intermittent and not continuous due to relatively low frequency of train passage with no “traffic congestion” and infrequent requirement to use horn. Since NSHSR is totally a new system the use of latest technology in the design of the total rail system (that has already been adopted in Japan and Europe with long operational history of high-speed train service), in particular in the design of rails and the train carriages, major sources of train operational noise and vibration, at-least extreme noise and vibration effect could be controlled. Still, noise and vibration is inevitable to high-speed train transport (effect due to wind shear is inevitable) that need to be controlled with effective speed limits in near populated urban areas (that should also be required due to operational safety and also train stoppage requirement at railway stations) and also in other sensitive areas like protected areas as also noted under item 2 of above on “Effect on Ecosystem”. Moreover, structural noise retaining barriers shall be provided along noise sensitive areas along the dedicated ROW of the tracks. Accordingly design and operational mitigation measures of NSHSR could be effective in controlling undue noise and vibration.

(7) Effect of Climate Change and Rise in Sea Level

As also noted in Item 6 under road sub-sector (and also all other sub-sectors) of above, according to the Marine Resources and Environment Investigation and Management Department of MONRE (Ministry of Natural Resources and Environment), in Vietnam, seawater level due to global warming is predicted to increase in the range of 15 to 90 cm by 2070. In such scenario, the affected areas would include Ca Mau, Kien Giang, Ba Ria–Vung Tau, Thanh Hoa, Nam Dinh, and Thai Binh. Moreover, in the event of worst-case scenario with rise in seawater up to 1 m, 23% of population will lose their land for living.

The effect due to potential future rise in sea level on NSHSR infrastructure would be very significant, which is a major high investment and strategic infrastructure more than even the North-South Expressway. In this respect the Option 1 on new alignment could be planned flexibly with due attention to mitigate future potential rise in sea level and hence could be aligned more towards inland along areas with relatively high natural ground elevation in comparison to the option 2 along existing railway (that is more aligned toward the lowland coastal areas). Adverse effects due to potential rise in sea level on this strategically very important NSHSR could obviously be serious and long-term. In this respect it is strongly recommended to set the design criteria to have the alignment as far as possible along areas with natural ground elevation of at least 1m above sea level (and hence the elevation of dedicated ROW to be further higher

when it is on embankment or overhead viaduct). This condition should be regarded as mostly achievable for option 1 if not entirely for option 2. In any case a minimum base elevation level of more than 1 m above sea level for the dedicated ROW of NSHSR (either on embankment or overhead viaduct) in order to facilitate the long-term sustainability in of this strategically important (high investment) link between northern and southern parts of Vietnam should be the minimum requirement.

(8) Pollution and Waste Management

The most significant long-term water pollution and solid waste management issue (including somewhat potential soil pollution along the railway tracks) is the requirement for proper management of wastes generated by passengers both in trains and in railway stations of NSHSR. However, since the NSHSR is a modern railway system with fully closed rail cars, an important condition for passenger safety in high-speed train service, such design of rail cars is also expected to fully contain all wastes generated within the train (including wastes due to catering service) for disposal management at railway stations. In particular, it is expected that no human wastes from toilets and washbasins in trains will be directly disposed on to tracks. Accordingly, total improvement of waste management both in trains and train stations are very important and duly taken into consideration in particular in the design of NSHSR railway stations. Moreover, during construction of NSHSR, proper management of all solid and liquid wastes arising from construction related activities (including very significant tunneling works) is very important and has to be done with due construction planning and management integrally as EHS (environment, health and safety) management and monitoring. This aspect shall be dealt with in detail by the relevant EHS management and monitoring of NSHSR based EIA.

(9) Safety in NSHSR Operation

Safety in NSHSR operation is very important that needs no over emphasis. The basic safety in operation will be ensured with the provision of fully dedicated ROW for NSHSR that would avoid interference with all other road and other pedestrian oriented surface transport modes. Still, any derailment or train collision would result in very serious disaster consequence. In this respect proper operation and maintenance of the whole system, the ROW, tracks, trains, train signaling and electric power supply system and others shall be ensured. In order to attain operational reliability and safety, as the basic requirement operational safety training oriented human resources and skill development aspects of NSHSR personnel need to be well organized and executed by the VNR or any other future operational agency of NSHSR.

(10) Historical and Cultural Aspects

There is a possibility for culturally important structures such as pagodas, churches and public facilities being located close to the existing railway lines. So this aspect has to be given due consideration, in particular, in the planning the option 2 of NSHSR, since it would be aligned, though within a new ROW, mostly located along (in parallel) the existing railways. Still, loss could be avoided with the provision of ROW in overhead viaducts or underground. On the other hand the option1along new alignment should be more flexible and the ROW could be planned so as to avoid historical and cultural treasures in addition to the added flexibility of provision dedicated ROW in overhead viaduct or underground. Still, as the basic plan all efforts shall be made to identify important cultural and historical treasures and to plan the alignment for either option as far as possible to avoid them. Moreover, during construction works care must be taken in areas with potentially high archeological significance so that construction works would not cause inadvertent destruction of any buried treasures. Construction contractors shall be instructed to follow due protocol in carrying out excavation works in areas with potential archeological

significance.

5) Port and Shipping Sub-Sector

Vietnam has a very long coastline of more than 2500 km in the east along the mainland itself and hence there are already many ports of various functions and sizes that exist along the east coastline. Also there are many beaches, mangrove forests, estuaries and other ecologically important areas including Halong Bay (World Heritage Site) along the east coast. So future port development and expansion works should be executed with due care to protect the ecologically important coastal areas and off shores. Still, ports are essential for international trade and also much preferred energy efficient mode for at-least long distance domestic cargo transportation in Vietnam (thereby reducing the need for long distance cargo trucks on roads, most significantly along the most important North-South Route) and hence very environmentally friendly mode for domestic cargo transport as well.

The significant environmental and social issues to be taken into due consideration and the relevant mitigation measures are described below on an itemized basis with due consideration to the fact that port is a near-shore infrastructure. Accordingly, some items of environmental issues are modified to suit this water based transport system against land surface based transport system of the above 4 sub-sectors (basically roads and railways). Still, most social issues are quite similar to the road and other sub-sectors of Item 1) as described above. Nevertheless, the adverse effects would be less severe since ports are cluster based and not linear and long like roads and railways and also most infrastructures is provided off-shore in basically uninhabited (reclaimed) coastal seawater areas. Accordingly, the scale of required land acquisition and resettlement would be much smaller than the development of surface transport system.

(1) Land Acquisition, Resettlement and Other Social Issues

Most port construction and improvement work might require some land acquisition and resettlement requirement, though not of large scale, at-least for the land based auxiliary port facilities like ware houses, storage yards for cargo, access roads and others, if not for the direct construction of offshore terminals. The due process well established in Vietnam that has already been followed with ongoing similar works includes public consultation, RAP (resettlement action plan) formulation, implementation and monitoring along with EIA during detailed project planning and design. Even when on small-scale, land acquisition and resettlement is a very difficult and contentious issue that has to be well planned and executed with due process of public consultation with project affected persons (PAPs) and the relevant RAP aspects.

Regarding RAP implementation, resettlement and relocation should be planned and executed very carefully during detailed project planning and design to mitigate adverse effects on the PAPs. In this respect, the minimum requirement should be “no decline in living condition of the PAPs should occur consequent to the involuntary resettlement”.

Apart from the most significant issue of involuntary resettlement other significant social issue related to port development and improvement project includes fishing rights of local communities. This fishing rights and coastal water uses of communities that could be affected by the port construction and operation shall also be addressed along with RAP formulation, as social impact assessment of the project during detailed planning and design of project and amicable mitigation measures agreeable to the affected people has to be carried out.

(2) Effect on Ecosystem

Vietnam has very important coastal ecosystems in particular also near the highly polulated offshore areas of Red River Delta in the north and Me Kong (Cuu Long) River Delta in the south.

Still, port development in these areas is also inevitable due to the high population and the related industrial activities induced demand for goods and services. In particular ecologically important areas where port development has to be given careful consideration include Hai Pong and Halong coastal areas that have the World Heritage site Halong Bay and also protected offshore islands like Cat Ba Island and also the peculiar estuary areas of Red River. Accordingly, the cargo handling facilities provided for those ports in the northeastern coastal areas (in particular for the improvement of the Cai Lan Port located within Halong Bay and the Lach Huyen Port planned as the gateway port near Cat Ba Island in Hai Phong area) should avoid at-least large-scale oil and other noxious liquid cargo like liquid chemical terminals. These cargoes in case of accidental spills could cause catastrophic damage to the coastal waters of Halong Bay due to oil and chemical pollution. These oil and noxious chemicals in bulk carried by oil and chemical tankers basically correspond to pollution mitigation by shipping activities as prescribed in Annexes I and II of MARPOL Convention 73/78 of IMO (International Maritime Organization). Other ecologically important coastal bay areas in which such large-scale oil and liquid chemical handling facilities may be avoided include Va Phong Port area in Va Phong Bay (south-central coast near Nha Trang) and the inland estuarine areas of Me Kong Delta. Considering the availability of long coastline in Vietnam it is regarded as totally possible to locate those specific port terminals for the handling of dangerous and noxious liquid cargo in areas with no sensitive coastal ecosystems and hence to avoid areas proximity to major river deltas of Red River and Me Kong River and other ecologically and recreationally important areas like coral reefs, mangrove forests, tidal wetlands, beaches, protected and ecologically important coastal islands (like Cat Ba).

(3) Effect on Coastal Water Environment

Port infrastructure development and operation and maintenance have potential to cause several adverse effects on coastal seawater environmental quality. In particular both capital dredging and reclamation works and also subsequent maintenance dredging for new port terminals maintenance of access channels and others would affect the water quality at least in short-term due to increased turbidity. Also the dredged material could be contaminated and hence its disposal has to be managed properly so as not to result in marine pollution in particular in areas near sensitive marine ecosystem like coral reefs, protected offshore islands and others. Potential short-term increase in turbidity should be tolerable and could be controlled with proper selection of dredgers to suit the soil material composition and property of the material dredged.

Moreover it is very important that wastes generated by shipping activity like waste oil (bilge waste), ballast waste and also sewage and solid waste shall be managed properly so as not to cause pollution in coastal water and near shore areas in accordance with the relevant annexes of MARPOL Convention of IMO. It is estimated that by the year of 2030, shipping will transport around 3 million ton of goods/day, with modal share of 7.9% total freight in terms of ton-kilometer, increase of about 420% in comparison with that in 2008. Therefore, the pollutants generated for disposal due to shipping activities would also increase very rapidly. So the design and operation of new ports (and also expansion of existing ports) should have built-in waste management system to receive and manage ship-generated wastes. Wastes generated due to shipping activities is estimated to increase up to around 195,000 ton of solid waste in 2030 from about 24,500 ton in 2008 and to about 11,700 ton of oil contaminated wastewater in 2030 from about 1500 ton in 2008. So the importance for the provision of waste reception facilities at port terminals so that ships could legally dispose of their wastes complying MARPOL requirement and also instituting an effective port surveillance mechanism to mitigate illegal disposal of wastes by ships in port and other coastal waters needs no further emphasis.

(4) Effect on Coastline Morphology due to Erosion and Deposition

Design and construction of both new ports and also expansion of existing ports (and also breakwaters) very often involves offshore reclamation works that basically changes the existing coastline morphology of the port seacoast. At time this would cause unintended consequence of coastal erosion or deposition in nearby coastal areas due to the interference of the reclaimed land (and breakwaters) with sea wave and current pattern. In the design of new port terminal involving significant reclamation (and breakwaters) this important issue on potential change in coastal morphology has to be studied and analyzed using simulation of waves and currents so that it could be reasonably confirmed that the expansion of port terminal offshore does not result in undue erosion or deposition in surrounding coastline areas.

(5) Ambient Air Quality, Green House Gas Emission and Noise and Vibration

In general increased future demand for coastal shipping, in overall, will result in increase in both air pollutants and green house gas (CO_2) emissions in comparison ot the existing condition. Still, the rate of such increase is low in comparison to truck based road transport at least with respect to the transportation of domestic cargo since waterway is comparatively more energy efficient mode of transportation than roads. As long as diesel oil is used as fuel for ships, which is the only viable energy source at present and also in the near future with no other viable alternative clean energy source is foreseen, local air pollution (and also green house gas emission) would be prevalent though its effect is not expected to be that significant since ports are located in coastal areas with high exchange of air between land and sea. With the tightening on the quality of fuel oil that could be used to power ships internationally consequent to Annex VI of MARPOL Convention the mitigation of air pollutant emission due to shipping is tackled at the source (fuel) in practical sense. Some local air pollutant emission due to construction material transport and activities of construction vehicles and machinery is inevitable and is a short-term temporary effect. This shall be managed in construction planning and execution in the form of EHS (environment, health and safety) management of construction works.

In general noise nuisance in ship berthing and movement in port waters is regarded as not that significant considering also the favourable location of ports facing vast open coastal water environment interspaced with noise due sea wave movement as well. Some temporary noise and vibration effects due to construction activities are inevitable that shall be managed with due construction planning and execution in the form of EHS (environment, health and safety) management of construction works as also mentioned above.

(6) Effect of Climate Change and Rise in Sea Level

As also noted in the similar Item 6 under road and all other previous sub-sectors (and also in above NSHSR Sector), according to the Marine Resources and Environment Investigation and Management Department of MONRE (Ministry of Natural Resources and Environment), in Vietnam, seawater level due to global warming is predicted to increase in the range of 15 to 90 cm by 2070. In such scenario, the affected areas would include Ca Mau, Kien Giang, Ba Ria–Vung Tau, Thanh Hoa, Nam Dinh, and Thai Binh. Moreover, in the event of worst-case scenario with rise in seawater up to 1 m, 23% of population will lose their land for living.

Since ports are sea facing coastal infrastructures effect due to potential future rise in sea level could obviously be serious and long-term. However, ports should be functional as well under existing sea level condition to facilitate effective cargo handling. Still, with future potential sea level rise in mind the design criteria of port terminals shall be set at as high as possible above the existing sea level to facilitate their sustainable long-term use to the extent possible. Also design could consider the extent possible to facilitate future rise in terminal levels. However, it is

impractical to design only ports to cope with extreme rise in sea level since such rise would inundate a vast area well beyond the port. Accordingly, future mitigation measures for extreme rise in sea level should be planned and executed in comprehensive manner like sea walls, embankments and others with port being one of such important structural element to be protected by any planned sea defense structures like sea wall.

(7) Safety in Shipping and Port Operation

Safety in ship berthing and overall port operation is very important also considering the offshore nature of the port facility. Effective control of ship movement to mitigate ship-based accidents is the most significant safety issue for the port operational authority (harbor master). Moreover, accidental oil spills and noxious chemicals (relevant to bulk liquid oil and chemical handling terminals, in particular) is very significant risk of ship movement. This accidental risk could not be entirely avoided due to uncontrollable factor like extreme weather as evident from oil spills occur due to vessel grounding and other accidents in Vietnam and around the world that at times result in very serious adverse coastal ecological damage. In order to cope with such vessel accidents the ports should have the necessary facilities to deal with such emergency situation to the extent possible according to the type of cargo handled at the port. Typical emergency facilities for dealing with oil spills include booms to contain oil spills and oil absorbent materials to quickly remove the oil to the extent possible. An emergency response system to deal with not only typical accidental oil spills but also life saving of affected vessel personnel should be an integral part of the port operational emergency management system in addition to enhancement of safety in vessel movement in the port.

(8) Historical and Cultural Aspects

There is a possibility for culturally important relics buried in offshore areas targeted for port construction (in particular for capital dredging works) since maritime trade and vessel movement had occurred since ancient times along the coast of Vietnam. Accordingly, dredging works need to be conducted with due protocol and care depending on the historical significance of the port offshore area targeted for dredging works so as not to damage any potential buried treasure consequent to dredging works. Moreover, all historically and culturally important relics on-land of the coastal area targeted for port construction shall be duly secured and preserved as the precondition for locating the port. The very location of the port has to be changed elsewhere if such a condition on preservation of on-land cultural and historical treasures could not be met considering the long coastline of more than 2500 km available in Vietnam (along the mainland itself without considering the coastline of small islands). In fact, there is known land based historically and culturally important assets exist in those new port development and expansion (of existing ports) areas targeted up to the year of 2030.

6) Inland Waterway Transport (IWT) Sub-Sector

There are three significant IWT areas in Vietnam with navigable inland river systems. They are the located in the north, central and southern regions of Vietnam. The largest IWT Region is the South having Me Kong (Cuu Long) Delta as the principal area in addition to the Dong Nai–Saigon River System. This is followed with the Red River Delta in the Northern Region. IWT in central region is the smallest consequent to the relative low capacity of the river system. Basically the facility requirement for IWT is quite similar to those for ports and shipping sub-sector, but on a much smaller scale due to the limited capacity and navigation depth of inland rivers in comparison to ocean facing coastal waters. Moreover, passenger transport in boats is very significant for IWT in addition to cargo transport (both of small-scale). Due to the overall small-scale of the facility requirement like mostly piers as port terminal for IWT the

potential adverse environmental and social effects consequent to IWT sub-sector in overall is also rather small-scale in comparison to ports and shipping sub-sector. Still, in particular in Me Kong Delta, there are many ecologically significant areas including mangrove forests and other protected areas that would require careful consideration in planning IWT ports and other facility improvement works. On the other hand IWT is very energy efficient for both domestic passenger and cargo transportation in comparison to roads and hence more environmentally friendly transport mode. Accordingly, it should be promoted and utilized to the optimum possible extent in consideration to the low relative capital investment cost for the IWT facilities as well. Moreover, for some inner Me Kong Delta communities living in areas crisscrossed with large branches of rivers forming small islands, it is the only available practical mode of transport for both people and cargo (goods) as could be evident from the floating markets in the heart of Me Kong Delta.

The significant environmental and social issues to be taken into due consideration and the relevant mitigation measures are described below on an itemized basis with due consideration to the fact that the facility requirement of IWT sub-sector is quite similar (but of smaller scale) to Port and Shipping Sub-sector. In particular potential social averse effects in overall are much less severe than that of Ports and Shipping Sub-sector since the development is in much small clusters than for ocean based ports and hence scale of required land acquisition and resettlement would also be much smaller.

(1) Land Acquisition, Resettlement and Other Social Issues

Most IWT construction and improvement work might require some land acquisition if not resettlement requirement, though not of large scale, at-least for the land based auxiliary port terminal facilities like passenger sheds, ware houses, storage yards for cargo, access roads and others, if not for the direct construction of riverbank based piers and port terminals. The due process well established in Vietnam that has already been followed with ongoing similar works includes public consultation as the minimum requirement, which shall be duly followed. Moreover, since the terminals are of small-scale located along riverbanks and hence the location is rather flexible every effort shall be made to select suitable location to entirely eliminate any requirement for resettlement of houses and other built-up properties. At times some small-scale resettlement requirement might be inevitable. Even when on small-scale, land acquisition and resettlement is a very difficult and contentious issue that has to be well planned and executed with due process of public consultation with project affected persons (PAPs) even though detailed RAP planning is not required. Regarding any resettlement the minimum requirement should be “no decline in living condition of the PAPs should occur consequent to the involuntary resettlement”.

Apart from the issue of some land acquisition other temporary adverse effects at-least during the construction of IWT port terminals might occur. They might include interference with fishing rights and other riverbank use rights like small-scale trade by local communities. These fishing rights and other river and riverbank uses of communities that could be affected by the IWT works shall also be addressed as social impact assessment of the project during detailed planning and design of project and amicable mitigation measures agreeable to the affected people has to be carried out.

(2) Effect on Ecosystem

Me Kong (Cuu Long) Delta in the south has many ecologically important national parks and protected areas (wetland reservation areas) as given in Table 4.1.4 of below. Accordingly, the provision of IWT port facilities as well any deepening of access channel works have to be planned so as not to adversely affect these ecologically important nature reserve and protected

areas. Considering the small-scale of facility requirement and also flexibility in locating the port terminal facility it is regarded as entirely feasible to plan the IWT facility provision and improvement works in the Me Kong Delta so as not cause any significant adverse effects on these areas. In particular no port or pier terminal facility shall be provided within the interior part of these national parks and wetland reservation areas and they shall be located at least along the border areas so as not to fragment their ecological (functional) value as the minimum requirement.

Table 4.1.4 National Parks and Wetland Reservation Area in Mekong Delta

Mui Ca Mau National Park	
Province : Ca Mau Area : 41,862 ha	Wetland located in Camau Cape. Typical characteristic wetland in South coastal area with high biodiversity and social, cultural and historical significance for Southernmost end of Vietnam.
Tram Chim National Park	
Province : Dong Thap Area : 7,588 ha	The national park protects the flooded indigo forest of Sub Mekong river, which is typically a lowland reeds area. The park serves as protected habitat for red head crane, a rare and valuable bird
U Minh Thuong National Park	
Province: Kien Giang Area : 8,038 ha	The national park protects indigo forest and alum wetland area located in peat soil. The park serves as protected habitat for several numbers of rare and valuable animals and also has the U Minh historical monument.
Thanh Phu Natural Conservation Area	
Province: Ben Tre Area: 4,510 ha	The area conserves and protects mangrove forest and estuary of high ecological value.
Kien Luong Conservation Area	
Province: Kien Giang Area: 14,605 ha	The area conserves and protects indigo forest, grass-plot and seasonal wetland area and also habitat for rare and valuable fauna, specially red head crane.
Lung Ngoc Hoang Natural Conservation Area	
Province: Hau Giang Area : 6,000 ha	The area protects indigo forest ecosystem and wetland area in West of Hau river.
Bac Lieu Bird Park	
Province: Bac Lieu Area: 127 ha	The park protects wetland area and habitat for several kind of rare bird species
Vo Doi National Conservation Area	
Province: Ca Mau Area: 3.394 ha	The area conserves and protects primeval alum indigo forest in the peat soil, and habitat for rare bird species.

Sources: Vietnam Wetland Status Report, 2005

The ecologically important wetland areas in the northern Red River Delta mostly concentrate in the big estuaries such as Bach Dang, Thai Binh, Van Uc and Xuan Thuy. Accordingly, they could be protected rather easily due to the provision of IWT facilities in comparison to the vast protected and ecologically important areas in the Me Kong Delta.

(3) Effect on River Water Environment

IWT infrastructure development and operation and maintenance, though of small-scale in comparison to coastal ports, still have potential to cause significant adverse effects on river water environmental quality, since river is basically a freshwater system (saline in estuarine areas) also of small scale. In particular both capital dredging and reclamation works and also subsequent maintenance dredging for new IWT port terminals and maintenance of access channels and others would affect the water quality at least in short-term due to increased turbidity and also due to very important peculiar soil properties underwater, in particular, in the Me Kong Delta. Typically acidic and alum soil underwater in Me Kong Delta is highly prevalent. Removal of such underwater soil due to dredging and exposing them to ambient environment would results in acidification that has potential to affect the river water quality in its vicinity. Effective control measures to deal with this isse have to taken in detailed planning of dredging works in such areas with peculiar acidic and alum soils underwater. Still, potential short-term increase in turbidity should be tolerable and could be controlled with proper selection of dredgers to suit the soil material composition and property of the material dredged.

Moreover it is very important that wastes generated by boats, vessels and shipping activity like waste oil (bilge waste) and solid waste shall be managed properly so as not to cause pollution in river water and ecologically important wetland and estuarine areas. IWT terminals shall provide the necessary facilities to receive waste oils and solid wastes (garbage) as the minimum requirement to mitigate water environmental pollution. Also campaign on the importance of proper disposal of waste oils and garbage targeting the boat and other vessel operators are necessary since many small boat operators and also passengers might lack the awareness on the importance of water environmental conservation.

(4) Effect on Riverbanks due to Erosion and Deposition

Increased IWT transport with improved facilities both with respect to increased frequency and increased capacity of vessels have the potential to cause undue erosion and deposition in riverbanks (and also potential landslide in river banks), especially in unstable river terrains. This issue has to be carefully studied when planning the IWT improvement works (with due geological investigations to determine soil properties) and the necessary structural mitigation measures as appropriate like revetment should be provided to protect vulnerable riverbank areas. Since the facilities provided are not of large scale in IWT, it is possible to mitigate such effects both with proper selection of location of port terminal facilities along with the provision of required structural mitigation measures like revetments.

(5) Ambient Air Quality, Green House Gas Emission and Noise and Vibration

In general increased future demand for IWT service, in overall, will result in increase in both air pollutants and green house gas (CO_2) emissions in comparison of the existing condition. Still, the rate of such increase is low in comparison to road transport since waterway is comparatively more energy efficient mode of transportation than roads. As long as diesel oil is used as fuel for boats and vessels, which is the only viable energy source at present and also in the near future with no other viable alternative clean energy source is foreseen, local air pollution (and also green house gas emission) would be prevalent though its effect is not expected to be that significant in consideration to the large open space provided by the river environment with exchange of air between land and open ambient river areas. Tightening on the quality of fuel oil that could be used to power boats and vessels is recommend for consideration as the effective mitigation measure against emission of air pollutant at source similar to the Annex VI of MARPOL Convention on mitigation of air pollution by shipping as also noted under similar item 5 on Port and Shipping Sub-sector. Some local air pollutant emission due to construction material transport and activates of construction vehicles and machinery is inevitable and is a short-term temporary effect. This shall be managed in construction planning and execution in the form of EHS (environment, health and safety) management of construction works.

In general noise nuisance in vessel berthing and movement in IWT terminals is regarded as not that significant considering also the favourable location of IWT terminals facing open river water environment interspaced with noise due river flow itself. Some temporary noise and vibration effects due to construction activities is inevitable that shall be managed with due construction planning and execution in the form of EHS (environment, health and safety) management of construction works as also mentioned above.

(6) Effect of Climate Change and Rise in Sea Level

As also noted in the similar Item 6 under all other previous sub-sectors (and also in the above Port and Shipping Sub-sector) according to the Marine Resources and Environment Investigation and Management Department of MONRE (Ministry of Natural Resources and Environment), in Vietnam, seawater level due to global warming is predicted to increase in the

range of 15 to 90 cm by 2070. In such scenario, the affected areas would include Ca Mau, Kien Giang, Ba Ria–Vung Tau, Thanh Hoa, Nam Dinh, and Thai Binh. Moreover, in the event of worst-case scenario with rise in seawater up to 1 m, 23% of population will lose their land for living.

IWT service infrastructures are provided in lowland areas including Me Kong Delta area that is highly vulnerable to the effect in potential sea level rise. Accordingly, effect due to potential future rise in sea level could obviously cause serious and long-term adverse effects on existing and planned IWT infrastructures; many even has the potential to be completely submerged. However, IWT terminals and ports should be functional as well under existing river stage (level) condition to facilitate effective and safe passenger boarding and cargo handling. Still, with future potential sea level rise in mind the design criteria of IWT terminals shall be set at as high as possible above the existing high water stage of rivers to ensure their sustainable long-term use to the extent possible. Also design could consider to the extent possible to facilitate future rise in IWT terminal levels. However, it is impractical to design only IWT terminals and ports to cope with extreme rise in sea level since such rise would inundate a vast area well beyond the IWT service area. Accordingly, future mitigation measures for extreme rise in sea level (rise in subsequent river stage) should be planned and executed in comprehensive manner like river embankments and others with IWT terminals and port being one of such important structural element to be protected to the extent practical. Moreover, considering the future possibility of abandonment of IWT Terminals and ports due to rise in river stage induced submergence (consequent to rise in sea level) the ITW infrastructure development should adopt least capital investment cost (to be economical).

(7) Safety in IWT Operation

Safety in IWT boats, vessels operation and berthing is very important also considering the flowing water nature of the inland rivers. Effective control of boat and vessel movement to mitigate ship-based accidents is the most significant safety issue for the IWT terminals and port operational authority in case of significantly large IWT terminals and ports. Moreover, considering the small-scale nature of IWT service it is economically not feasible to monitor vessel movements in rivers for their safety in a complete sense. So proper safety education and training of vessel operators with strict vessel operational silencing system is most important to mitigate potential vessel related accidents in inland waterways. In order to cope with such vessel accidents at least the relatively large IWT terminals and ports should have the necessary facilities to deal with emergency situation to the extent possible according to the type of cargo handled at the port. Typical emergency facilities for dealing with oil spills include booms to contain oil spills and oil absorbent materials to quickly remove the oil to the extent possible. An emergency response system to deal with not only typical accidental oil spills but also life saving of affected vessel personnel should be an integral part of the port operational emergency management system in addition to enhancement of safety in vessel movement in the IWT terminals and ports.

(8) Historical and Cultural Aspects

There is some possibility for culturally important relics buried underwater areas targeted for for capital dredging works considering the long history of IWT operation in the relevant areas like Me Kong Delta and Red River Delta. Accordingly, dredging works need to be conducted with due protocol and care depending on the historical significance of the river water area targeted for dredging works so as not to damage any potential buried treasures consequent to dredging works. Moreover, considering the flexibility in selecting the location of IWT terminals and also the relatively small-scale nature of IWT infrastructures it is regarded as totally possible to locate

those IWT terminals and ports in riverbank areas having no on land historically and culturally important treasures.

7) Civil Aviation Sub-Sector

The development strategy for civil aviation sub-sector until the year 2030 basically oriented toward capacity expansion and air navigational system (and safety) improvement of existing airports. The only new airport planned (at entirely new location) that would replace the existing airport located at the city centre of Ho Chi Minh City/HCMC (Tan Son Nhat International Airport) is the new Long Thanh International Airport located in Long Thanh in Dong Nai Province, basically a less developed rural area. Accordingly, in overall the strategy for development of civil aviation sub-sector is also oriented toward environmental impact mitigation due to noise, vibration and air pollution in the city centre of HCMC with the construction a new airport away from the city centre in Long Thanh as the most significant major project component. The required land acquisition for all airport expansion works including the new Long Thanh International Airport has already been accomplished. Accordingly, no significant social issues are anticipated at-least concerned most contentious social issues of land acquisition and resettlement.

The significant environmental and social issues to be taken into due consideration and the relevant mitigation measures are described below on an itemized basis with due consideration to the fact that civil aviation is basically air based long-distance oriented fast transport system (also most significant fast international link among major cities around the world) with airports as the only major land based infrastructure requirement. Accordingly, some items of environmental issues are modified to suit this principally air based transport system against land and water based transport systems of the above 6 sub-sectors (basically roads, railways, oceans and IWT ships and vessels).

(1) Social Issues of Airports

As noted above, there is no land acquisition and resettlement requirement for civil aviation sub-sector development and expansion plans, at-least for the provision of runways and other expanded airport physical infrastructure. Still, in the detailed planning the required buffer zone for airport developments might warrant some further land acquisition and resettlement requirements. Such buffer zone requirement might be necessary as mitigation against aircraft noise and vibration nuisance. In such cases the required due process of public consultation and resettlement implementation should be planned and executed very carefully during detailed project planning and design to mitigate adverse effects on the PAPs (project affected persons). In this respect, the minimum requirement should be “no decline in living condition of the PAPs should occur consequent to the any involuntary resettlement”.

Aircraft (landing and takeoff induced) noise and vibration at airports could be another major significant social issue that shall be mitigated with the provision of required buffer zone that in turn might require some additional land acquisition and resettlement requirement as noted above.

(2) Effect on Ecosystem

No significant adverse effects on ecologically important areas is anticipated since both the existing and the newly planned location for the Long Thanh International Airport have already been selected to be away from such ecologically important areas. Such planning policies need to be continuously adopted for any new airport development plans in future as well.

(3) Ambient Air Quality, Green House Gas Emission and Noise and Vibration

In general increased future demand for both domestic and international air travel, in overall, will result in increase in both air pollutants and green house gas (CO_2) emissions in comparison to the existing condition as long as petroleum based jet fuel is used to power aircrafts. Since jet fuel is the only available energy source at present and also in the near future with no other viable alternative clean energy source is foreseen, local air pollution (and also green house gas emission both locally and internationally) would be prevalent though effect due to air pollutant emission is not expected to be that significant since airports require large open area for runways and also safety buffer zone to facilitate safe landing and takeoffs as basic technical requirement, which in turn would facilitate effective dispersion of air pollutants. Some local air pollutant emission due to construction material transport and activities of construction vehicles and machinery is inevitable and is a short-term temporary effect. This shall be managed in construction planning and execution in the form of EHS (environment, health and safety) management of construction works.

Still, noise and vibration nuisance principally due to landing and takeoff of aircrafts would be very significant and could only be mitigated with the provision of adequate buffer zone around the airport as green area (effective tree plantation in green area would further mitigate noise and also air pollution effect). This buffer zone requirement at times might exceed the technically required open space for runways and space for safe landing and takeoff. In such case the required buffer zone around airport shall be expanded with due land use control measures that might even require some additional land acquisition and resettlement as noted above under item 1. The maximum allowable noise limit that ranges from 50 to 75 db for mixed areas (mixed commercial and residential areas) as per the Standards of Vietnam (TCVN 5949-1999) could be used as the basis to determine the required buffer zone around airports.

(4) Waste Management at Airports

Airport operation generates various kinds of both liquid and solid wastes both due to passenger and airfreight related services like catering and shops, restaurants and warehouses and also aircraft refueling, maintenance and cleaning requirements. In particular catering and other passenger originated solid waste due to international flight should be regarded as infectious waste and properly managed and disposed. Moreover, the spent chemical and fuel wastes of aircraft refueling and other maintenance works also duly managed and should not be directly disposed into surface drains or normal toilet originated sewerage management system. These waste management measures have to be duly planned and provided as integral component of airport design for all new construction (in this case Long Thanh Airport as the only totally new airport) and expansion works of existing airports in future. In fact other than the Noi Bai Airport in Hanoi all other airports in Vietnam currently have no sewage treatment plants to treat wastewater generated in airport toilets and this human activity related wastewater is disposed into surface drains with no treatment. Improvement in overall waste management has to be given due attention by all airports and should be incorporated in the design of all expansion works planned in existing airports as the basic sanitation and public health requirement.

(5) Effect of Climate Change and Rise in Sea Level

As also noted in the similar Item 6 under road and all other previous sub-sectors of above, according to the Marine Resources and Environment Investigation and Management Department of MONRE (Ministry of Natural Resources and Environment), in Vietnam, seawater level due to global warming is predicted to increase in the range of 15 to 90 cm by 2070. In such scenario, the affected areas would include Ca Mau, Kien Giang, Ba Ria–Vung Tau, Thanh Hoa, Nam Dinh, and Thai Binh. Moreover, in the event of worst-case scenario with rise in seawater up to 1 m, 23% of population will lose their land for living.

In fact effect due to potential rise in sea level has not been given due attention in the past in deciding the location of airport not only in Vietnam but also around the world. In fact this is the case with all transport infrastructure development strategies even in the very recent past around the world not only in Vietnam. So for the time being in order to facilitate effective utilization of existing airport facilities their expansion in the same area as additional terminals and runways is inevitable to serve the increase in travel demand in short-term as the most economically feasible option even when the airport is located near coastal areas and hence vulnerable to flooding due to potential future rise in sea level. However, in future when locating airports at totally new location like the one at Long Thanh (new Long Thanh International Airport) in this case until 2030, potential rise in sea level in future should be taken into due consideration. In this respect minimum ground elevation of at least 2 m above sea level could be set as important criteria in planning airport near coastal areas to ensure they are not vulnerable to flooding due to future rise in sea level. This in effect would imply the provision of future airport in further inland from coastal areas where higher natural ground elevation could be found. Moreover, provision of airports on reclaimed offshore islands either due to lack of on-land area near coastal population centers or to mitigate noise nuisance to residents of such population centers (as in the case of the Kansai International Airport in Japan) should be regarded as not feasible in future as planning mitigation measure against future rise in sea level.

(6) Safety in Airport Operation

Safety in airport operation in particular during aircraft landing and takeoff is very important and needs no further emphasis. In fact this is the prime functional purpose of an airport. An aircraft is most prone to accident while takeoff and landing than during stable flight on air. In this regard the strategy also incorporates navigational safety improvement as important component of the Civil Aviation Development since increase in the frequency of landing and takeoff of aircrafts due to increase in the capacity enhancement in airports also would increase the probability of accidents. Accordingly, aircraft navigational safety has already been integrally incorporated in the development strategy.

Moreover, the necessary emergency management plans and the required facilities to cope with aircraft accident at airports shall also be incorporated, in particular effective fire fighting capability since most aircraft accidents are fire disaster prone, integrally in the airport development design and operation.

(7) Historical and Cultural Aspects

There is no known culturally or historically important relics either in the existing airports slated for expansion or the new one planned in Long Thanh since such areas are effectively avoided in selecting those locations for airports. This should continue to be applied as prime criteria (along with the avoidance of ecologically important nature reserve and other protected areas as noted under item 2 of above) in future as well in selecting locations for new airports.

8) Concluding Remarks and Public Consultation Aspects

Irrespective of the type of transport sub-sector an important factor common to all sub-sectors is the operational safety. This is still a major concern in particular for the road transport sector in Vietnam and need to be continuously improved with education, traning and campaign targeting all actors including general public as well (pedestrians). Moreover, effect due to potential rise in sea level so far has not been seriously taken into consideration in the transport development strategy not only in Vietnam but also in other countries with extensive costal area developments. This has to be taken into consideration to the extent possible in future since Vietnam is one of such countries vulnerable to potential rise in sea level in future consequent to global warming.

Still, in particular for the development of port terminals in coastal areas and inland waterways there is practical limitation is adopting effective mitigation measure to cope with future rise in sea level without affecting the required current functional requirement of coastal ports and IWT terminals. Significant environmental themes to be considered during future environmental impact assessment (EIA) in the development of relevant 7 transport sub-sectors delineated above are summarized in ***Appendix 4B***.

Public consultation with the relevant stakeholders of all transport sub-sector development and concerned public institution like Hanoi University was conducted as important component of this SEA study. The consultation meeting was held at Enery Hotel in Hanoi on 17 July 2009. The contents of public consultation including the list of participants are given in ***Appendix 4C***.

4.2 Environmental Consideration for Master Plan of VITRANSS 2

1) Environmental Classifications

In examining the environmental impacts for all projects for Master Plan of VITRANSS 2, the environmental classification was carried out on environmental zone, populated area, natural protection area, and natural disaster area.

(1) Environmental Zone

The whole country was examined by the characteristics such as climate type (north, central, south), elevation (delta, hilly/mountainous area), and administrative region. As a result of the examination, Vietnam was divided into 5 Environmental Zones (Figure 4.2.1)

(2) Populated Area

The populated area has a potential for the impact by resettlement and pollution such as air/ water pollution and noise/ vibration. It was identified that each project will be located in populated area.

(3) Natural Protection Area

The natural protection area has vulnerability for the impacts to flora/fauna and/or ecology. The most important areas as a natural protection area are protected area and natural forest area (Figure 4.2.2 and Figure 4.2.3).

(4) Natural Disaster-prone Area

Various disasters have been striking frequently in Vietnam. The natural disaster-prone area has vulnerability for the impacts to topography/geology, hydrological situation and/or condition in coastal zone. The most important areas as a natural disaster-prone area are earthquake-prone area, landslide/flood-prone area, and typhoon hits area (Figure 4.2.4 and Figure 4.2.6).

2) Environmental Classifications of the Proposed Projects for Master Plan

VITRANSS 2 Study Team prepared a large number of projects for Master Plan and these projects are divided by environmental classifications. The results of classifications are shown in Table 4.2.1. The projects are roughly classified into 3 environmental impacts groups. Table 4.2.2 shows the relationship between environmental items and project activities.

Figure 4.2.1 Environmental Zone

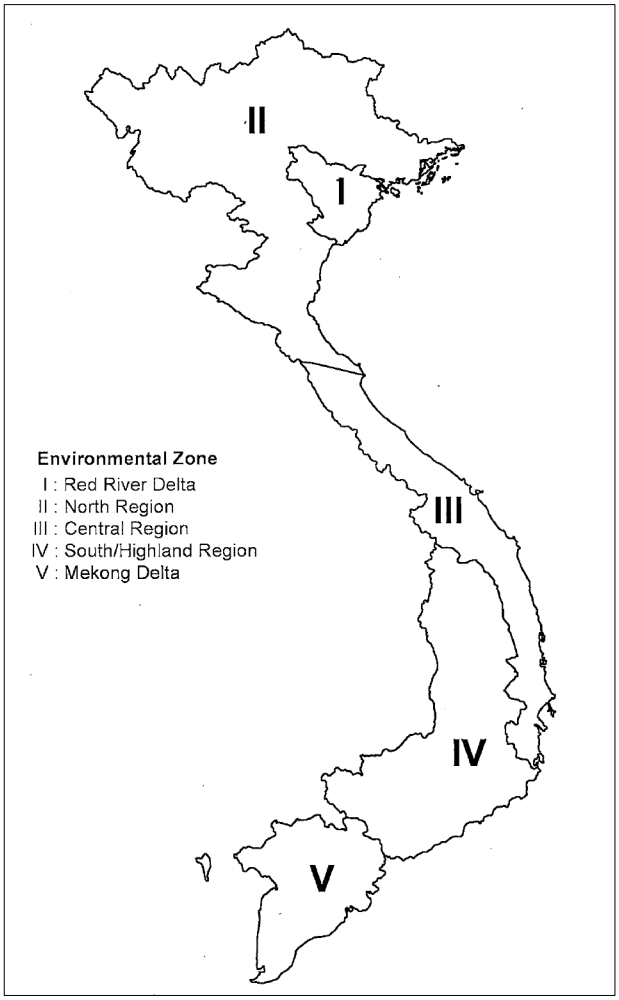


Figure 4.2.2 Protected Areas

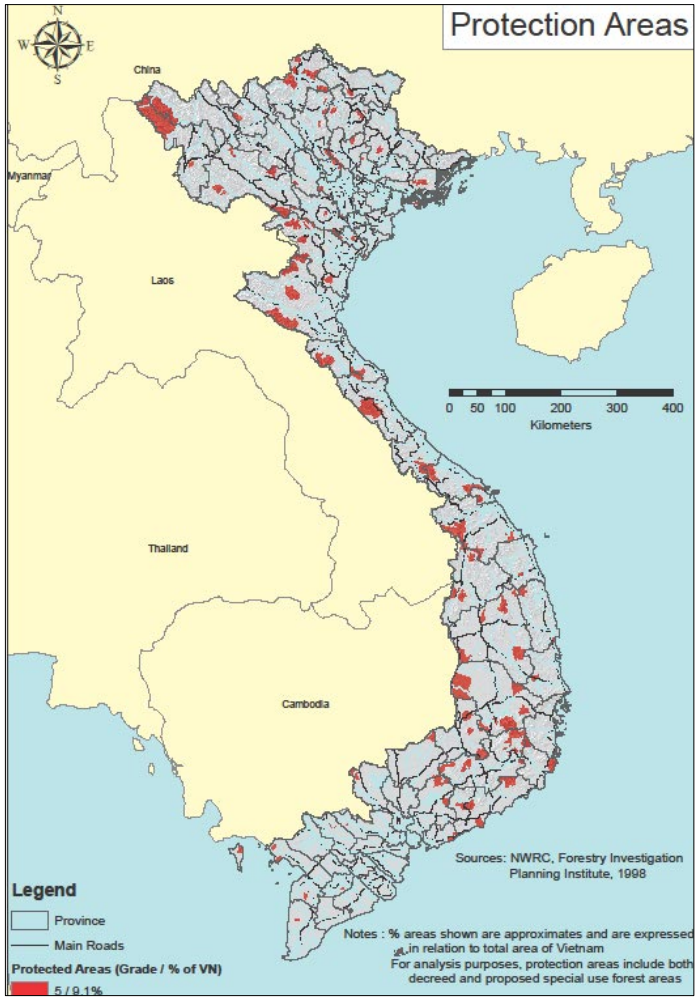


Figure 4.2.3 Land Cover

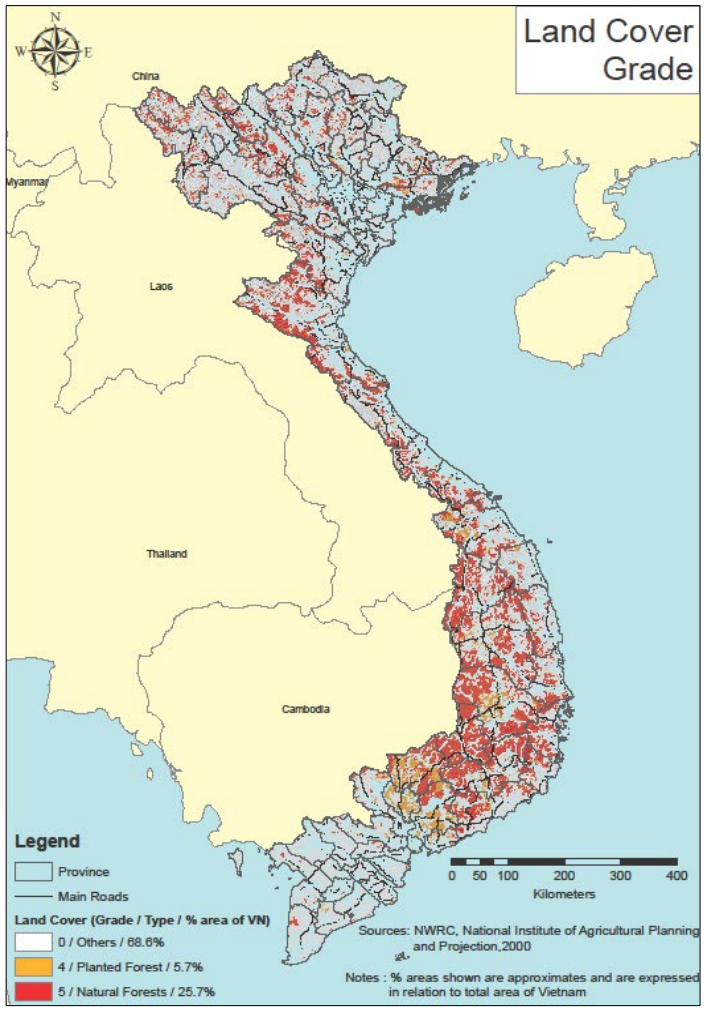


Figure 4.2.4 Earthquake-prone Areas

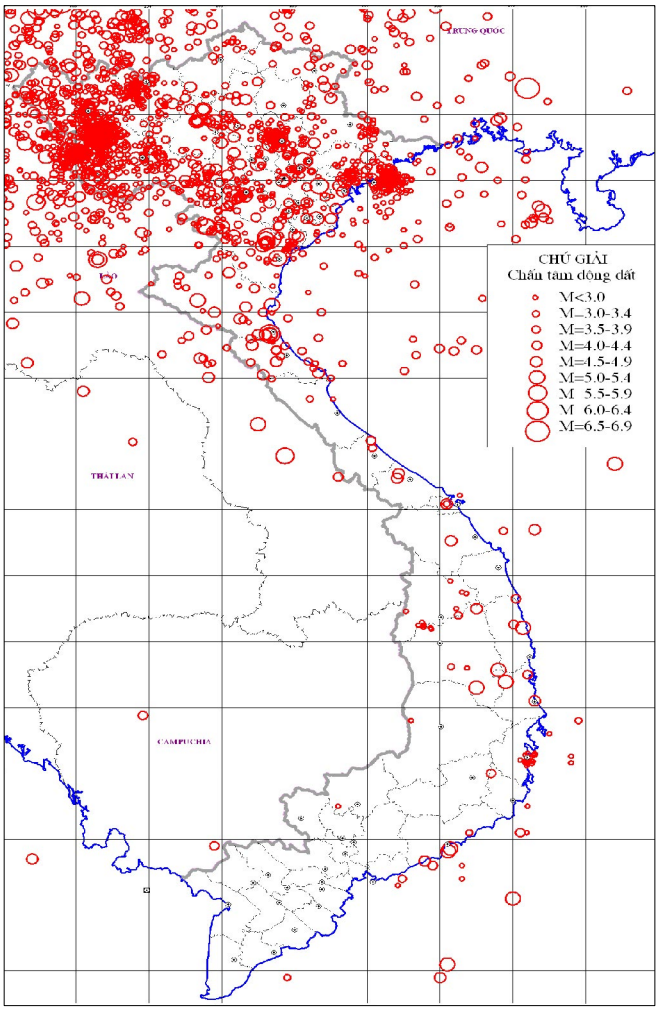


Figure 4.2.5 Landslide and Flood-prone Areas

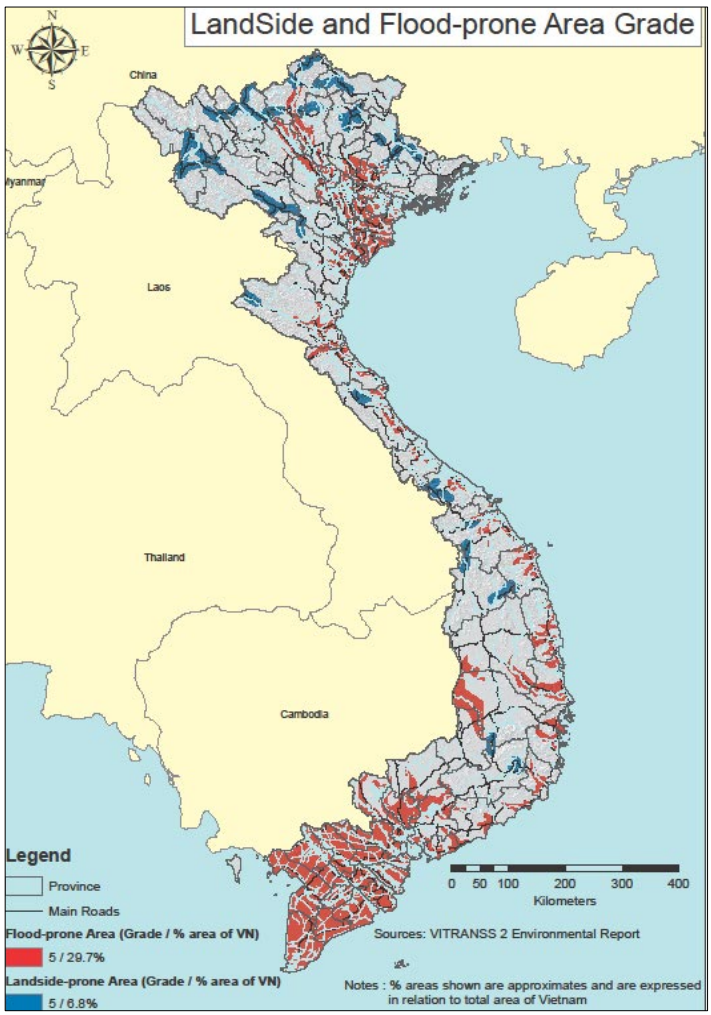


Figure 4.2.6 Typhoon Hits Areas

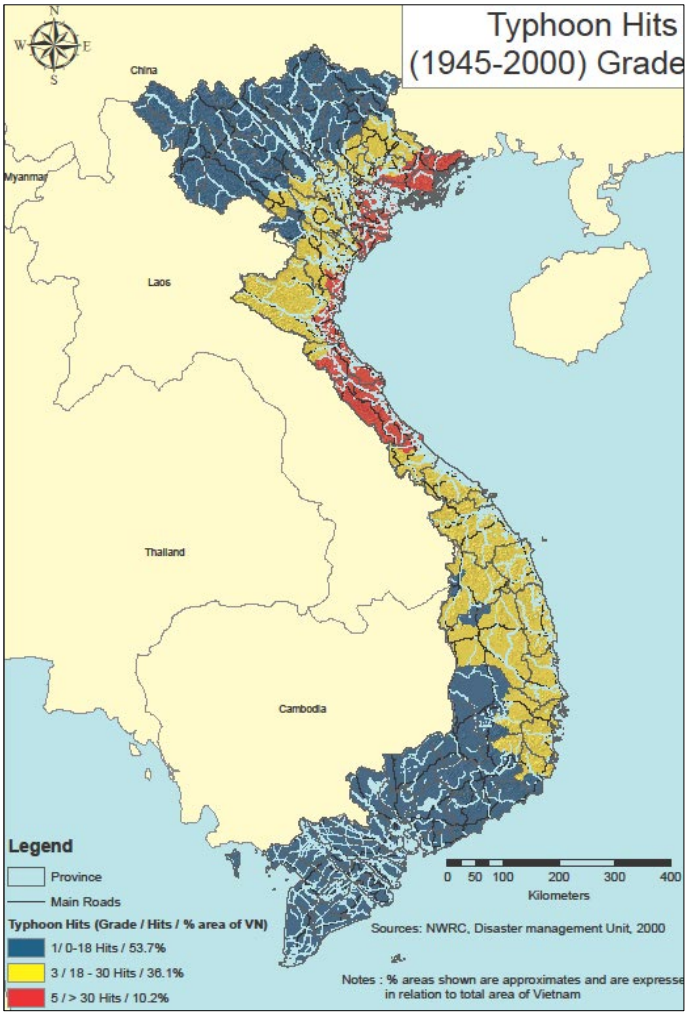


Table 4.2.1 Classification of the Proposed Projects for Master Plan (1)

Project type (*1)		Project No. (*2)	Project title (*3)	The proposed route/ site will be located in/ around the following area.								Environmental impact type
				Environmental Zone (*4)	Populated area (*5)	Natural protection		Natural disaster				
						Protected Area (*6)	Land cover (*7)	Earthquake (*8)	Landslide (*9)	Flood (*10)	Typhoon (*11)	
New construction on land	PT1A	H31	Ring Road No.5 in Ha Noi (320km)	I,II	X	X	X	X		X	X	EIT1-1
	PT1A	H11	Doan Hung – Hoa Lac – Pho Chau Expressway (457km)	I,II	X	X	X	X		X		
	PT1A	H40	NH20 Extension(Da Lat – Nha Trang) (85km)	III,IV	X	X	X		X	X		
	PT1A	CH02	Da Nang – Quang Ngai Expressway (131km)	III	X	X	X			X		
	PT1A	H19	Quy Nhon – Pleiku Expressway (160km)	III,IV	X	X	X			X		
	PT1A	H25	Ha Tien – Rach Gia – Bac Lieu Expressway (225km)	V	X	X	X			X		
	PT2B	CR04	Ha Long- Cai Lan Raiway Line	II	X	X		X			X	
	PT1A	CH07	Lang Son – Bac Giang – Bac Ninh Expressway (130km)	I,II	X		X	X	X	X		
	PT1A	CH09	Ha Noi – Lao Cai Expressway (264km)	I,II	X		X	X	X	X		
	PT1A	H15	Bac Ninh – Ha Long Expressway (136km)	I,II	X		X	X		X	X	
	PT1A	H12	Ngoc Hoi – Chon Thanh – Rach Gia Expressway (864km)	IV,V	X		X			X		
	PT1A	H22	HCMC – Thu Dau Mot – Chon Thanh Expressway (69km)	IV	X		X			X		
	PT1A	H26	Can Tho – Ca Mau Expressway (150km)	V	X		X			X		
	PT2B	CR05	Railway line from Chua Ve to DAP factory-Dinh Vu (Hai Phong)	I	X			X	X	X	X	EIT1-2
	PT2B	CR03	Yen Vien-Pha Lai Railway Line	I,II	X			X	X	X	X	
	PT2B	R08	Hanoi-Lao Cail New Railway Constrcution (SRI &SMI)	I,II	X			X	X	X		
	PT1A	CH01	Cau Gie – Ninh Binh Expressway (50km)	I	X			X		X	X	
	PT1A	CH08	Ha Noi – Hai Phong Expressway (105km)	I	X			X		X	X	
	PT1A	H01	Ninh Binh – Thanh Hoa Expressway (75km)	I,II	X			X		X	X	
	PT1A	H16	Ninh Binh – Hai Phong – Quang Ninh Expressway (160km)	I,II	X			X		X	X	
	PT1A	H30	Ring Road No.4 in Ha Noi (90km)	I	X			X		X	X	
	PT1A	H36	NH21 Construction (Phu Ly – Nam Dinh) (25km)	I	X			X		X	X	
	PT1A	CH31	NH1A Bypass (Ha Tinh) (16.3km)	II	X			X		X	X	
	PT1A	H43	NH47 Construction (Sam Son – Thanh Hoa City) (5km)	II	X			X		X	X	
	PT1B	CH18	Linh Dam Bridge Construction (NH15, Ha Tinh)(2 lane)	I	X			X		X	X	
	PT1B	CH24	Ben Thuy II bridge Construction (NH1&NH8B, Nghe An-Ha Tinh) (2lane, 1km)	II	X			X		X	X	
	PT1A	CH10	Ha Noi – Thai Nguyen Expressway (62km)	I,II	X			X		X		
	PT1A	CH11	Lang – Hoa Lac Expressway (30km)	I	X			X		X		
	PT1A	H33	Economic axle-road Construction (24km)	I	X			X		X		
	PT1A	H34	Do Xa - Quan Son Highway Construction (30km)	I	X			X		X		
	PT1A	H75	NH21B Bypass (Binh Da, Hanoi)(10km)	I	X			X		X		
	PT1A	H76	NH21B Bypass (Kim Bai, Hanoi)(10km)	I	X			X		X		
	PT1A	CH29	NH1A Bypass (Thanh Hoa) (10km)	II	X			X		X		
	PT1A	H13	Thai Nguyen – Cho Moi Expressway (28km)	II	X			X		X		
	PT1B	CH22	Vinh Thinh Bridge Construction (Ha Tay)	I	X			X		X		
	PT2B	R09	Hanoi-Hai Phong New Railway Constrcution (SRI &SMI)	I	X			X		X		
	PT1B	CH21	Dinh Vu Bridge Construction (Hai Phong)	I	X			X				
	PT1A	CH30	NH1A Bypass (Dong Hoi, Quang Binh) (19.3km)	III	X					X	X	
	PT1A	CH36	NH 1 Widening (Dong Ha - Quang Tri)	III	X					X		
	PT1A	CH04	HCMC – Long Thanh – Dau Giay Expressway (55km)	IV	X					X		
	PT1A	H21	Bien Hoa – Vung Tau Expressway (76km)	IV,V	X					X		
	PT1A	H32	Ring Road No.3 in HCMC (83km)	IV,V	X					X		
	PT1A	H147	New RoadConstruction (HCMC - Long Xuyen) (140km)	IV,V	X					X		
	PT1A	CH05	HCMC- Trung Luong Expressway (40km)	V	X					X		
	PT1A	CH06	Trung Luong – My Thuan – Can Tho Expressway (92km)	V	X					X		

Table 4.2.1 Classifications of the Proposed Projects for Master Plan (2)

Project type (*1)	Project No. (*2)	Project title (*3)	The proposed route/ site will be located in/ around the following area.								Environmental impact type
			Environmental Zone (*4)	Populated area (*5)	Natural protection		Natural disaster				
					Protected Area (*6)	Land cover (*7)	Earthquake (*8)	Landslide (*9)	Flood (*10)	Typhoon (*11)	
New construction (Land)	PT1A	H10	Long Thanh – Nhon Trach – Ben Luc Expressway (45km)	V	X				X		EIT1-2
	PT1A	H24	Soc Trang – Can Tho – Chau Doc Expressway (200km)	V	X				X		
	PT1A	H65	NH1A Bypass (Vinh Long) (7.5km)	V	X				X		
	PT1A	H69	NH91 Bypass (An Chau, An Giang)(10km)	V	X				X		
	PT1A	H73	NH60 Bypass (Ham Luong (Ben Tre – Mo Cay))(10km)	V	X				X		
	PT1B	CH25	Dong Nai bridge Construction	IV	X				X		
	PT1B	H37	Vam Cong Bridge Construction (An Giang&Can Tho)	V	X				X		
	PT1B	H38	Cao Lanh Bridge Construction (Dong Thap)	V	X				X		
	PT2B	R07	Trang Bone – Vung Tau New Railway Construction (SRI & SMI) (71.3km)	IV	X				X		
	PT1B	CH13	Can Tho Bridge Construction	V	X				X		
	PT2B	R10	HCMC – Loc Ninh New Railway Line Construction	IV	X				X		
	PT2B	R11	HCMC – Can Tho New Railway Line Construction (146km)	IV,V	X				X		
	PT1A	CH15	Border Ring No2 Construction (Northern Part)	II		X	X	X	X		EIT1-3
	PT1A	CH14	Border Ring No1 Construction (Hai Giang - Lao Cai) (151km)	II		X	X	X	X		
	PT1A	H04	Ha Tinh – Quang Tri Expressway (277km)	II,III		X	X	X		X	X
	PT1A	H143	New Road Construction(Ky Anh - Tan Son) (45km)	II,III		X	X	X			X
	PT1A	H28	Nha Trang – Da Lat Expressway (80km)	III,IV		X	X		X	X	
	PT1A	H29	Da Nang – Ngoc Hoi Expressway (250km)	III,IV		X	X		X	X	
	PT1A	H20	Dau Giay – Da Lat Expressway (189km)	IV		X	X		X	X	
	PT1A	H06	Hue – Da Nang Expressway (105km)	III		X	X			X	
	PT1A	H35	NH1A (Chi Lang - Bac Giang) Construction (Pho Gio)) (40km)	II		X		X	X	X	
	PT1A	CH34	NH 25 Upgrading (Le Bac Bridge - To No pass) (11.5km)	III		X				X	
	PT1A	CH16	Border Ring No2 Construction (Northwest Part, Pho Rang - Minh Thang) (160km)	II			X	X	X		
	PT1A	H02	Thanh Hoa – Vinh Expressway (140km)	II			X	X		X	X
	PT1A	H17	Hong Linh – Huong Son Expressway (34km)	II			X	X		X	X
	PT1A	H14	Hoa Lac – Hoa Binh Expressway (26km)	II			X	X		X	
	PT1A	CH12	Ha Long – Mong Cai Expressway (128km)	II			X	X			X
	PT1B	H42	Van Tien Bridge Construction (Quang Ninh)(1341m)	II			X	X			X
	PT1A	H05	Quang Tri – Hue Expressway (73km)	III			X			X	
	PT1A	H07	Quang Ngai – Quy Nhon Expressway (150km)	III			X			X	
	PT1A	H08	Quy Nhon – Nha Trang Expressway (240km)	III			X			X	
	PT1A	H18	Cam Lo – Lao Bao Expressway (70km)	III			X			X	
	PT1A	H27	Quang Ngai – Dak To Expressway (170km)	III,IV			X			X	
	PT1A	CH03	Phan Thiet – Dau Giay Expressway (100km)	IV			X			X	
	PT1A	H09	Nha Trang – Phan Thiet Expressway (280km)	IV			X			X	
	PT1A	H61	NH1A Bypass (Cam Ranh, Khanh Hoa) (10km)	III			X			X	
	PT1A	H03	Vinh – Ha Tinh Expressway (20km)	II				X		X	X
	PT1A	H39	New Coastal Road Construction (100km)	II				X		X	X
	PT1A	H74	NH38 Bypass (Hoa Mac, An Giang)(10km)	I				X		X	
	PT1A	H78	NH21B Bypass (Que, Ha Nam)(10km)	I				X		X	
	PT1A	CH17	Border Ring No3 Construction	II				X		X	
	PT1A	H71	NH10 Bypass (Nga Son, Thanh Hoa)(10km)	II				X		X	EIT1-4
	PT1A	H77	NH21B Bypass (Van Dinh, Ben Tre)(10km)	I				X			
	PT1A	H44	NH14E Extension(Ha Lam along PR 613 – Binh Duong) (21.2km)	III						X	
	PT1A	H58	NH1 Bypass (La Ha, Quang Ngai) (15km)	III						X	
	PT1A	H60	NH1A Bypass (Ninh Hoa, Khanh Hoa) (10km)	III						X	

Table 4.2 Classifications of the Proposed Projects for Master Plan (3)

Project type (*1)		Project No. (*2)	Project title (*3)	The proposed route/ site will be located in/ around the following area.								Environmental impact type
				Environmental Zone (*4)	Populated area (*5)	Natural protection		Natural disaster				
						Protected Area (*6)	Land cover (*7)	Earthquake (*8)	Landslide (*9)	Flood (*10)	Typhoon (*11)	
New construction (Land)	PT1A	H64	NH1A Bypass (Duc Pho, Quang Ngai) (9.7km)	III						X		EIT1-4
	PT1A	H23	HCMC – Moc Bai Expressway (55km)	IV,V						X		
	PT1A	#N/A	#N/A	IV						X		
	PT1A	H62	NH1A Bypass (Cho Lau, Binh Thuan) (10km)	IV						X		
	PT1A	H63	NH1A Bypass (Phan Thiet, Binh Thuan) (10km)	IV						X		
	PT1A	CH35	Mekong Delta River Infrastructure Development (NH53,N54,NH91 & PHs; WB5)	V						X		
	PT1A	H68	NH91 Bypass (Thot Not, Can Tho)(10km)	V						X		
	PT1A	H70	NH91 Bypass (Cai Dau, An Giang)(10km)	V						X		
	PT1A	H72	NH60 Bypass (Mo Cay, Ben Tre)(10km)	V						X		
	PT1A	H146	New RoadConstruction (Ngan Dua - Vi Thanh) (25km)	V						X		
	PT1B	CH19	Ong Bo Bridge Construction (NH1A, Quang Nam)(2 lane,108m)	III						X		
	PT1B	CH20	Huong Anh bridge Construction (NH1A, Quang Nam)(4lane, 250m)	III						X		
	PT1B	CH23	45 Rural Traffic Bridges in Central and Central Highland Provinces	III,IV						X		
	PT5A	A01	Long Thanh Airport	IV						X		
	PT1A	H59	NH1A Bypass (Van Gia, Khanh Hoa) (10km)	III						X		
	PT1A	CH32	NH1A Bypass (Phan Rang, Ninh Thuan) (8.3km)	IV						X		
	PT1A	H66	NH14 Bypass (Ea Drang, Dak Lak)(10km)	IV						X		
	PT1A	H67	NH14 Bypass (Buo Ho, Dak Lak)(10km)	IV						X		
	PT1B	H41	Hau River Bridge Construction (NH60, Soc Trang) (4lane)	V						X		
	PT5A	CA01	Phu Quoc Island Airport	V						X		
Improvement (Land)	PT2A	R01	Function-Improvement Items (Hanoi-Saigon Line)	I,II,III,IV	X	X	X	X	X	X	X	EIT2-1
	PT2A	R04	System Reinforcement Items (Hanoi-Saigon Line)	I,II,III,IV	X	X	X	X	X	X	X	
	PT2A	R06	System Modernization Items (Hanoi-Saigon Line)	I,II,III,IV	X	X	X	X	X	X	X	
	PT1C	CH45	NH 2 Improvement (Hanoi - Ha Giang) (261km)	I,II	X	X	X	X	X	X		
	PT1C	CH72	Storm No.5 Recovery Projects on NH6 (Hoa Binh – Son La)	II	X	X	X	X	X			
	PT1C	H117	NH2B Rehabilitation (Vinh Yen - Tam Dao) (25km)	I	X	X	X	X		X		
	PT2A	CR01	Improvement & Upgrading in North-South Railway Line	I,II,III,IV	X	X	X	X		X		
	PT2A	CR02	Improvement in Railway Routes in the North	I,II	X	X	X	X				
	PT1C	H104	NH14B Improvement (Da Nang - Thanh My) (78km)	III	X	X	X		X	X		
	PT2A	R03	Function-Improvement Items (Hanoi-Dong Dang Line)	I,II	X	X		X	X	X		
	PT2A	R05	System Reinforcement Items & System Modernization Items (Hanoi-Dong Dang Line)	I,II	X	X		X	X	X		
	PT1C	H128	NH1D Rehabilitation(Quy Nhon - Song Cau, Binh Dinh & Phu Yen) (33km)	III	X	X				X		
	PT1C	H97	NH3 Improvement (Thai Nguyen - Ta Lung) (274km)	II	X		X	X	X	X		
	PT1C	CH82	NH15 Upgrading (Mai Chau - Hoi Xuan) (109km)	II	X		X	X	X			
	PT1C	H119	NH23 Rehabilitation (NH2 - Phuc Yen) (27km)	I	X		X	X		X		
	PT1C	CH33	NH2 Bypass (Vinh Yen (Vinh Yen – Vinh Phuc)) (10.6km)	I, II	X		X	X		X		
	PT1C	H122	NH49 Rehabilitation(Cang Thuan An - HCM Road) (75km)	III	X		X		X	X	X	
	PT1C	H95	NH19 Upgrading(Quy Nhon - NH14) (169km)	III,IV	X		X			X		
	PT2A	R02	Function-Improvement Items (Hanoi-Lao Cai Line)	I,II	X			X	X	X		EIT2-2
	PT1C	H85	NH5 Upgrading (106km)	I	X			X		X	X	
	PT1C	H87	NH21 Upgrading (Nam Dinh - Thinh Long) (61km)	I	X			X		X	X	
	PT1C	H96	NH10 Improvement (Lai Thanh - Tao Xuyen) (50km)	I	X			X		X	X	
	PT5B	A05	Cat Bi Airport Upgrading	I	X			X		X	X	
	PT1C	CH39	NH2 Upgrading (Noi Bai - Vinh Yen) (22km)	I	X			X		X		
	PT1C	CH60	Thang Long Bridge Surface Repair	I	X			X		X		
	PT1C	CH70	NH 32 Upgrading (Dien – Nhon) (7km)	I	X			X		X		

Table 4.2.1 Classifications of the Proposed Projects for Master Plan (4)

Project type (*1)	Project No. (*2)	Project title (*3)	The proposed route/ site will be located in/ around the following area.								Environmental impact type
			Environmental Zone (*4)	Populated area (*5)	Natural protection		Natural disaster				
					Protected Area (*6)	Land cover (*7)	Earthquake (*8)	Landslide (*9)	Flood (*10)	Typhoon (*11)	
Improvement (Land)	PT1C	H90	NH 6 Widening (Ba La - Xuan Mai) (20km)	I	X			X		X		EIT2-2
	PT1C	H115	NH32 Widening (Hanoi - Son Tay) (32km)	I	X			X		X		
	PT1C	CH42	NH 21B & NH21 Upgrading (Hanoi) (76km)	I,II	X			X		X		
	PT1C	H121	NH45 Rehabilitation(Pho Ria - Thanh Hoa - Yen Cat) (136km)	I,II	X			X		X		
	PT1C	H99	NH37 Improvement (Sao Do - Co Noi) (533km)	II	X			X		X		
	PT1C	H120	NH47 Rehabilitation(NH1 - NH15) (61km)	II	X			X		X		
	PT5B	CA03	T2 Terminal Construction at Noi Bai International Airport	I	X			X		X		
	PT5B	CA04	Cargo Terminal Expansion at Noi Bai International Airport	I	X			X		X		
	PT5B	CA09	Control Tower Construction at Noi Bai International Airport	I	X			X		X		
	PT5B	A02	T1&T2 Terminal Expansion at Noi Bai International Airport	I	X			X		X		
	PT5B	A03	T3 Terminal Construction at Noi Bai International Airport	I	X			X		X		
	PT5B	A04	Runway Construction at Noi Bai International Airport	I	X			X		X		
	PT1C	H125	NH49B Rehabilitation (Cau My Chanh - Vinh Hien, Thu Thien Hue) (89km)	III	X					X	X	
	PT1C	H129	NH1C Rehabilitation (Dien Khanh - Nha Trang) (17km)	III	X					X		
	PT1C	H82	NH 51 Widening(Dong Nai - Vung Tau)(73.6km)	IV	X					X		
	PT1C	H88	NH22 Upgrading (HCMC - Moc Bai) (82km)	IV	X					X		
	PT1C	H89	NH80 Upgrading (Cau My Thuan - Xa Xia) (213km)	V	X					X		
	PT1C	H107	NH30 Improvement (An Huu - Dinh Ba Border) (121km)	V	X					X		
	PT1C	H108	NH61 Improvement(Tan Phu - Vinh Loi) (96km)	V	X					X		
	PT1C	H131	NH62 Rehabilitation (Tan An - Binh Hiep) (77km)	V	X					X		
	PT1C	H133	NH53Rehabilitation (Vinh Long - Duyen Hai - NH54) (132km)	V	X					X		
	PT1C	H134	NH63 Rehabilitation(Minh Luong - Ca Mau) (109km)	V	X					X		
	PT5B	CA02	Terminal Construction at Danang International Airport	III	X					X		
	PT5B	CA06	Runway Extension and Apron Expansion at Danang International Airport	III	X					X		
	PT5B	CA07	Passenger Terminal Expansion at Danang Internaitional Airport	III	X					X		
	PT5B	A11	Runway Improvement at Danang international Airport	III	X					X		
	PT5B	A12	Taixway Construction at Danang international Airport	III	X					X		
	PT5B	CA08	Cargo Terminal Constrcution at Tan Son Nhat International Airport	IV	X					X		
	PT5B	A13	Expansion of Tan Son Nhat International Airport	IV	X					X		
	PT5B	A15	Control tower Construction at Tan Son Nhat International Airport	IV	X					X		
	PT1C	CH28	NH279 Construction (Tuyen Quang – Bac Can) (94.5km)	II		X	X	X	X	X		EIT2-3
	PT1C	H101	NH43 Improvement (Gia Phu - Pa Hang) (113km)	II		X	X	X	X			
	PT1C	H91	NH6 Extension (PR 127 Lai Chau – border corridor line in Muong Te, through Pac Ma – Nam La border) (120km)	II		X	X	X				
	PT1C	H113	PR507(NH47) Rehabilitation (Thuong Xuan - Kheo Border) (60km)	II		X	X	X				
	PT1C	CH44	Rehabilitation Project (NH19, NH20, NH26, NH27, NH28)	III,IV		X	X		X	X		
	PT1C	CH84	NH20 and Other Sections Repairment and Upgrading (268km)	IV		X	X		X	X		
	PT1C	H124	NH27 Rehabilitation(Phan Rang Thap Cham - Buon Ma Thuot) (276km)	IV		X	X		X	X		
	PT1C	CH68	NH 27 Upgrading (98km)	IV		X	X		X			
	PT1C	CH81	NH25 Upgrading (Phu Yen – Gia Lai)(160km)	III,IV		X	X			X		
	PT1C	H123	NH25 Rehabilitation (Tuy Hoa - HCM Road) (180km)	III,IV		X	X			X		
	PT1C	H93	NH12B Upgrading (Tam Diep - Hang Tram) (46km)	I,II		X		X		X		
	PT1C	H80	NH 14 Widening (Gia Lai - Kon Tum)(50km)	IV		X				X		
	PT1C	CH46	NH 3 Improvement (Hanoi - Cao Bang) (310km)	I, II			X	X	X	X		
	PT1C	CH48	NH 32 Improvement (Hanoi - Lai Chau) (358km)	I, II			X	X	X	X		
	PT1C	CH43	Ho Chi Minh Highway Phase 2 Upgrading (Pac Bo - Dat Mui excluding Hoa Lac - Ngoc Hoi) (2,072km)	I,II,IV,V			X	X	X	X		

Table 4.2.1 Classifications of the Proposed Projects for Master Plan (5)

Project type (*1)	Project No. (*2)	Project title (*3)	The proposed route/ site will be located in/ around the following area.								Environmental impact type
			Environmental Zone (*4)	Populated area (*5)	Natural protection		Natural disaster				
					Protected Area (*6)	Land cover (*7)	Earthquake (*8)	Landslide (*9)	Flood (*10)	Typhoon (*11)	
	PT1C	CH47	NH 6 Improvement Phase 2 (Son La - Dien Bien)	II		X	X	X	X		
	PT1C	CH74	NH3B Upgrading (Xuat Hoa-Po Ma) (60km)	II		X	X	X			
	PT1C	H100	NH34 Improvement (Ha Giang - Cao Bang) (260km)	II		X	X	X			
	PT1C	H141	NH279 Improvement(Tay Trang - Viet Quang) (242km)	II		X	X	X			
	PT1C	H83	NH8 Upgrading (Hong Linh - Cau Treo Border) (77km)	II		X	X		X	X	
	PT1C	H114	NH48 Rehabilitation (Thai Hoa - Kim Son) (74km)	II		X	X		X		
	PT1C	H81	NH 18A Upgrading (Mong Duong - Mong Cai)(122km)	II		X	X			X	
	PT1C	CH67	NH6 Upgrading (Tuan Giao – Lai Chau) (96km)	II		X	X				
	PT1C	H112	NH3B Rehabilitation (Yen Lac - That Khe) (44km)	II		X	X				
	PT1C	H116	NH32B Rehabilitation (Xom Giac - Muong Coi) (21km)	II		X	X				
	PT1C	CH41	East-West Corridor Improvement (NH12A) (182.3km)	III		X		X	X	X	
	PT1C	CH79	NH24 Upgrading (Pho Phong – Quang Ngai) (8km)	III,IV		X		X			
	PT1C	CH80	NH24 Upgrading (Pho Phong – Kon Tum) (160km)	IV		X		X			
	PT1C	H127	NH27B Rehabilitation(Tan Son - NH1) (48km)	III,IV		X			X		
	PT1C	CH53	NH22B Improvement (Go Dau - Xa Ma) (73km)	IV		X			X		
	PT1C	H79	NH 14 Widening (Dong Xoai - Chon Thanh)(34km)	IV		X			X		
	PT1C	H92	NH 20 Improvement(Dau Giay - Lien Khuong)(250km)	IV		X			X		
	PT1C	CH37	Highway Rehabilitation Project III (NH1, Can Tho - Nam Can) (288km)	V		X			X		
	PT1C	H109	NH 40 Rehabilitation (24km)	IV		X			X		
	PT1C	H98	NH4A, 4B Improvement (Cao Bang - Tien Yen) (225km)	II			X	X		X	
	PT1C	CH69	NH 32 Upgrading (Vach Kim – Binh Luu) (72km)	II			X	X			
	PT1C	CH73	NH 279 Upgrading (Ttan Son – Than Muoi, Dong Mo – Tu Don) (43km)	II			X	X			
	PT1C	H142	NH6 Improvement (Moung Khen - Lai Chau) (19km)	II			X	X			
	PT1C	CH40	NH10 Upgrading (Tan De bridge - La Uyen bridge) (5.5km)	I			X		X	X	
	PT1C	CH78	NH8A Upgrading (Ha Tinh) (37km)	II			X		X	X	
	PT1C	H94	NH7 Upgrading (Do Luong - Con Cuong) (54km)	II			X		X	X	
	PT1C	H102	NH7 Improvement (Dien Chau - Do Luong) (36km)	II			X		X	X	
	PT1C	H86	NH21 Upgrading(Son Tay - Xuan Mai) (32km)	I			X		X		
	PT1C	H118	NH2C Rehabilitation (Vinh Yen - Son Duong) (60km)	I,II			X		X		
	PT1C	H110	NH217 Wideining (NH217 – NH1, Thanh Hoa) (30km)	II			X		X		
	PT1C	CH76	NH 31 Upgrading (Huu San – ban Chat) (61km)	II			X			X	
	PT1C	H103	NH12A Improvement (Vung Ang - NH1(connection to Vung Ang port), Ha Tinh) (10km)	II			X			X	EIT2-4
	PT1C	H111	NH31 Rehabilitation (An Chau - Dinh Lap) (48km)	II			X			X	
	PT1C	CH26	Cau Phung Bridge Construction (NH32)	II			X				
	PT1C	CH27	Border Ring Road No 1 Construction (Ha Giang – Lao Cai) (151km)	II			X				
	PT5B	A10	Runway Upgrading at Na San Airport	II			X				
	PT1C	H84	NH9 Upgrading (Pho Lai (Song) - Cua Viet) (14km)	III					X	X	
	PT1C	CH83	NH1A Upgrading (Hoa Cam – Hoa Phuoc, Danang) (8.4km)	III					X		
	PT1C	H126	NH24B Rehabilitation (NH1 - An Hai, Quang Ngai) (18km)	III					X		
	PT1C	H130	NH56 Rehabilitation (Xuan Thanh - Ba Ria) (50km)	IV					X		
	PT1C	CH49	NH 50 Improvement (HCMC - My Tho) (88km)	IV,V					X		
	PT1C	CH50	NH 80 Improvement (My Thuan - Vam Cong) (50km)	V					X		
	PT1C	CH51	NH 60 road and bridges Improvement	V					X		

Table 4.2.1 Classifications of the Proposed Projects for Master Plan (6)

Project type (*1)		Project No. (*2)	Project title (*3)	The proposed route/ site will be located in/ around the following area.								Environmental impact type
				Environmental Zone (*4)	Populated area (*5)	Natural protection		Natural disaster				
						Protected Area (*6)	Land cover (*7)	Earthquake (*8)	Landslide (*9)	Flood (*10)	Typhoon (*11)	
Improvement on land	PT1C	CH52	NH 61 Improvement (Can Tho - Kien Giang)	V						X		EIT2-4
	PT1C	CH59	NH1 Upgrading (My Thuan - Can Tho) (38.4km)	V						X		
	PT1C	CH71	NH 91 Upgrading (Chau Doc- Tinh Bien) (27.3km)	V						X		
	PT1C	CH77	NH53 (not including Km56-Km60 and Km130-Km139 in WBS project) (121km)	V						X		
	PT1C	H132	NH54Rehabilitation (Cai Von - Tieu Can) (167km)	V						X		
	PT5B	A06	Phu Bai Airport Upgrading	III						X		
	PT5B	A07	Chu Lai Airport Upgrading for Cargo Transport (Stage1: original schedule: 2009-2015)	III						X		
	PT5B	A08	Chu Lai Airport Upgrading for Cargo Transport (Stage2: original schedule: 2015-2025)	III						X		
	PT5B	CA05	Runway upgrading and terminal Construction at Can Tho Airport	V						X		
	PT1C	H144	NH15Improvement (Tan Son - Thanh Lan) (20km)	III							X	
	PT1C	H145	NH12AImprovement (Thanh Lan - Cha Lo) (7km)	III							X	
	PT1C	H105	NH14D Improvement (HCM Road - Lao Border) (75km)	III								EIT2-5
	PT1C	CH57	Improvement of Rural Bridges in Central Coast & Central Highland Provinces	III,IV								
	PT1C	H106	NH13 Improvement (Chon Thanh - Hoa Lu Border) (142km)	IV								
	PT1C	CH38	Bridge Rehabilitation Project - Phase III (NH1)	---								
	PT1C	CH54	Secondary Road Network rehabilitation Program	---								
	PT1C	CH55	Tertiary Road Improvement Project	---								
	PT1C	CH56	Rural Road Projects improvement III (2,500km)	---								
	PT1C	CH58	Other Roads and Bridges Improvement	---								
	PT1C	CH63	NH 1 Rehabilitation (Phase 3)	---								
	PT1C	CH64	Rural Traffic Project No.3 (3150km)	---								
	PT1C	CH65	Rehabilitation of Weak bridges (140 bridges) ((Phase 1)	---								
	PT1C	CH66	Southern Coastal Corridor Upgrading (NH80 & NH63) (225km)	---								
	PT1C	CH75	Weak Bridge Rehabilitation Project (Stage 2: 83 bridges)	---								
	PT5B	A09	Cam Ranh Airport Expansion	III								
	PT5B	CA10	Terminal Building and Control Tower Construction at Cam Ranh Airport	III								
	PT5B	A14	Other Tertiary Airport Improvement	---								
	PT5B	A16	Air Navigation System	---								
	PT6A	L01	North Logistic Park Development	---								
	PT6A	L02	South Logistic Park Development	---								
	PT6A	L03	Lao Cai Cross-border gate improvement	II								
	PT6A	L04	Lang Son Cross-border gate improvement	II								
	PT6A	L05	Moc Bai Cross-border gate improvement	IV								
Improvement (water)	PT4A	W07	Upgrading of Pha Lai - A Lu Route (to Class III) (33.0 km)	I,II	X	X	X	X		X	X	EIT3-1
	PT4A	CW08	Improvement of Sai Gon-DongThap-Long Xuyen Route	IV,V	X	X	X			X		
	PT3A	P09	Danang Seaport Terminal Development	III	X	X						
	PT4A	W06	Upgrading of Quang Ninh - Pha Lai Route (to ClassII) (128km)	I,II	X		X	X		X	X	
	PT4A	W21	Improvement of Sai Gon - Hieu Liem Route (88km)	IV	X		X			X		
	PT4A	W15	Improvement of Sai Gon - Kien Luong/Dong Thap Muoi area Route (334km)	V	X		X			X		
	PT4A	W03	Upgrading of Ha Noi – Viet Tri - Lao Cai Route (to Class II III and IV) (362 km)	I,II	X			X	X	X		EIT3-2
	PT3A	P04	Hai Phong Seaport (Lach Huyen) Development (Stage3, original schedule: 2020-2030)	I	X			X		X	X	
	PT4A	W01	Upgrading of Quang Ninh/Hai Phong - Ha Noi Route (to ClassII) (166km)	I	X			X		X	X	
	PT4A	W02	Upgrading of Lach Giang - Ha Noi Route (to Class I) (192km)	I	X			X		X	X	

Table 4.2.1 Classifications of the Proposed Projects for Master Plan (7)

Project type (*1)	Project No. (*2)	Project title (*3)	The proposed route/ site will be located in/ around the following area.								Environmental impact type
			Environmental Zone (*4)	Populated area (*5)	Natural protection		Natural disaster				
					Protected Area (*6)	Land cover (*7)	Earthquake (*8)	Landslide (*9)	Flood (*10)	Typhoon (*11)	
Improvement (water)	PT4A	W04	Improvement of Quang Ninh - Ninh Binh Route (266.5km)	I	X			X		X	X	
	PT4A	W05	Upgrading of Cua Day - Ninh Binh (to Class I)(74.0km)	I	X			X		X	X	
	PT4A	W08	Upgrading of Pha Lai - Da Phuc Route (to ClassIII) (87km)	I,II	X			X		X	X	
	PT4A	W30	Improvement of Cua Hoi-Ben Thuy-Do Luong	II	X			X		X	X	
	PT4A	CW10	Improvement of Viet Tri Port	II	X			X		X		
	PT4A	W09	Upgrading of Viet Tri - Tuyen Quang – Na Hang Route (to class III and IV/V) (115km)	II	X			X		X		
	PT3A	CP03	Hai Phong Seaport (Dinh Vu) Channel & Terminal Development	I	X			X			X	
	PT3A	P02	Hai Phong Seaport (Lach Huyen) Development (Stage 1, original schedule: 2010-2015)	I	X			X			X	
	PT3A	P03	Hai Phong Seaport (Lach Huyen) Development (Stage 2, original schedule: 2015-2020)	I	X			X			X	
	PT3A	CP06	Vung Ang Seaport Terminal Development (Committed Stage)	II	X			X			X	
	PT3A	P06	Vung Ang Seaport Terminal Development	II	X			X			X	
	PT4A	W35	Improvement of Thuan An-Tuan T-junction	III	X					X	X	
	PT3A	P14	Nha Trang Seaport Channel & Terminal Development	III	X					X		
	PT3A	CP12	Ho Chi Minh Seaport (Hiep Phuoc) Channel & Terminal Development (Stage1)	IV	X					X		
	PT3A	CP11	Vung Tau Seaport (Cai Mep - Thi Vai) Channel and Terminal Development (Stage 1)	V	X					X		EIT3-2
	PT3A	P19	Ho Chi Minh Seaport (Hiep Phuoc - Stage2 + other) Channel and Terminal Development	V	X					X		
	PT3A	CP07	Dung Quat Seaport Terminal Development (Committed Stage)	III	X					X		
	PT3A	P18	Vung Tau Seaport (Cai Mep Thi Vai - stage2 + other) Terminal Development	IV	X					X		
	PT3A	P22	Expansion of terminal in Can Tho seaport	V	X					X		
	PT3A	P23	Expansion of terminal in My Thoi seaport	V	X					X		
	PT4A	W19	Improvement of Sai Gon - Ben Suc Route (89km)	IV	X					X		
	PT4A	W14	Improvement of Sai Gon - Kien Luong/Lap Vo canal Route (315km)	IV,V	X					X		
	PT4A	W16	Improvement of Sai Gon - Ca Mau/Xa No canal Route (336km)	IV,V	X					X		
	PT4A	W18	Improvement of Sai Gon - Moc Hoa Route (96km)	IV,V	X					X		
	PT4A	W22	Improvement of Mekong river Delta – Thi Vai - Vung Tau Route (75km)	IV,V	X					X		
	PT4A	W17	Improvement of Sai Gon - Ca Mau/coastal Route (367km)	V	X					X		
	PT4A	W23	Improvement of Cua Tieu – Cambodia Route (223km)	V	X					X		
	PT4A	W24	Improvement of Dinh An estuary - Tan Chau Route (214km)	V	X					X		
	PT4A	W27	Upgrading of Rach Gia - Ca Mau (to Class III) (149km)	V	X					X		
	PT3A	CP08	Quy Nhon Seaport Channel & Terminal Development (Committed Stage)	III	X					X		
	PT3A	P11	Quy Nhon Seaport Terminal Development	III	X					X		
	PT3A	P20	Expansion of terminal in My Tho seaport	V	X					X		
	PT4A	W34	Improvement of Cua Viet-Dap Tran (spillway)	III		X				X	X	
	PT4A	CW04	Upgrading of the east-west northern corridor in the northern delat regeion (to Class II)(Viet Tri - Quang Ninh) (280km)	I,II			X	X	X	X	X	EIT3-3
	PT4A	W10	Improvement of Hong Đa T-Junction - Hoa Binh Port Route (58.0km)	II			X	X	X	X		
	PT4A	W13	Upgrading Cho Gao Canal Route (11km)	V			X		X			
	PT4A	W25	Improvement of Moc Hoa - Ha Tien (108km)	V			X		X			
	PT4A	CW07	Inter-connecting canal between the Day and Ninh Co River	I				X		X	X	
	PT4A	W11	Improvement of Ninh Binh-Thanh Hoa	I,II				X		X	X	
	PT4A	W28	Improvement of Lach Trao-Ham Rong	II				X		X	X	
	PT4A	W31	Improvement of Cua Sot – Nghen Bridge	II				X		X	X	
	PT4A	CW11	Improvement of Ninh Phuc Port	I				X		X		
	PT3A	CP01	Cam Pha Seaport Channel Development	II				X			X	EIT3-4
	PT3A	CP04	Nghi Son Seaport Channel & Terminal Development	II				X			X	
	PT3A	CP05	Cua Lo Seaport Channel Development (Committed Stage)	II				X			X	
	PT3A	P05	Cua Lo Seport Channel & Terminal Development	II				X			X	
	PT3A	CP02	Hon Gai Seaport (Cai Lan) Terminal Development (Committed Stage)	I				X			X	
	PT3A	P01	Hon Gia Seaport (Cai Lan) Terminal Development	II				X			X	

Table 4.2.1 Classifications of the Proposed Projects for Master Plan (8)

Project type (*1)	Project No. (*2)	Project title (*3)	The proposed route/ site will be located in/ around the following area.								Environmental impact type
			Environmental Zone (*4)	Populated area (*5)	Natural protection		Natural disaster				
					Protected Area (*6)	Land cover (*7)	Earthquake (*8)	Landslide (*9)	Flood (*10)	Typhoon (*11)	
Improvement (water)	PT3A	P07	Son Duong Breakwater Development	II				X			X	EIT3-4
	PT4A	CW06	Improvement to Ninh Co River Estuary	I				X			X	
	PT4A	CW13	Invesgtment of small ferry boats stages	I,II				X				
	PT4A	W39	Improvement/upgrading of cargo port system in the northern region	I,II				X				
	PT4A	W40	Improvement/upgrading of passenger port system in the northern region	I,II				X				
	PT4A	W32	Improvement of Cua Gianh-Quang Truong	III						X	X	
	PT4A	W33	Improvement of Nhat Le Estuary –Long Dai bridge	III						X	X	
	PT3A	CP13	Quan Chanh Bo Channel Development	V						X		
	PT3A	CP09	Van Phong Seaport Terminal Development (Stage 1)	III						X		
	PT3A	P10	Dung Quat Seaport Terminal & Breakwater/Revetment Development	III						X		
	PT3A	P25	Industrial Terminal Development	III,IV						X		
	PT3A	P21	Expansion of terminal in Dong Thap seaport	V						X		
	PT3A	P24	Coal Fired Thermal Power Stations Port Facility Development	III,V						X		
	PT4A	W36	Improvement of Hoi An –Cua Dai– Cu Lao Cham	III						X		
	PT4A	W37	Improvement of Ky Ha Estuary- Hoi An – Vinh Dien T – junction - Cua Han	III						X		
	PT4A	CW01	Upgrading of Northern Trans Mekong coriddor (to Class III)(253km)	IV,V						X		
	PT4A	CW09	Improvement of Thi-Vai-Nuoc ManCanal Route	IV,V						X		
	PT4A	CW02	Updating of Southern coastal coriddor (to Class III) (153km)	V						X		
	PT4A	CW03	Upgrading of the feeder canals in Mekong Delta region (to Class IV) (58km)	V						X		
	PT4A	CW12	Demonstration investment for provincial port facilities in Mikong Delta region	V						X		
	PT4A	W20	Improvement of Sai Gon - Ben Keo Route (166km)	V						X		
	PT4A	W26	Upgrading of Phuoc Xuyen – Tien river (canal 28) (to Class III) (75km)	V						X		
	PT3A	CP10	Ba Ngoi Seaport (Cam Ranh) Terminal Development (Stage 1A)	III								EIT3-5
	PT3A	P08	Chan May Seaport Terninal Development	III								
	PT3A	P12	Van Phong International Tranship Terminal Development (Stage 2, original schedule: 2010-2015)	III								
	PT3A	P13	Van Phong International Tranship Terminal Development (Stage 3, original schedule: 2015-2020)	III								
	PT3A	P15	Ba Ngoi Seaport (Cam Ranh) Terminal development Development (Stage 1B, original schedule: -2010)	III								
	PT3A	P16	Ba Ngoi Seaport (Cam Ranh) Terminal development Development (Stage2: original schedule: 2010-2020)	III								
	PT3A	P17	Ca Na Seaport Industrial Port Facility Development	IV								
	PT4A	W43	Improvement/upgrading of cargo port system in the central region	III								
	PT4A	W41	Improvement/upgrading of cargo port system in the southern region	V								
	PT4A	W42	Improvement /upgrading of passenger port system in the southern region	V								
	PT4A	CW16	Pilot maintenance project	---								
	PT4A	W12	Various Regional/Feeder Routes	---								
	PT4A	W29	Improvement of Lach Sung-Len Bridge	---								
	PT4A	W38	Maintenance Dredging to reduce backlogs	---								
	PT4A	W44	Selective Ports Investment Package	---								
	PT4A	W45	Improvement of landing stages	---								
	PT4A	W48	Ship building	---								
	PT4A	W49	Ship building and repair factory	---								
Institutional	PT1D	CH61	Road Network Improvement and Upgrading of (WB4) (Improvement component) (629km)	---								No impact
	PT1D	CH62	Road Network Improvement and Upgrading (WB4) (maintenance and institutional improvement component)	---								
	PT1D	CH87	Railway and Road Safety Traffic System Building	---								
	PT1D	CH85	Road Safety Improvement Program	---								

Table 4.2.1 Classifications of the Proposed Projects for Master Plan (9)

Project type (*1)		Project No. (*2)	Project title (*3)	The proposed route/ site will be located in/ around the following area.								Environmental impact type
				Environmental Zone (*4)	Populated area (*5)	Natural protection		Natural disaster				
						Protected Area (*6)	Land cover (*7)	Earthquake (*8)	Landslide (*9)	Flood (*10)	Typhoon (*11)	
Institutional project	PT1D	CH86	Northern Vietnam National Roads Traffic Safety Improvement Project (NH 3, NH 5, NH 10, NH 18)	---								No impact
	PT1D	H148	Black Spot Improvement Plan	---								
	PT1D	H149	Traffic Safety Audit Development Plan	---								
	PT1D	H150	Traffic Safety Corridor Development Plan	---								
	PT1D	H151	Highway Traffic Safety Facility Enhancement Plan	---								
	PT1D	H152	Vulnerable Road User Accident Prevention Plan	---								
	PT1D	H153	Expressway Safety Development Plan	---								
	PT1D	H154	Road Work Traffic Safety Development Plan	---								
	PT1D	H155	Traffic Safety Monitoring and Maintenance Plan	---								
	PT1D	H156	Urban Road Traffic Safety Development Plan	---								
	PT4B	CW14	Institutional development concerned with Mekong Delta Inland waterways	---								
	PT4B	CW15	Institutional development concerned with Northern delta Region Inland waterways	---								
	PT4B	W46	Installment and improvement of navigation aids	---								
	PT4B	W47	Search and rescue	---								
	PT4B	W50	Organizational Reforms	---								
	PT4B	W51	Capacity development	---								
	PT4B	W52	Database: River Surveys and Vessel Registry	---								

(*1): PT1A; Construction of road, PT1B; Construction of bridge, PT1C; Improvement of road/ bridge, PT1D; Improvement of traffic safety etc., PT2A; Improvement of existing railway line for capacity expansion, PT2B; Construction of new railway line, PT3A; Expansion & upgrading of port functions, PT4A; Improvement of waterway/ river port, PT4B; Institutional/ safety improvement, PT5A; Construction of new airport, PT5B; Capacity expansion of existing airport, PT6A; Construction of new facility for multimodal cargo handling

(*2), (*3): same as the long list of proposed projects

(*4): I; Red river delta, II; North region, III; Central region, IV; South/Highland region, V: Mekong delta (Data: VITRANSS2)

(*5): X: Populated area (more than 10 person/ ha) (Data: VITRANSS2), (*6): X; Protected areas (Data: VITRANSS2)

(*7): X; Natural forests (Data: VITRANSS2), (*8): X; Earthquake epicentres (Data: VITRANSS3), (*9): X; Landslide-prone area (Data: VITRANSS2)

(*10): X; Flood-prone area (Data: VITRANSS2), (*11): X; Typhoon hits area (more than 30 hits) (Data: VITRANSS)

Table 4.2.2 Matrix for Environmental Items and Activities which may Cause Impacts

Activities which may cause impacts / Environmental items		New Construction (land) Environmental Impact Type (EIT1-1~EIT1-4)									Improvement (land) Environmental Impact Type (EIT2-1~EIT2-5)									Improvement (water) Environmental Impact Type (EIT3-1~EIT3-5)					
		Before		After operation							Before		After operation							Before		After operation			
		Reclamation & spatial occupancy	Operation of construction equipment/ vehicles	Spatial occupancy	Operation of vehicles	Operation of trains	Operation of airplanes	Operation & maintenance of yards	Operation of facilities	Accumulation of people & goods	Reclamation & spatial occupancy	Operation of construction equipment/ vehicles	Spatial occupancy	Operation of vehicles	Operation of trains	Operation of airplanes	Operation & maintenance of yards	Operation of facilities	Accumulation of people & goods	Reclamation & spatial occupancy	Operation of construction equipment/ vehicles/ ships	Spatial occupancy	Operation of vehicles	Operation of ships	Operation of port facilities
Social environment	Resettlement	XX									X									X					
	Economic activities	X		X					X	X	X		X						X	X					
	Traffic/public facilities		X	X	X	X	X																		
	Split of communities			X																					
	Cultural property	X			X	X	X			X	X			X	X	X			X	X					
	Water rights/rights of common			X			X			X										X		X			X
	Public health condition					X																			
	Waste	X							X	X														X	X
	Hazards (risk)	X					X									X				X				X	
Natural environment	Topography & geology	X																		X					
	Soil erosion	X																							
	Groundwater	X						X																	
	Hydrological situation	X		X					X											X		X			X
	Coastal zone	X		X																X		X			
	Fauna & flora	XX	X	XX	X	X	X	X	X		X		X	X	X	X				X		X			
	Meteorology																								
	Landscape	X		X																					
Pollution	Air pollution		X		XX		X							X		X									
	Water pollution	X	X		X	X		X	X								X	X		X				X	X
	Soil contamination				X																				
	Noise & vibration		X		XX	XX	XX	X						X	X	X									
	Land subsidence																								
	Offensive odor																								X

Legend: XX; The environmental items to which special attention has to be paid. They might cause serious impacts that may affect the project formation depending on the magnitude of the impacts and the possibility of the measures.
X; The environmental items which may have a significant impact depending on the scale of the project and site conditions.
No mark; The environmental items which the anticipated impacts are, in general, not significant.

3) Typical Environmental Impacts caused by the Projects

(1) Social Environment

(a) Resettlement

The new expressway sections or other stretches were the existing road will be doubled or tripled in width, requiring considerable additional lands on both sides of the road, triggering large scale involuntary resettlement issues. For the road the resettlement effects will be greater given the need to provide adequate sized feeder roads to make the expressway effective. Encroachment on road RoWs is extremely common, requiring large relocation programs.

The impacts from the improvement/construction airports and the maritime ports will be small in relation to road and rail impacts. Resettlement may be needed to provide better access or land for new facilities. However the present plans for ports call for the use of only existing port lands or unused inundated areas that will need filling before they can be used, e.g., both ports planned

in the vicinity of Vung Tau, west of HCMC are on sites presently under seawater. Rehabilitation and reconstruction of ports can only benefit the local areas as these have traditionally been run down polluted sections of urban zones.

Due to runways and need for a sizeable landside infrastructure and the noise issue, airport resettlement issue will be larger than with ports, but could be significantly mitigated if runways are located away from densely populated urban zones. At least 5 airports are proposed, three in urban settings and two in rural settings.

The inland waters developments planned will involve adding facilities along the waterway shorelines, displacing some people, but with relatively very small resettlement issues.

With highways and their feeder roads, harbors, airports and railways to be significantly upgraded or newly built, there will be large social environment impacts. Minimizing or significantly reducing the number of affected people will be relatively easy, but will depend on careful site planning and maximum use of existing facilities and alignments. Well executed EIAs with good EMPs and thorough Resettlement Plans will significantly reduce the overall cost of resettlement compensation and environmental impact mitigation. With such actions project benefits will be highlighted instead of allowing impacts to occur, remediation costs to escalate and negative perception to degrade the value of the projects.

(b) Economic Activities

Gauging the effects of major transport projects on the social environment is complex and laced with cumulative and synergistic effects. In the long term the proposed projects will have a significant net positive effect on the nation, but there will be considerable hardships for the hundreds of thousands of people. They will loose land, assets, traditional livelihoods, access and community structure, plus face having to painstakingly rebuilding the community around them. There are also the greatly differing benefits for the urban versus rural affected persons (APs). In general such infrastructure projects provide the rural population with better linkages to urban services, assuming they can pay for them. The urban resident will see more immediate benefits since urban centers are linked by design into the transport network.

Poverty and social impact analyses addressing livelihood restoration issues, poverty alleviation (Transport corridors passing through urban areas are often located in the poorest parts of the city where property is cheap and officials receive the least amount of resistance when expropriation is required, thus further aggravating the plight of the poor (ADB RETA. 2003. Assessing the Impact of Transport and Energy Infrastructure), minority people rehabilitation and development, on regional basis, will be required. As a way of quantitatively justifying the social environment losses, social disruption and opportunity loss costs over the construction years and first five operating years will need to be carefully assessed in the overall benefit cost analysis. The benefits and costs associated with diversion of vehicular traffic and people from the old alignments to new ones, thereby significantly shifting the livelihood bases of many, will be of particular concern.

As identified in the ADB's 2003 study, ports have been important sources of employment for the unskilled poor, but now with technological change the jobs are being cut back. This is true for Vietnam's maritime facilities, but much less so for the inland waterways. Inland water transport remains very important for the people in the Red River Delta and a vital transport method for the Mekong Delta stretching from HCMC to south. In that region, many villages are accessible only by vessel. There are many social and biophysical environmental benefits associated with the improvement of the marine and inland water freight and passenger transport system. Reliability and reduction of travel time are the most serious hurdles to overcome if this mode is to compete

with road and rail modes.

To conclude, avoiding or minimizing the serious negative effects of the developments on the livelihoods/incomes and businesses of the affected population is possible. This will require the careful design of a number of (say four) regional entitlement frameworks, defining the various types of affected persons and the appropriate compensation options. The entitlement framework would then be subjected to detailed consultations with the public and the proponent, then revised and applied on a project-specific basis within each region by the provincial governments.

(c) Traffic and Public Facilities

For expressway development, impact on traffic and public facilities will be significant since during construction there will be considerable traffic disruption, access restrictions and many environmental effects which will translate into temporarily degraded community living conditions. Until proper alternative passage across the expressway is established there will be ongoing travel time costs since road users will need to use detours, routes sometimes poorly controlled and maintained.

Fortunately the expressways will be off limits to small engine displacement motorbikes, but a large amount of truck traffic is expected to be diverted to the new road(s). This should reduce the risk of truck-motorbike accidents on the old roads.

Documenting the destabilizing effects of the loss of traffic in one area and the growth in another will be a critical output, since there is a pattern that users are used to and local businesses are geared up to serve. Once that is significantly changed a long unstable period usually follows. Providing appropriate compensation (assistance) for mitigating major traffic pattern shifts, loss of income, etc. will be an important output of the PSAs.

The impact on traffic and public facilities will be most significant in the urban areas, due to the high population density and the inevitability that some part of the alignment will impact on people and public facilities. These effects will likely be amplified since the alignments are often located in the poorer urban areas where land is cheaper and resistance is not quite as organized and impact on people who do not have the resources to choose is very serious.

For the rail line, the impacts will be quite similar to those of the road, but since the design is to elevate the tracks (at least one alternative), traffic problems should end once the construction is finished; particularly if stations are also elevated. However, should the plan for a mixed at-grade and elevated system be selected a much larger operating period effect, including serious traffic delays and safety issues at the level crossings, will need to be addressed.

Elevated structures will add visual intrusion and shadow effect as social environment impacts. In small rural community areas which have enjoyed uncluttered vistas for decades or even centuries, a new rail causeway extending for many kilometers across the horizon permanently blocking the view of local residents, will be a significant impact. Mitigation will be difficult but proper sighting and design, possibly including colour, multiple use surfaces under the causeways, such as drying surfaces or sheds, would make the structures multipurpose and less intrusive.

The shadow effects will be most striking in urban areas since the elevated tracks could place entire streets into permanent shadow. Again careful sighting and a review of the experience with specific compensation measure on other projects e.g. the Japanese Railway's experience with their elevated system or the recent Bangkok Skytrain project could provide valuable lessons.

The impact of airports on traffic and public facilities will be far less dramatic than from linear

development, but nevertheless could be very significant locally. A new airport will create a clearly definable zone of influence bounded by the aircraft approach patterns. Undoubtedly a new airport will influence local traffic patterns but since the five proposed facilities are mostly in urban fringes and rural settings, impacts should be minor. Minor impacts will be conditional on the airport authority establishing appropriate land use restrictions, a no build/no use zone around the high noise safety areas of airport operations (as per international airport safety standards), implements them during the detailed design stage of each project, and enforces them from that time forward.

In comparison to other types of development proposed in the transport strategy, the impact of new port construction or upgrading in both coastal and inland sites on traffic and public facilities will be minor. Some localized traffic congestion and access restrictions to public facilities will be common during the construction period and new facilities will create new traffic pattern and increased traffic volumes once in operation. The five port facilities being proposed will all be new or very major additions to existing small operations, but located on unused land or areas least likely to create social environmental impacts. The creation of new and upgraded connections from the ports to the existing transportation infrastructure may cause a large social environment impact since these roadways will require land and assets of people.

(d) Split of Communities

Of the four transport modes being developed, all but ports are expected to lead to issues dealing with split communities. For road and rail developments these impacts are obvious. An alignment passing through a village with limited crossing structures creates a large barrier to cross traffic and local commerce. There are also serious safety concerns since people will always find ways to cross all at-grade facilities, risking accidents and serious injury. The more elevated rail structures are planned through urban areas and in intensively farmed agriculture zones such as the North Central Region where a production area would be otherwise split in two, the greater the benefits will be. Community splitting can also have very serious negative effects on a town's social structure and economic stability, particularly if it is small and business depends on cross-town exchanges. Culturally important sites used by the entire town can become very difficult to get to.

Poorly planned airports, particularly if they are located inside densely populated zones, can lead to significant loss of access across communities. Such a boundary often leads to long detour routes and the use of low grade roads. Noise is usually distributed along the axis of the runway at either end, creating noise levels dangerous to hearing and therefore no use zones.

Careful planning and alignment placement, as part of an assessment of alternatives, will be very important to finding least destructive solutions to rail, road and airport projects. This must be undertaken in parallel with high-level environmental assessments that incorporate both biophysical and socio-cultural impact analysis in impact mitigation. Provision of adequate crossing facilities based on knowledge of pre-project use, is a very effective mitigation measure. As a last resort, reconstruction of badly split communities or another alternative site should be considered.

(e) Historical and Cultural Property

Vietnam's basic highway and provincial road network was built in the first part of the twentieth century with very narrow rights of ways. This permitted culturally important structures such as pagodas, churches and public facilities such as schools, post office and cemeteries to be located close to the road edge. In the past, when new roads were being built in the old alignments many, cultural structures and infrastructure were demolished and new ones were built, with little regard

for the loss of cultural heritage. Some recent examples of impacts associated with past transportation infrastructure activities are:

(i) **East-West Highway (Ho Chi Minh City)**

The East-West highway project is located parallel to the Ben Nghe-Tau Hu Canal which was crossed by many historical bridges and roadside facilities which were destroyed and replaced (in most cases); including the Khanh Hoi and Calmettle bridges, the Ngu Hanh Son and Tinh Quang Pagodas and the Cau Ong Lanh market;

(ii) **Highway No. 1 Improvements: Dong Ha to Quang Ngai**

Within this section of Hwy. No. 1 more than 10 pagodas were torn down and new ones built and a number of schools and cemeteries had to be relocated, with little concern for history and cultural impacts.

Given Vietnam's diverse and ancient history it is highly likely that at least the rail and road developments will affect existing cultural features and potentially damage cultural relics still buried underground (For example in late 2007 an archeological site full of metallurgy tools and pottery dating back nearly 3,000 years was discovered in Van Ninh District in central Khanh Hoa Province. The Vietnam Archeology Institute found a number of bronze molds and bronze-refining tools, eight tombs and over 126,000 pieces of pottery.). Avoiding this will be relatively easy through consultations with authorities in areas where known cultural sites might be or where old towns once stood. Secondly, as part of the environmental assessments, a cultural relic's protection process should be established for use by all contractors building new structures. This would be particularly important for any development along the Red River Valley, Tue Thin Hue Province as well as South Central Region where the Cham Dynasty (Champa Kingdom) flourished. Thirdly, the cultural relic's protection process must contain a step by step methodology on what actions to take should a cultural relic be found.

Upgrading and expanding existing ports where excavation is needed must also be done with great care since these areas, especially inundated old port shorelines on known important trade routes were probably some of the oldest inhabited parts of ancient Vietnam and may contain important artifacts. Consultation with Vietnam's Institute of Archeology (within the Vietnam Academy of Social Sciences) would be a requirement.

(f) Water Rights as Common Property

Given the extent of habitat destruction, particularly the aquatic habitat of rivers through discharge of waste, aggregate mining and uncontrolled damming, very few areas where the road or rail line is likely to pass across have healthy wild fish populations and where people actually harvest wild fish populations. The impacts of the transport projects will be at water crossings, where there could be access problems.

New road or rail alignment sections along the coastline could obstruct access and therefore must be located at a minimum distance from the shoreline (as defined by legislation) and in no way obstruct this access. Household wells or community groundwater supplies could be affected by pile driving, tunneling or construction equipment damage to the aquifer recharge areas, thus contaminating or reducing the supply. Properly completed EIAs should identify these issues and define appropriate preventative actions; and such results would then be incorporated in the PSAs.

Most regions of the country have extensive irrigation canal networks, essential for rice growing and other agricultural production. These networks often have important canals along existing roads or close by, thus any upgrading or new construction activity would impact them. These

conveyances are common community property and if damaged by contractors must be immediately repaired and carefully maintained by them to the satisfaction of the community leaders. One of the most frequent complaints about linear development projects in irrigated lands is the destruction of canal and paddy systems by contractors. These systems require great deal of manual labour to repair, yet require relatively little time when heavy equipment is available.

(g) Public Health Conditions (Garbage, Sewage, Insect Born Diseases)

Solid and liquid waste issues arise mainly from domestic and industrial activities. For example in the four large urban areas of Vietnam more than 380,000 tons of solid wastes were generated in 2007. MONRE has indicated that this volume increases at a rate of 10-16% per year. This is in contrast to waste generated by all transport facility development and operation in Vietnam which is less than 0.9% of that amount.

In most urban areas, domestic waste account for 60-90% of the total urban solid waste, with a generation rate, (MONRE data) of about 0.8 kg/person/day on urban areas and 0.3 kg/person/day in rural areas.

Solid waste is an issue during construction and operation of transport facilities. During operations issues arise mainly at bus and train station, and airport terminals. The solid waste from these sources is usually collected and disposed using conventional methods. Since sewage from toilets on trains is discharged from the moving trains as untreated waste along the tracks, and this practice continues to be permitted, or rather the MONRE decree governing the treatment of sewage is not enforced by the VRA, significant pollution results. For example, in 2007 there were four daily trains from North to South and 50 local trains with > 25,000 passengers and thousands of staff working on the railway. If each person discharged about 0.4kg sewage waste (not counting grey water) every day, 25,000 passengers will generate around 10 tons of sewage per day, of which at least 50% is discharged directly onto the ground from moving trains. Some trains have over 800 passengers at any one time. Since 1998, the railway department has added dining cars to the trains, thereby increasing the total sewage discharged. The simple solution to this dangerous practice that can easily and quickly spread infectious diseases across long distances of the country is to install sewage collection tanks and provide pump out stations at selected terminals where the sewage can be taken to a treatment plant. If one is not available the VRA should establish a procedure acceptable to the provincial DONRE and PPC, use it and if appropriate make it available to local communities.

Train and bus stations are often poorly fitted with toilet facilities and maintenance is insufficient to keep up with the level of use. The upgraded road and rail facilities with large numbers of passengers will need completely rebuilt toilet facilities including not only the toilets themselves but the treatment facilities. General experience suggests that there be one complete toilet for every 14–18 passengers, therefore for a station accommodating 500 passengers there need to be at least 30 individual toilet units (13 for men and 17 for women).

Large construction sites and work camps have many locations where water collects, even in small areas such as in discarded tires and tins, ideal breeding grounds for the insect-borne diseases.. With dengue fever, malaria and encephalitis very common throughout rural Vietnam, any activities that can aid in the increase in their distribution must be prevented. Hatches of mosquitoes can occur within five days and quickly infect a significant portion of the local workforce.

Depressions in the ground created by construction machinery and capable of retaining puddles of water, drainage ditches and waste materials that could hold water, need to be monitored at

least every 3 days to insure that water is not collecting and mosquito larvae are not present. If this is done as a regular inspection task, the sources for the resulting debilitating diseases can be eliminated (In wet rice growing areas the mosquitoes transmitting these diseases also breed in rice paddy waters, but concentrations around work camps can be extremely damaging.).

Another construction related health issue (The problem of new linear structures acting as HIV/AIDS transmission routes is not only mentioned in the JICA guidelines but also by both the World Bank and ADB to be a very significant factor.) is the management of sewage and garbage generated by the construction workers at work camps; which can be in tons per day. Environmental management plans contained in EIAs should provide detailed mitigation measures for the management of this problem, and those results integrated into PSA studies.

(h) Waste (Construction Demolition Waste, Debris and Logs)

Construction work, particularly when large scale demolition is involved, such as a reconstruction of long stretches of highway and railroads or the redevelopment of ports, large volumes of waste materials are produced and must either be re used or disposed of. This is often done without any knowledge of the real constituents of these materials or what happens to these materials as they degrade over time. With thousands of tons to be produced during any of the proposed linear projects a closer examination of this issue is warranted.

A 2001 study by the US National Transport Research Board (NTB) 2001. Environmental Impact of Construction and Repair Materials on Surface and Ground Waters examined this issue for road construction and reconstruction waste and found that at least 11 categories of potentially problematic materials were turning up in construction wastes (Table 4.2.3). These materials ranged from slag and fly ash from various sources mixed in with asphalt concrete to wood preservative for insect control in wooden structural elements.

Testing was done on these materials to establish the toxicity of leachate over time. Results were highly variable but with some materials exhibiting significant toxicity. These included asphalt sealer, treated wood, aggregate mixed with gypsum waste, and various types of asphalt concrete that include crumb rubber, or roofing shingles, foundry sand, and municipal incinerator ash. Organisms on which the leachate was tested using bioassay method included algae, zooplankton and fish, with results indicating that wood preservatives were the most toxic followed by the leachate from old asphalt concrete waste. The danger with the storage of these wastes is during the initial 10–15 day storage time in piles open to weathering and rain-based leaching. After the first 15 days the leachate has drained into the environment, has done its damage, leaving the waste pile as a mildly but chronically hazardous site. Toxicity can be eliminated or greatly reduced by incorporating some of the materials into pavement mixtures or sub grade fill as soon as they are produced, eliminating exposure to the elements.

Table 4.2.3 Materials Commonly Found on Road Construction Waste and Demolition Waste

Waste or By-Product Material	Common Use in Construction
Crushed Reclaimed Concrete	Aggregate Base - Aggregate Replacement
Recycled Asphalt Pavement	Asphalt Mix - Aggregate Replacement/Binder Modification
MSW - Bottom Ash	Asphalt Mix - Aggregate Replacement
Fly Ash	Aggregate Base - Stabilizer/Aggregate Replacement
Bottom Ash	Asphalt Mix - Aggregate Replacement
Foundry Sand	Asphalt Mix - Aggregate Replacement
Used Asphalt Shingles	Asphalt Mix - Binder Modification
Ground Tire Rubber	Asphalt Mix - Binder Modification
Phospho-gypsum	Aggregate Base - Stabilizer/Aggregate Replacement
Mine Tailings - Coarse	Asphalt Mix - Aggregate Replacement

Waste or By-Product Material	Common Use in Construction
Mine Tailing - Fine	Asphalt Mix - Aggregate Replacement
Ammoniac copper zinc arsenate(ACZA)	Wood preservative

Source: US Transport Research Board Report No 448, 2001

If the leachate is retained for a period of time, i.e. not permitted to flow directly to a runoff stream, adsorption will trap much of the toxic characteristics of the leachate. Obviously there has to be some sorting of the construction waste to remove organic matter (which presumably is already done as part of efficient construction practices) such as the preserved wood.

Contractors should sort and reuse materials as quickly as possible or provide storage facilities that allow for leachate retention for at least 24 hours, or are protected from the elements.

If construction wastes are to be dumped, a procedure sanctioned by the provincial DONRE and PPC must be agreed to before any such activity can begins, thereby reducing the risk of pollution and serious visual intrusion from large areas of stored construction and demolition waste.

For rail lines the waste problems will be different in that potentially toxic components will be the used ballast material contaminated with petroleum products, fines and human feces, old wooden sleepers treated with preservative and bridge superstructure demolition materials. Sorting and proper storage and prevention of leachate reaching local surface waters that may be used by animals and even rural households should be avoided.

Construction wastes toxicity from port development will be highly dependent on the work to be undertaken, since construction of new facilities will yield large volumes of dredge wastes, sometimes from contaminated rivers, bays or estuaries. The act of dredging, particularly when the 'clam shell bucket method' is used, can re-suspend contaminants triggering mortality among aquatic and marine organisms. Dredge waste that is dug up, temporarily stored on barge then moved to a shore facility, has three chances for releasing contaminants, once while being dug up, again when draining in the barge and finally on land as rain water leaches polluted water to the local surface water courses. Clearly these problems will be heightened if the new port is in an industrial coastal or river area where pollution has been ongoing. Therefore, it will be important to establish a port's (and upstream area) historical uses before a dredging program begins.

In the Mekong Delta a further problem with excavation of port sites in the rivers and canals is acid-sulphate soils. Old marine sediments which underlay much of the Delta area trap sulphates and these materials remain inert as long as they are under water. On contact with air, a chemical process allows the sulphates to mix with fresh water forming highly corrosive/toxic sulfuric acid. Large areas of the Delta have been denuded as a result of the exposure of these soils. Therefore, when working in this area, contractors must consult local authorities to establish the best practice, handling, storage and reuse methods of this waste. Can Tho University has a research institute specializing in acid sulphate soil management.

(i) Hazards (Risks): Unstable Landforms, Cave-Ins, Accidents

The geography and topography of Vietnam create special climate characteristic resulting in diversified and sometimes serious hazards (Table 4.2.4). To understand and prevent damage to infrastructure from natural hazards the types of hazards and areas affected by them need to be examined and data incorporated into project design. Natural disasters include: floods, typhoons, storm surges, whirlwinds, flash flooding, river bank and coastline erosion, hail, drought and landslide. Of these the greatest damage in recent times has been from typhoons which bring heavy rain, storm surges and flooding to parts of Vietnam.

Table 4.2.4 Record of Impact of Tropical Storms for 2004 to 07/ 2005

Type of Event	2004	Up to 7/2005
Storm	2	2
Tropical low pressures	2	
Number of dead people	232	3
Number of house damaged	>4,200	233
Ship wrecks	>200	25
Agriculture damage (ha)	>483,000	5,725
Economic damage (billion dong)	>900	335

Source: Vietnam National Steering Committee on Flood and Storm Prevention and Control, 2006

Coastal erosion, slope instability and landslide: Landslides, land collapse, erosion and instability are natural phenomena which are difficult to control and complicated by inappropriate design and construction methods that do not address these issue before the work begins.

Adequate exploratory drilling, determination of the underground geology, groundwater flows, and seismic details will be essential planning tools to reduce the potential impact of a cave in. This work coupled with modern tunneling machines will mitigate cave-ins entirely since the protective concrete shell is poured as the tunnel is drilled. Failure of that shell due to an unusually large seismic event or poor construction would be the only way that a cave in would occur. The Vietnamese Institute of Geophysics maintains an up-to-date record by district, of earthquake locations and intensities, which needs to be consulted by the tunnel designers. For example, the site for the high speed rail project tunnel is in a significant seismic risk zone and all preparatory analyses will need to be undertaken.

The total package of projects will require a complex and comprehensive set of social environmental analysis. This will include poverty and social assessments as well as resettlement plans, completed according to the recently revised GoV procedures. An assessment protocol must be established first to define the sequence of work to be done, and given that projects will be done in phases or stages considerations for localized and cumulative regional effects will need to be incorporated into the work.

A thorough analysis of alternative and a careful social impact assessment and resettlement plan is needed for each VITRANSS 2 projects. Information exchange between the ongoing social and environmental analyses will be very important, since there will be many overlapping data needs. The reward for the social environment will be much reduced social disruption, minimization of socioeconomic losses and an overall reduction in compensation cost.

Of the five categories of projects the most complicated and with the most impacts will be the road and rail developments, since they stretch for such long distances and for roads include feeder road networks, and affect a very large number of people, estimated to be 200,000 or more. The other project will lead to more site specific impacts, affecting a much more clearly definable group of people. This however will not be simple analyses since most will be in or near urban areas and could result in significant local change for large numbers of people.

(2) Natural Environment

(a) Topography and Geology

Reformation of valuable topographical and geological areas caused by excavation works or banking of soil will have significant impacts on a factor of topography and geology. These kinds of impacts are expected to be caused mostly by road, airport and maritime sub-sectors since many of these are located in coastal zones and natural reservation areas. Railway and inland

waterway sub-sectors will have comparatively marginal impacts.

Transport infrastructure activities of road have the highest rate of appropriated land in the construction activities compared to marine, airport and railway sector. Because, density of population in Vietnam is quite high and cultivated land per person is quiet low. Therefore, appropriated land in construction activities will definitely occur. Besides, construction needs a large amount of soil, gravel and sand. So large volume of soil and gravel is required for building highway.

(b) Soil Erosion

Soil erosion will be caused by large reclamation activities. Unless suitable counter-measures are taken, the surface soil will be washed away by rain after land reclamation works and land clearing. Road, airport and maritime sub-sectors are among those of these concerns. The projects of the railway, inland waterway and rural transport subsectors will be of less concern.

(c) Underground Water

Factors related to underground water, such as the deterioration of water quality due to construction and the decrease of underground water caused by the excessive pumping will be caused by the reconstruction with large reclamation activities. This is expected to be caused mainly by road and railway sub-sectors that include the construction of the Hai Van tunnel. The airport subsector projects will require large land reformation during construction that may cause significant impacts. The projects of the maritime subsector will not be much significant except for those within industrial zones.

(d) Hydrological Situation

Factors related to hydrological situation, such as the changes in flow volume and the riverbeds due to land reclamation or the changes in the flow of its drainage, will affect lakes, marshes, lagoons and rivers. Especially substantial impacts are expected from maritime and inland waterway subsectors. Meanwhile, airport sub-sector will have marginal impacts on it. The impacts of road and railway sectors are not expected to be severe.

(e) Coastal Zone

Factor related to coastal zone, such as coastal erosion and the decrease of coastal biodiversity due to land reclamation or to the changes in sea current, may be caused by all transport subsectors. Especially substantial impacts are from the projects of the maritime subsector. Regarding road and airport sub-sectors, they could do harm to the coastal zone, if their projects are located in or near coast. Also, inland water sub-sector could bring serious disadvantages to the coastal zone, if projects are located in the river mouth of the Red River and the Mekong River.

(f) Flora and Fauna

The impacts on flora and fauna, such as the breeding obstructions and extinction of valuable species due to changes in their habitat, will be caused by locating the transport sector projects in biodiversity-rich areas such as National Parks, Nature Reserves, as well as Lagoon and Mangrove forests. Road, railways, airport and maritime transport sectors may cause serious impacts on biodiversity areas, if they are located in such ecologically important areas. The impacts of the inland waterway sub-sector will be small except for the improvement of river mouths.

For the habitat loss, the consumption of land, and the consequent loss of natural habitat, is inherent in road development. Where new roads intersect habitat, the area occupied by the road itself, borrow pits, and quarries is subtracted from the total habitat area available to flora and fauna.

For habitat fragmentation, when a road cuts through an ecosystem, the sum of the two parts

created by the cut is less than the value of the initial whole, even when the habitat loss is ignored. Ecosystems are characterized by complex, interdependent relations between component species and their physical environment, and the integrity of the ecosystem relies on the maintenance of those interactions. By slicing through habitat, roads affect an ecosystem's stability and health. Roads tend to fragment an area into weaker ecological sub-units, thus making the whole more vulnerable to invasions and degradation. Nevertheless, roads and natural ecosystems can co-exist if the relationship is built on careful planning.

For example, Ho Chi Minh Highway was appropriated 1,916 ha forest and passed though 2,000 km forestry land in which thousands of km is watershed. The project passes though 6 National parks and natural reserves including Cuc Phuong, Bach Ma National Park, Ben En, Song Thanh, Ngoc Linh, Phong Nha natural reserves. Besides, many of such type projects has been appropriated and caused direct and indirect adverse impacts to the flora and fauna.

Maritime transport sectors may have serious impacts on biodiversity areas. Improving Hai Phong, Hanoi, Ho Chi Minh, Can Tho, Rach Gia, My Tho, Quy Nhon, Nha Trang, Da Nang, Cua Lo, and Dung Quat Port has caused impacts on aquatic ecosystems due to increasing turbidity.

Use of mangrove forest and alluvial ground to build port such as Sao Mai–Ben Dinh in Vung Tau Province, Thi Vai, Phu My, Cai Mep in Thi Vai River and Hon Chong in Kien Giang Province and Cai Lan in Quang Ninh Province have caused impacts on natural environment.

Habitat loss of wild life and Impacts on aquatic ecosystem, such as mangrove leads to decreasing biodiversity in estuary of Dong Nai–Sai Gon, Thi Vai, Can Gio, Con Dao, Hon Chong, Phu Quoc, Truong Sa, Cat Ba.

(g) Meteorology

Meteorological impacts including changes in temperature or wind even due to large-scale reclamation are not anticipated for all the transport subsectors. But there could be natural disasters by meteorological phenomena like severe storms and typhoons on transport infrastructures.

(h) Landscape

Road and airport sub-sectors could have serious impacts on landscape. For instance, the construction of bridges or airport could bring topographic changes and, as a result, could affect the landscape. On the other hand, maritime sub-sector will have marginal impacts except Cai Lan Port project which has a very significant potential to affect beautiful landscape of Ha long Bay, one of the World Heritage site.

(3) Pollution

(a) Air Pollution

Air pollution, such as the deterioration of air quality due to harmful exhaust caused by both the construction and operation of the transport subsectors except the railway subsector. Especially substantial impacts are expected to come from the road subsector, due to the increase in the number of vehicles. Air, inland water and maritime sub-sectors will also have impacts on air pollution but their impacts are not as substantial as those of road sector. On the contrary, railway subsector will contribute to the improvement of air quality.

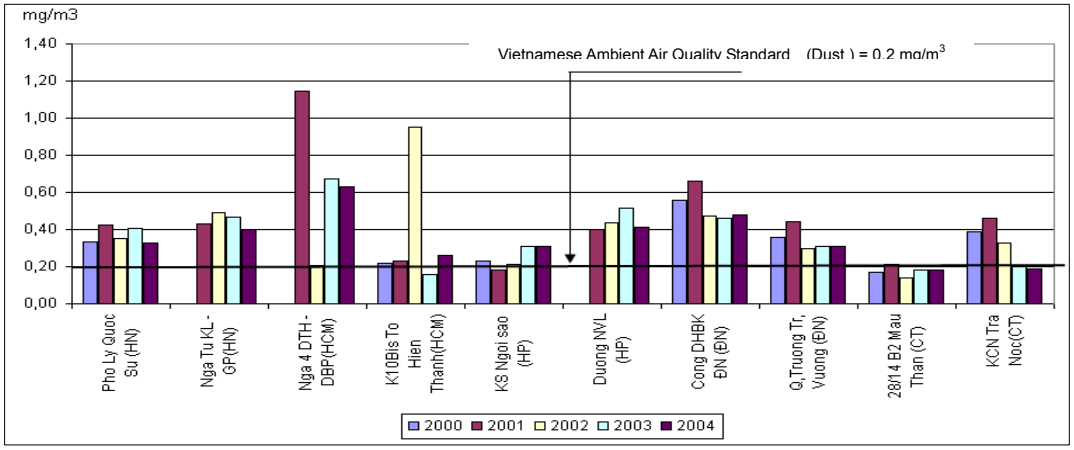
Transportation infrastructure activities in Vietnam have been facing with dust pollution. According to the analysis of available Environmental Impact Assessment Reports concentration of dust usually varied around 0.75–2.94 mg/m^3 in while concentration of dust in Vietnamese ambient air

quality standard 2937–2005 is 0.15 mg/m^3. The dust concentration at construction area of railway tunnel and road tunnel is 20–50 times higher than Vietnam ambient air quality standards.

Transport activities emit is dust, exhalant petrol, CO, NO_2, SO_2. In Vietnam, road activities emit largest radiation of air pollutants. The figures below show changes in annual concentration (2000–2004) of dust, SO_2, CO at intersections in large cities.

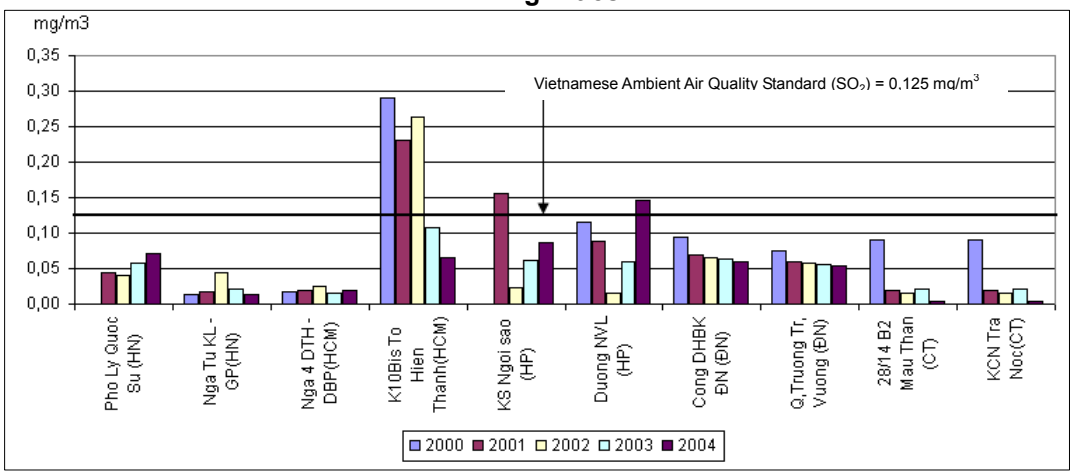
Besides, air pollution at intersections, large cities have been facing with air pollution at terminal stations because the traffic volume at terminal stations are high, approximately 1,000–15,000 per day. Table 4.2.5 shows the air quality at Giap Bat Terminal Station.

Figure 4.2.7 Changes in Annual Concentration (2000–2004) of Dust at Intersections in Big Cities



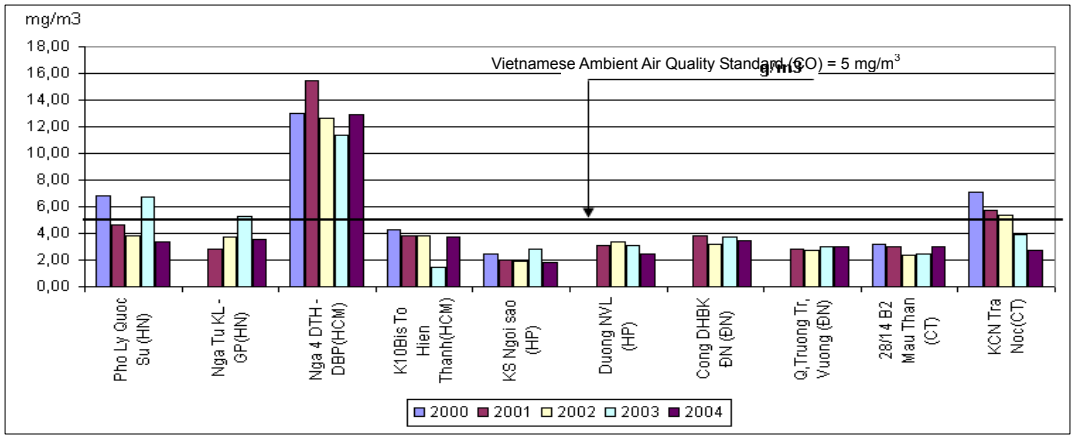
Source: CEETIA (2005), Motorcycle Emission Control in Major Program (MECCP) for Vietnam, P 11

Figure 4.2.8 Changes in Annual Concentration (2000–2004) of SO_2 at Intersections in Big Cities



Source: CEETIA (2005), Motorcycle Emission Control in Major Program (MECCP) for Vietnam, P 11

Figure 4.2.9 Changes in Annual Concentration (2000–2004) of CO at Intersections in Big Cities



Source: CEETIA (2005), Motorcycle Emission Control in Major Program (MECCP) for Vietnam, P 12

Table 4.2.5 Air Quality at Giap Bat Terminal Station

Pollutant	Unit	Concentration		TCVN 5937/2005	
		Highest	Average	1h	24h
CO	mg/m^3	375.5	87.5	30	5
CO_2	mg/m^3	1,110	-	-	-
SO_2	mg/m^3	1.4	0.1	0.35	0.125
NO_2	mg/m^3	17.0	3.43	0.2	-
Dust	mg/m^3	5,654	0.735	-	0.15
Noise	dBA	110	90.57	85 dBA (TCVN-5949:1995)	

Source: TERI 2006, Integrating Environmental Protection Measures in the Transportation Development Master Plan, P15

(1) Air Pollution – Pollution Control and Mitigation Measures

Although not fully supported by extensive emissions inventory, mobile sources are considered as one of the major sources of pollution in Vietnam. In order to reduce air pollution from mobile sources, the following methods should be implemented.

(2) Tightening Vehicle Emission Standard

Emissions standards have been established for both in-use and newly registered vehicles in the country. The emissions standards have been updated in 2005 to provide a better road map of implementation of emissions standards in the country in 2007 using step-by-step approach (for example, new standards—equivalent to Euro 2—for brand new vehicles implemented starting 1 July 2007). Vehicles failing to meet the emission standards set by law can be suspended from operation and their drivers subject to a fine of dong (D) 500,000.

(3) Strengthening Inspection and Maintenance

An inspection system that measures vehicle emissions to identify gross polluters and requires those that do not meet the standards to be repaired is standard approach adopted worldwide to address air pollution problem.

Developing countries face a number of challenges in implementing an effective inspection and maintenance (I/M) program. What is needed are reliable data on active vehicle population, suitable test protocols, and administrative control.

(4) Fuel Composition Change

In Vietnam, current transport means consume either gasoline or diesel. The quantity of fuel consumed by road vehicles is around 1.5 to 2 million tons per year, and accounts for 30% of Vietnam's total gasoline and diesel imports. Transportation petrol consumption increased annually by 7% in the early 1990's and by 10% in late 1990's. Automobiles and motorcycles account for 65% of the total gasoline and diesel consumed by transportation (including ship, train and plane). Therefore, the quality of fuel composition has strong effect on air emission. Vietnam successfully phased out leaded gasoline since July 1st, 2001, however, in order to maintain octane number, aromatic are used as the anti-knock agents. TCVN 6776 – 2000 regulates the maximum benzene content in gasoline at 5% (STAMEQ, 2000), effective from 2001. However, because of high benzene concentration in Hanoi and Ho Chi Minh city streets, a more stringent benzene limit in gasoline (2.5%) would be enforced by TCVN 6776 – 2005 which became effective from January 1st 2007 (STAMEQ, 2005). In addition to this, sulfur content in diesel fuel is up to 0.5% or 1% by weight. A new directive, signed by Deputy Prime Minister Pham Gia Khiem on 7 March 2006 and for implementation 15 days after it is published by the Official Gazette, the Government's publishing arm, provides for more stringent fuel standards. Under

this new policy, the sulfur content in unleaded transport fuels would be cut to 0.05%, while diesel for industrial use would be cut to 0.25%.

(5) Alternative Fuel Consumption

Alternative fuels include gaseous fuels such as compressed natural gas (CNG) and liquefied petroleum gas (LPG), bio-fuels, and electricity. Alternative fuels are known as clean fuel with low air pollutants emission, however, for successful fuel switching, it is necessary to consider fuel availability and distribution networks; refueling infrastructure; and cost related to vehicle modification, maintenance and operation.

In Vietnam, LPG fuel is used for taxi and van tax. The LPG market appeared in Vietnam since 1993, however, because of the lack of distribution networks as well as refueling infrastructure the use of LPG in Vietnam has not become popular.

(6) Traffic Management

Both fuel consumption and exhaust emissions vary significantly with variability of vehicle speed. Traffic management can, in principle, reduce fuel consumption and exhaust emissions by making traffic flow more smoothly. A steady speed is also the key to reducing the emissions of harmful pollutants per unit distance traveled. A number of devices, such as one-way street systems, linked traffic signal systems, and traffic control systems can contribute to smoothing traffic flow.

(7) Traffic Signal Systems

Traffic signal control systems are the most common traffic management instruments aiming to secure traffic flow objectives. However, their impact on air quality has been controversial. Some have argued that because traffic signal makes the flow stop and start running, they are likely to increase air pollution and some arguing that the impact of traffic signals on pollution is highly situation- specific.

The most efficient traffic signal systems are area traffic control (ATC) systems, which link signals across whole networks. These systems can be made traffic-responsive on a real-time basis but are more expensive in terms of capital equipment (partly because of the need for more traffic-sensing equipment).

(8) Road System Design

Road system design such as ring roads and by-passes are designed and constructed to reduce traffic flow across urban areas and environmentally sensitive areas, therefore pollutant emission and noise pollution effect on residents could be reduced. Increasing infrastructure capacity will result in improved air quality only if embedded in a comprehensive urban transport strategy involving parallel restraint of vehicles and local environmental protection.

Some pollutants, such as CO, are within air quality standards on average but can be extremely high at urban “hot spots” (such as heavily congested traffic corridors and intersections). CO and PM concentrations fall rapidly with increasing distance from these roads. Schools, hospitals, homes for the elderly, and shopping streets should therefore be located several hundred meters away from busy traffic corridors. For existing hot spots, traffic management can be used to minimize the impact of traffic on local air quality.

(a) Water Pollution

The impacts on water quality, such as the deterioration of water quality due to inflow of soil and wastewater in the construction and operation stages, could be caused by the transport

sub-sectors projects. Road, air, inland waterway and rail sub-sectors will have substantial impacts mostly during their construction. Especially significant is the impacts of port sector projects on semi-enclosed sea areas such as the Cai Lan Port, where very significant adverse impact is anticipated.

Water environment has been affected by heavy metal pollution in seaports in Vietnam, especially Danang and North Seaport. In North and Central Seaport, land environment was polluted by Cu, Zn and Cd. In South Seaport (including Nha Trang, Vung Tau), water environment was extremely polluted by Hg, Cd with pollution co-efficient 3.55 to 16.77. According to monitoring results concentration of heavy metals in most of seaports in Vietnam is increasing annually. Average concentration of oil in coastal seawater environment in North Seaport, Central Seaport and South Seaport were 0.234 mg/l, 0.127 mg/l and 0.086 mg/l respectively.

(b) Soil Contamination

Both construction and operation of all the transport sub-sectors will have significant impacts on soil contamination mainly due to coarse dust and asphalt emulsion. Especially significant are the impacts of road, rail and air sub-sectors though they would mostly occur in the construction stage and hence the effect is short-term. Maritime sub-sector will have only marginal impacts.

(c) Noise and Vibration

Noise and vibration generated by vehicles and facilities during the construction and operation stages will be very significant for all the transport sub-sectors except inland water sub-sector. Especially road, air and maritime sub-sectors will be major sources of noise and vibration because of increasing vehicles on roads, increasing landing/take-off (LTO) cycles at airports and construction works at seaports. Meanwhile the impact by rail sub-sector should decrease because of improvement of track and carriage.

(1) Noise Pollution - Pollution Control And Mitigation Measures

Noise pollution is very common to transportation sectors, in which road account for approximately 70% of total noise, rail account for 10% of total noise and aircraft for 20%. In Vietnam, 90% of people using motorcycle with mixed traffic, as a result noise pollution has become a seriously problem, especially in big cities like Hanoi, Hai Phong, Ho Chi Minh City and Da Nang.

In order to mitigate noise pollution from transportation, the following measures should be implemented:

(2) Installing Noise Barriers For Road Transport

Noise barriers are designed to cut off direct sound from various sources, aiming to diminish noise levels through energy losses that are created upon the occurrence of sound diffraction. When new roads are scheduled to be built, environmental impact assessment should be carried out to evaluate the adverse impacts due to noise pollution. If the predicted noise level exceeds the prescribed limit, noise barriers should be installed to maintain the quality of living.

(3) (Reducing Road Traffic Noise at Sources for Road Transport

To reduce road traffic noise pollution at source, the government should tighten permissible limits, crack down on illegal vehicle modifications such as muffler alterations, encourage research and development on better noise reduction technologies, impose more stringent noise standard for new vehicles and promote the sale and use of low-noise vehicles such as electric vehicles.

(4) Land Use Planning

For incorporating mitigation of traffic noise in town planning strategies, the following measures should be followed:

(i) zoning land and planning urban projects with the considerations of noise factor;

(ii) building bypasses and ring roads; and

(iii) establishing buffer zones on both sides of a road.

(5) Noise Pollution - Pollution Control and Mitigation Measures for Rail Transport

Noise from rail transport accounts for 10% the total of noise from traffic. Rail transport noise not only annoys residents along the track but also affects passengers. Therefore, there is a range of initiatives to address this issue, including:

(i) retrofitting existing locomotives to reduce noise emission

(ii) upgrading existing track to continuously welded rail which removes rail joints-a significant source of noise and vibration

(iii) designing new bridges to reduce noise and retrofitting of existing bridges with noise attenuation devises

(a) Land Subsidence

Land subsidence including sinking of land surface accompanying geological changes or a drop in ground water level is partly caused by extraction of underground water. Air and maritime sub-sectors can somewhat cause land subsidence particularly with reclamation activities.

(b) Offensive Odor

Offensive odor produced by production of exhaust gases from vehicles and the malodorous substances from waste could be caused by projects of the transport sub-sectors. The projects of road sub-sector will considerably cause such impacts mainly due to the increase in traffic volume. The projects of maritime sub-sector can cause offensive odor by the eutrophication of the semi-enclosed sea surfaces at seaports such as Cai Lan Port

(1) Environmental Impact Assessment Measure

The environmental impact assessment includes environmental impact assessment in project level (EIA) and in the level of plans, strategies and programs (SEA). EIAs and SEAs are considered as vital tools for protecting environment from economic development projects and for realizing sustainable development. Because, it is important to identify potential impacts early in the planning process and to make provisions for avoiding or mitigating these effects wherever possible. Failure to identify potential impacts may result in delays and cost increases later on in the project's development.

However, the problems arise from Vietnam context are the enforcement and effectiveness of the environmental impact assessment in the transportation development projects and applying the research results of EIA and SEA documents in the project's implementation as well as operation periods. Sometime most of EIA reports or SEA documents have been done as a requirement of administrative procedures, and not duly focused on its intended main purpose of environmental protection. The effectiveness and efficiency of EIA reports and SEA documents deeply depend on the monitoring of the negative environmental impacts and to undertake mitigation measures during the project implementation and operation periods.

The classification of appraising EIA and SEA are detailed in Vietnam's Law on Environmental Protection (2005), and Decree 80/CP (2006) which guides its implementation. Pursuant to this

law, EIA and SEA appraisal process in Viet Nam are classified as follows:

(i) Ministry of Natural Resources and Environment (MONRE): Responsible for EIA and SEA appraisal for interdisciplinary and interprovincial projects and projects approved by Government, National Assembly, and Prime Minister.

(ii) Ministries, Ministerial – level agencies, Government bodies: Responsible for EIA and SEA appraisal for projects approved by their authority except interdisciplinary projects

(iii) Peoples' Committees of provinces and/or central cities: Responsible for EIA and SEA appraisal for projects in their localities and for projects approved by their authority and their people council – level.

(2) Land Use Planning Measure

Suitable land use planning can help to avoid environmental conflicts and mitigate negative environmental impacts. However, this measure can be considered as long-term solution, which needs the corporation and coordination among all kind of development actions and plans.

(3) Environment Protection System In Transport Sector

According to the Law on Environment Protection (2005), the Government unified the state's environmental management of the whole country and Ministry of Natural Resource and Environment (MONRE) is responsible to government for unifying management of environmental protection. Ministry of Transport (MOT) coordinates with MONRE to implement environmental protection in MOT's sector or branches according to its functions, tasks and authority. The Department of Science and Technology, which belongs to MOT, directly implements environmental protection measures in transport sector.

In order to implement environmental protection in transport sector, the MOT is responsible for developing and applying environmental standards, appraising and approving environmental impact assessment (EIA) as well as strategic environment assessment (SEA) report in transport sector.

Environment protection policies in transport sector: In current situation, after Vietnam joined WTO, many investment projects have been ongoing in Vietnam which leads to development of transport infrastructure system. However, in order to avoid damage on environment and for sustainable development, environment protection management systems at all levels of government were studied and established. With the replacement Environmental Protection Law 1994 by Law on Environment Protection 2005, the Government Decree No 80-CP on guideline Law implementation and the Circular No. 08- TT-BTNMT on guideline to implement environmental impact assessment and strategic impact assessment were issued. The functions and tasks of Ministry of Transport also mentioned in those documents. In order to mitigate adverse environmental effect by transport activities, the following policies were applied in transport sector:

(4) Transport Infrastructure Development

(i) Studying and providing out guidelines for Strategies on Environmental Assessment in transport sector;

(ii) Improving effectiveness of Environmental Impact Assessment reports and its implementation;

(iii) Raising environment awareness;

(iv) Integrating transport development plan into local land use

(5) Transport Activities

(i) Tightening emission standard and strengthening effects of current standard;

(ii) Integrating environmental protection policies into importing and exporting policies;

(iii) Transport demand management;

(iv) Enhancing fuel composition quality and promoting cleaner alternative fuel use.

4) Proposed Mitigation Measures

Since the planning in VITRANSS 2 is just at preliminary, the correction and change of route proposals has not been reported. Planning of linking routes and power supply stations have not been made, these maters must be concerned in the later planning version. This chapter is only dealing with mitigation methods as well as orientation of environment impact assessment for high-speed railway planning.

(1) Recommendation of Alternative Adjustment

(a) Road Subsector

Developing strategy for road specialty mentioned issues such as: upgrading road network competence, allocating transport to improve transport safety and effect, protecting road assets, improving road construction quality, increasing safe methods, environment in transportation. In order to make strategy more completed, the report on assessing strategic environment proposes some adjustments with the aim of optimizing targets, oriented-development for road specialty as following:

(i) Strategy: it is necessary to propose strategy on constructing stop and rest network station to ensure environment and traffic safety. Stop and rest stations will have design for restaurant areas, motels, gas station, vehicle maintaining station, toilet system, car park.

(ii) Government should be increasing vehicle exhaust emission criteria to reduce exhaust fume pollution for meeting the demand of environmental protection in national scope and incompliance with process of international integration.

(b) Port and Shipping Subsector

With advantage of long coastal line, Vietnam has considered as having a number of suitable areas to develop sea ports and deep water ports. with the trend of rapidly increase in international transport demand, development of sea ports has been indentified as main priority. However, recently good and passenger transported by ships is relatively low and Vietnam has still not utilized the strengthen of the transport mode yet, due to infrastructure underdevelopment, low logistic services leading to long travel time.

Beside, water transport has been considered as lower emission and fuel save transport mode per unit of transported goods and passenger. Thus, in the coming years, to compete with countries in the region and cope with green house gasses emission and global warming, water transport development in Vietnam is indispensable. Main constrains the Vietnam has been identified are infrastructure development and ship fleet modernization. Regarding to infrastructure development Vietnam has set up plans to develop its port network and mobilize capital and resource from several sources, but rapidly develop port infrastructure will result in a lot of environmental issues, thus these environmental impacts need to be considered during planning period. Location of ports, specially deep water ports must be considered carefully to avoid the environmental sensitive areas and recorded wetland areas.

Table 4.2.6 CO_2 Emission Rates of Various Transportation Modes

Mode	Emission Rate (g – CO_2 / ton-km)	
	Source [1)]	Source [2)]
Truck	173	[69]
Rail way	22	29
Shipping	39	35
Aviation	1490	665

1) The Guidelines for CO_2 Emission Calculation in the Logistics Sector, METI and MLIT of Japan.
2) Mobility Networks Logistics DB AG, in VISTRANSS 2 interim report

Therefore, fuel saving, air pollution emission and other transport cost need to be taken place when making plan of allocation of good transport demand share, specially North-south and international transport. However, to avoid environmental risks, the pollution prevention and control need to be build up for vessels in both side of capacity building and equipment purchase.

Vietnam is appreciated that is one of five countries, which is seriously affected by climate change and sea water level rising. However, there is lack of studies about the impacts of these phenomenons on Vietnamese coastal zone. So, in future it is necessary to take into account sea water level raising issues when designing and constructing ports.

With plan for improving Cai Lan Port and constructing Van Phong gateway port is needed to consider:

(i) In North, Lach Huyen Port construction project is considered as a gateway port, thus there is no pressure of port capacity, meanwhile, if Cai Lan Port is improved more, environment effect will be very high because Cai Lan Port is belong to Ha Long Bay. For the long term development of this port, it is strongly recommended that a cleaner vessel and pollution control for shipping in this port should be carefully put in priorities.
(ii) In case of Van Phong Port, the capacity of Central ports is still high, besides, in general, natural condition is appraised that is inappropriate to develop port in the Van Phong Bay area. Only Dam Mon has considered as meet the demand to develop port, but this area is also evaluated that presenting a typical and diversified coral ecosystem, and quite suitable to develop eco-tourism. Therefore the new port plan in this area must be carefully assessed.

Referring to ship fleet development not only priority modernization target but also focus on developing environmental friendly ship as well as targets of fuel saving, alternative clean fuel development.

(c) Inland Transport Subsector

For the Mekong river delta: Inland water transport should be considered as the main shares of transport demand in the region due to several reasons as below:

(i) Wetland, including inland wetland and tide wetland, covered about 95,88% of total natural land area in the Mekong River Delta,
(ii) Beside, due to dense river network and most of crowded urban areas located along the river sides as Tien River, Hau River, Sai Gon River, which facilitate for easy goods transport and passenger travel by inland water transport in the region wide. .
(iii) In addition, develop water transport is also meet the targets of air pollution reduction due to this kind of transport has been known that cleaner transport means.

(iv) Moreover, rapid development of road and railway infrastructure in the Mekong delta in the few years has been considered as concrete walls on the region, and also resulted in many serious environmental problems such water and soil acidification and promotion of seawater intrusion phenomena, jeopardize proper flood control as well as encroachment of cultivated land in the region.

5) Proposed Technical Mitigate Measures

(1) Road Sector

(a) Air Pollution

Air pollution mainly is caused by emission of road transport vehicle. Therefore, it is necessary to propose pollution reduction solution for transport vehicle.

(i) Controlling exhaust fumes of road transport vehicle, progressing itinerary for applying standard EURO 4.

(ii) Reinforcing checking and period maintaining tasks of road transport vehicle:

(iii) sing replacing fuel including natural gas CNG, liquidizing petrol gas LPG, biological and electrical fuel. Replacing fuel is known as super-clean fuel, low dismissing polluted gas, however in order to success in changing fuel, it is necessary to consider factors such as: available fuel, distributing system, fuel selling station and expenses relating to changing vehicle structure, maintenance and operation.

(iv) In plan, planting range of trees on two sides of the road to reduce air pollution and noise.

(b) Noise Pollution

(i) **Installing Noise Barriers:** Noise barriers are designed to cut off direct sound from various sources, aiming to diminish noise levels through energy losses that are created upon the occurrence of sound diffraction. When new roads are scheduled to be built, environmental impact assessment should be carried out to evaluate the environmental impact. If the predicted noise level exceeds the prescribed limit, noise barriers should be installed to maintain the quality of living.

(ii) **Reducing Road Traffic Noise At Sources:** To reduce road traffic noise pollution, the Government should be tightened permissible limits, cracked down on illegal vehicle modifications such as muffler alterations, encourage research and develop better noise reduction technologies, impose more stringer noise standard for new vehicles and promote the sale and use of low-noise vehicles such as electric cars.

(iii) **Land Use Planning:** Incorporating mitigation of traffic noise in town planning strategies, the following measures should be followed:

- Zoning land and planning urban projects with the considerations of noise factor;
- Building bypasses and ring roads; and
- Establishing buffer zones on both sides of a road.

For expressway, the following additional solutions can be used:

(i) Building Buffer Space between Transport Line and Residential Area: This solution is applied popularly on high-speed road, expressway of Japan and other developed countries. The main purpose of this buffer zone is to reduce traffic noise which cause environmental problems at residential area next to transport road. The width of buffer zone is around 10 to 20m depending on type of road surface and transport volume.

The buffer zone is usually built along main transport road, expressway with four-lane and over.

(ii) Inside buffer zone, planted trees, noise retaining sign, pavement, bicycle line can be built and that is also the way to use land in surrounding area. The buffer zone is not only to reduce noise but also to reduce the dispersion of transport vehicle emission and restrict vibration transmittance.

(iii) Building noise retaining sign: This is also the solution is being used popularly on national expressway. There are three types of plank used as noise retaining sign; noise retaining sign made of metal; concrete and plastic.

(c) Acquisition Land Resources

Selecting planning methods so that using land for agriculture is diminished maximum; Building soil map of planning area, avoiding sensitive road line such as: subsidence area, landslide area.

(d) Reducing Impacts on Ecosystem

Selecting planning methods so that ecological impacts are diminished. If the road is compelled to go through, it should have thorough researches in terms of biological diversity, operating habitat of plants and animals in order to propose diminishing solutions in compliance with each ecological area.

(e) Reducing Impacts caused by Landslide

Early determining sections, routes go through weak geology, risk with landslide. In design and construction should be applied appropriate technical measures such as talus reinforce, application vetiver grass technology of the stabization of road infrastructure. Vetiver grows up to 1.5–2.5 m high, its crown stays in clumps and its stems are erect, strong and hard, therefore the plant can form hedgerows easily when it is planted densely along the contour. Vetiver has deep, massive and rapid – growing roots, which can grow down to 2–3 m in one year. 2–3 year old roots can down to 5 meters. Moreover, the roots have great tensile strength, reaching 1/6 the ultimate tensile strength of mild steel (Hengchaovanich, 1988). These properties enable it to anchor soil and keep the soil stable even under the condition of heavy downpours or floods[1].

Vietnam has two centers for vetiver research (including Can Tho University and Mekong University. Can Tho University has a commercial-scale vetiver grass nursery.

[1] http://www.vetiver.org/ICV3-Proceedings/CHN_quarry.pdf

Photo 4.2.1 Vetiver along Ho Chi Minh Highway, Planted in Combination with Conventional Retaining Wall[2]

Source: Vietnam Transport Network Development Project, Initial Examination Environment on Lam Dong province, TERI, 2007

Several projects have been applied this technology such as Ho chi Minh Highway and Vietnam Transport Network Development Project (ADB funded)

6) **Solid Waste and Water Quality Protection:** wasted materials, wastage on site, organic, inorganic substances from daily activities, waste water in construction stage, etc., must be collected, treated to control the land and surface water pollution by oil and chemical and others pollutants.

7) **Inundation Solutions:** the design should consider the high of road –bed, drainage systems.

(1) Expressway Subsector

(a) Land Acquisition

(i) Selection of alignment that minimizes that the impact such as resettlement and acquisition of farm land.

(ii) Planning and implementation of appropriate land acquisition plan and resettlement/rehabilitation plan through public participation.

(iii) Installation of grievance mechanism to monitor and address social issues.

(b) Impacts to Natural Ecosystems

Selection of alignment or structure that avoids or minimize the impact to natural ecosystems, especially section of alignment pass though the buffer zone of Bach Ma National Park, Phong Dien Natural Reserve and Han Dam ecotourism, flyovers and bridges should be considered in design period.

(c) Landslide and Flooding

Proposed technical mitigate measures in North – South expressway will be as the same proposed technical mitigate measures in road sector.

[2] Paul Trong, Visit to Vietnam notes. Jan. 2005

(d) Economic and Social Conditions

Cultural heritage: Selection of alignment or structure that avoids or minimizes the impact to culturally important sites or sceneries; Aesthetic design of flyovers and bridges.

(e) Air pollution and Greenhouse Gases

Proposed technical mitigate measures in North-South expressway will be as the same proposed technical mitigate measurements in road sector.

(f) Noise Pollution and Vibration

For expressway, the following additional solutions can be used:

(i) Building buffer space between transport line and residential area: This solution is applied popularly on high-speed road, expressway of Japan and other developed countries. The main purpose of this buffer zone is to reduce traffic noise which cause environmental problems at residential area next to transport road. The width of buffer zone is around 10 to 20 m depending on type of road surface and transport volume. The buffer zone is usually built along main transport road, expressway with four-lane and over.

(ii) Inside buffer zone, planted trees, noise retaining sign, pavement, bicycle line can be built and that is also the way to use land in surrounding area. The buffer zone is not only to reduce noise but also to reduce the dispersion of transport vehicle emission and restrict vibration transmittance.

(2) Railway Subsector

(a) Air Pollution Impacts and Climate Change

Railway has been known as clean transport; therefore the effects of railway air pollutants are minor. The consequence of climate change on national railway system must be studied in order to have appropriate consolidation. Avoiding constructing new bridges and tunnels, and giving out mitigation methods of detail conditions.

(b) Geological Condition

The alignment which runs through flood flash and landslide area much be taken into account for consolidated planning. Geological survey must be done to determine appropriate tunnel alignment.

(c) Biological System

Planning upgraded, new alignment locate far from biological zones. New cross road is constructed correspondent to environment, avoiding split environment.

(3) Port and Shipping Subsector

(a) Mitigating Effects to Water Resources

During detail design should focus deeply on major effect to propose mitigate measurements appropriately, such as reducing the effect on hydrograph regime, coastline, bank rivers, as well as protecting surface water quality and constraining acidification and seawater intrusion.

Referring to ship fleet investment plans, it is necessary to build up waste control action plan for each kind of fleet that expected to invest.

(b) Mitigating Effects to Fauna and Flora

To mitigate the impacts on fauna, flora and ecosystem, It is needed to deeply studies about in

term of ecosystem characters, physiological cycle, genera and species diversify in order to propose appropriate construction period and technologies.

Building up long-term plan to recover natural environment of seriously affected ecosystems.

(c) Mitigating Affects to Social

During planning phase, it is necessary to consider benefits and affects of beneficiary groups. Leaving out developmental actions that can create conflicts and social gaps and integrating community development programs into plan action plans.

It is needed to carry out stable and suitable resettlement policy for each local community in order to limit culture shock, tradition erosion, and social evils.

(d) Mitigating Effects to Land Use Conversion

To mitigate the impacts of land use conversion on local communities, resettlement policy frame and guide need to prepare appropriate for each social groups, and local people's cultivation habits, as well as their belief. Beside, it is gratefully paid attention to compensation policies for affected local people.

(e) Building Up Program of Environment Risk Prevention

Environment risk prevention program is taken to avoid and cope with accidents during transportation such as oil spills, harmful goods leak which may cause serious environmental impacts and harmful matter that is disposed to the environment, originated from accidents through transportation.

(4) Inland Water Transport Sector

(a) Water Pollution Mitigate Measure

Impacts on water quality is the most importance impacts of inland water transportation, several measures are recommended during planning and construction activities to mitigate impacts in water as below:

(i) Building up pollution control programs for the vessels and the port services, specially oil spill prevention

(ii) Study on the soil characters of the region to avoid development activities on the sensitive areas

(iii) Planning the mud keep yards as well as design appropriate treatment technologies during infrastructure development.

(iv) For the projects in the estuary and depression areas need to been assessed the water acidification and seawater intrusion phenomena as well as propose mitigation measures.

(b) Natural Ecosystem Encroachment

Inland water transport will causes effects mostly on wetland ecosystem, especially in Mekong River delta region. To minimize the impacts, several measurements could be proposed as below:

(i) Study and identify character of natural ecosystem in the region.

(ii) Classify biodiversity if the planning areas: terrestrial, aquatic species.

(iii) Assessing the environmental value of these ecosystems such as: natural conservation areas, natural reservation areas, flood prevention areas,..

(iv) Study about geology, soil of bottom, hydrography regime of planned lines to indentify main impacts of projects on surrounding ecosystems.

(c) Mitigating Effects on Soil Quality and Prevent Acidification and Seawater Intrusion

Development of inland water transportation infrastructure in the estuary and wetland areas which is necessary to carry out study carefully and scientifically or inherit results from others to indentify the high acidification sensitive areas, as well as volume of potential alum in the project areas. Thus, during planning period, development project need to avoid high potential alum volume areas or must propose mitigation measure early to control water and soil acidification, specially, for the projects of dredge, enlarge and increase loading capacity for the inland water transport lines.

Beside, monitoring programs need to be built to supervise alum spread out in the soil and water environment in the project areas.

(d) Building Up Pollution Control Programs

Main purposes of these programs is to control and mitigate waste discharge from vessels and port service activities.

(i) Program on waste water and oil sludge discharge control.

(ii) Program on garbage and solid waste elimination control.

(iii) Program on environmental risk and accident prevention, including oil spill.

(iv) Environmental capacity building for port and vessel staffs.

(5) Aviation Subsector

For aviation planning, the mitigation environmental methods in construction period will be mentioned in environmental impact assessment report. This chapter only mentions macroscopic mitigation methods.

(a) Air Pollution

The direct impacts in rehabilitation and construction of airport infrastructure are local, however, indirect impacts such as increasing arrive and departure flights, increasing ground activities will cause air pollution in regional and global scale. In order to mitigate, aside from infrastructure planning, aviation transport planning also must be considered, as well as quantity of oil used for aviation sector also forecasted, oil quality standard must be issued and vehicles shall meet air pollution emission standards.

(b) Noise Pollution

Mitigation of noise impact in residential area by plan new airports station far from residential area, mitigate noise level at sources and plan the green belt around airports.

(c) Waste Water

At present, only Noi Bai airport has waste water treatment plant, therefore, if new airport are planned or expanded any current airport, treatment plant must be provided. Due to airport operation including many companies, from preparing meal to repairing workshops, therefore waste treatment plant must be built to meet Vietnam standard.

6) Orientation of Environmental Impacts Assessment to Component Project

Regarding the implementation of environmental impacts assessment for types of investment project in road planning development; it is necessary to follow Government's Regulation and

guidelines of Ministry of Environment and Resources. Project types, however, need to thoroughly examined in terms of environment before granting construction permit such as expressway construction, projects go through Nature Reserve, National Parks, and biosphere reserve area.

Table 4.2.7 Specially Considered Themes in EIA of Projects having Potentiality of Serious Environment Impacts

No	Types of Project	Themes Need Special Consideration		
		Pre-Construction Stage	During Construction Stage	Implementation Stage
Road Subsector				
1.	Construction projects of expressway, national, provincial and district road	• Impacts to natural ecosystem • Impacts arising from land acquisition and resettlement	• Air pollution • Noise and vibration pollution • Impact to water environment, aquatic fauna, flora and plankton. • Changing landscape, current, flood • Solid waste, daily living waste during construction process	• Air pollution by using fuel, dust... • Noise pollution
2.	Project for transportation development	• Impacts arising from land acquisition and resettlement	• Air pollution • Noise and vibration pollution • Solid waste, domestic waste during construction process • Hazardous solid wastes generated in the construction stage are oil-contaminated wastes. • Impact to water environment, aquatic fauna, flora and plankton	• Air pollution by using fuel, dust. • Noise pollution • Changing biological habitat, biological rhythm disturbance of some plant and animal species by transport vehicle's noise
Railway Subsector				
1	Improving the existing line for capacity expansion to provide 50 trains / day frequency of service on a single truck in Hanoi – Saigon line	• Land acquisition for the project; • Geological survey to identify location of settlement and landslide potentiality; • Computation and examination of vibration; • Long – term impacts of climate change on project location	• Local air pollution at construction area • Noise impact from construction machine operations • Water pollution when the railway passes through rivers or streams • Changes of landscapes, flowing current, flood	• Noise pollution • Air pollution • Solid waste management
2	Construction a new railway between Trang Bom and Vung Tau.	• Impacts of project location on natural ecosystem; • Resettlement impacts; • Social – economic impacts if station planning is inappropriate; • Long – term impacts of climate change on project location.	• Air pollution; • Noise pollution; • Water pollution when the railway passes through rivers or streams; • Changes of landscapes, flowing current, flood	• Noise pollution; • Air pollution; • Solid waste management.
Port and shipping				
	Developing gateway ports and improvement current ports	• Effects of project location on natural ecosystem. • Waste carried capacity of self-clearing abilities of project area. • Effects from resettlement and site clearance	• Environment pollution. • Change hydrographic system, deposition, rosion (forecasting model) • Effects to ecosystems: marine, sea grass, cuphorbia, salt-marsh forest.	• River, sea, bay water source pollution. • Oil spread risk, affect to water, marine, aquatic quality. • Effect to national park, natural preservation area.
Inland water transport				
2	Improving water transportation infrastructure	• Effects of project location on natural ecosystem. • Accepting waste ability,	• Sand, water environnent pollution. • Erosion, costal zone depositing. • Effect to aquatic ecosystems in	• River water, lower section environment pollution

No	Types of Project	Themes Need Special Consideration		
		Pre-Construction Stage	During Construction Stage	Implementation Stage
		self-clearing (self-transporting ability) of project area. • Effects from clearing the ground– Resettlement • Total effects to lower section	project area and lower section	• Environment problem: oil, harmful matter overflow. • Effects to lower section community living
Aviation				
1	Extension of runway, construction of new airplane parking field, construction of terminal	• Occupation of land for the project • Computation and examination of vibration	• Local air pollution at construction area • Noise impact from construction machine operations	• Indirect impacts due to increase of passenger amount • Air pollution and noise due to increase in number of airplanes • Pollution by solid and liquid waste.

7) Built Environment Management and Monitoring Plans

Environmental (and social) management and monitoring plans for each of project pre-construction, construction and subsequent operation stages shall be formulated and implemented by later EIA studies and subsequent environmental management and monitoring implementation measures. These environmental measures will be conducted during later detailed planning engineering design, construction and operation period of the projects. This is necessary to conform to relevant environmental and social regulation of Vietnam. Moreover, concerned to resettlement of project affected people (PAPs) and the required RAPs (Resettlement Action Plan) shall be formulated and its implementation and monitoring shall be conducted in compliance with relevant social and resettlement regulations and guidelines of Vietnam.

8) Necessary Actions

These impacts are able to minimize or resolve by the following actions:

(1) Adequate Resettlement Action Plan

To minimize environmental impacts to residents, resettlement action plans (RAPs) should be planned and implementation of compensation should be implemented in accordance with RAPs adequately.

(2) Route/Site Selection Considered Disaster and Protected Areas

(a) **Risk of Earthquake in North West Region and Red River Delta:** Some railway sections and national roads in the north are built on or slightly away from these high seismic intensity zones. Detail studies on faults and seismic condition including geographic survey, and the necessity on adoption of design standard for earthquake are required.

(b) **Disaster Management (at Central Coastal Region):** The narrow plains area is concentrated by many transportation development, there fore integrated disaster management plan should be implemented especially in the Central Coast region including Hue city.

(c) **Natural Conservation:** At the selection of routes or sites for transportation development, routes or sites should not plan in the protected area and should avoid to damage forest resources.

(d) **Coastal Zone Management:** Main transportation development will be proposed in this coastal zone, therefore integrated coastal management plan should be implemented.

(3) Pollution Control

(a) **Pollution Control in Hanoi and HCMC:** Integrated pollution control plan should be implemented. Main countermeasures are (i) monitoring system, (ii) traffic management, (iii) traffic signal systems, and (iv) road system design.

(b) **Solid Waste Management:** A system on surplus matters for flexible use among developments should be examined.

(4) Implementation of SEA & EIA

MOT, as a responsible agency, should implement the (i) SEA for the master plan of VITRANSS 2, (ii) EIA for priority projects of North-South Expressways, and (iii) environmental study for priority sections of North-South High-speed Railway

(5) Legal Settings of Standard for Aircraft Noise and Noise of High-Speed Railways

Vietnam has not yet established environmental standards for aircraft noise and noise for high-speed railways. MOT shall have a discussion with MONRE to provide the necessary action.

Annex

Table 4.2.8 1:50,000 Topographic Sheets (2004 data) Available with VITRANSS 2

No	Series Code	Half	Name	Use	
1	F-48-68-D		Ha Noi	rw	rpt
2	F-48-69-D		Bac Ninh		rpt
3	F-48-80-B		Ha Dong	rw	rpt
4	F-48-81-A		Ke Sat		rpt
5	F-48-81-B		Hai Duong		rpt
6	F-48-82-A		Hai Phong		rpt
7	F-48-82-B		QUang Yen		rpt
8	F-48-80-D		Phu Ly	rw	
9	F-48-81-C		Hung Yen		
10	F-48-81-D		Dong Hung		
11	F-48-82-D		Do Son		
12	F-48-92-B		Ninh Binh	rw	
13	F-48-93-A		Ninh Dinh	rw	
14	F-48-93-B		Thai Binh		
15	F-48-92-D		Bim Son	rw	rpt
16	F-48-93-C		Phat Diem		rpt
17	E-48-8-A		Trieu Son		
18	E-48-8-B		Thanh Hoa	rw	rpt
19	E-48-8-C		Nong Cong	rw	rpt
20	E-48-20-A		Khoa Truong	rw	rpt
21	E-48-20-C		Cau Giat	rw	rpt
22	E-48-32-A		Cua Lo	rw	rpt
23	E-48-32-B	X	Hoi Thuy		
24	E-48-32-C		Thanh Pho Vinh	rw	rpt
25	E-48-32-D	X	Nghi Xuan		rpt
26	E-48-44-A		Hoi Trung	rw	rpt
27	E-48-44-B		Ha Tinh		rpt
28	E-48-44-C		Huong Khe	rw	
29	E-48-44-D		Ho Ke Go	rw	
30	E-48-45-C		My Phong		
31	E-48-56-B		Kim Lu	rw	
32	E-48-57-A		Dong Le	rw	

No	Series Code	Half	Name	Use	
33	E-48-57-B		Ba Don	rw	
34	E-48-57-C		Thon 4		
35	E-48-57-D		Quyet Thang	rw	
36	E-48-58-C	X	Hoan Lao	rw	
37	E-48-69-B		Xung Kich		
38	E-48-70-A		Dong Hoi	rw	
39	E-48-70-C		My Duc	rw	
40	E-48-70-D		Kien Giang	rw	
41	E-48-71-C	X	Ho Xa		
42	E-48-82-B		Cam lo		
43	E-48-83-A		Dong Ha	rw	
44	E-48-83-C		Hai Lang	rw	
45	E-48-83-D		Phong Dien	rw	
46	E-48-84-C	X	TT Sia		
47	E-48-95-B		Binh Duong		
48	E-48-96-A		Hue	rw	
49	E-48-96-B	X	Phu Loc	rw	
50	E-48-85-A	X	Dong An	rw	
51	E-48-96-C		Khe Tre		
52	E-48-96-D		Bai Dap		
53	E-48-85-C		Da Nang	rw	
54	E-48-85-D		Nui Son Tra		
55	E-48-12-B	X	Thanh My	rw	
56	D-49-1-A		Vinh Dien	rw	
57	D-49-1-B		Hoi An	rw	
58	D-49-1-C		Tan An		
59	D-49-1-D		Tam Ky	rw	
60	D-49-2-C	X	Huong Tra 2	rw	
61	D-49-13-B		Tien Ky		
62	D-49-14-A		Nui Thanh	rw	
63	D-49-14-B	X	Chau O	rw	
64	D-49-14-C		Hung Nhuong Nam		
65	D-49-26-A		Ba To		
66	D-49-26-B		Mo Duc	rw	
67	D-49-27-A	X	Thuy Thach		
68	D-49-26-D		Hung Long		
69	D-49-27-C	X	Tam Quan	rw	
70	D-49-39-A		Bong Son	rw	
71	D-49-39-C		Phu My	rw	
72	D-49-51-A		Qui Nhon	rw	
73	D-49-51-B	X	Hai Dong		
74	D-49-50-D		Thuan Van	rw	
75	D-49-51-C		Chanh Loc	rw	
76	D-49-63-A		Chi Thanh	rw	
77	D-49-63-B	X	Phu Hoi		
78	D-49-63-C		Phong Hau		
79	D-49-63-D	X	Tuy Hoa	rw	
80	D-49-75-A		Lac Dien		
81	D-49-75-B		Ban Thanh	rw	
82	D-49-75-C		Van Gia	rw	
83	D-49-75-D		Khai Luong	rw	
84	D-49-87-A		Nha Trang	rw	
85	D-49-87-B	X	Ninh Tinh		
86	D-49-87-C		Xuan Lap	rw	
87	C-49-3-A		Cam Ranh	rw	
88	C-49-2-D		Phan Rang-TCham	rw	
89	C-49-3-C		Khanh Hai	rw	
90	C-49-14-A		Ca Vuong	rw	

No	Series Code	Half	Name	Use	
91	C-49-14-B		Lac Nghiep	rw	
92	C-49-13-C		Ma Lam	rw	
93	C-49-13-D		Hong Lam		
94	C-49-14-C	X	Phan Ri Cua	rw	
95	C-48-34-A		TP. HCM	rw	
96	C-48-34-B		Bien Hoa	rw	
97	C-48-35-A		Long Khanh	rw	
98	C-48-35-B		Gia Ray	rw	
99	C-48-36-A		Dong Hoa	rw	
100	C-48-36-B		Thuan Nam	rw	
101	C-48-25-A		Phan Thiet	rw	
102	C-48-34-C		Can Giuoc		
103	C-48-34-D		Binh Phuoc		
104	C-48-35-C		Phu My		
105	C-48-35-D		Phuoc Buu		
106	C-48-36-C		Lang Gang		
107	C-48-36-D	X	La Gi		
108	C-48-46-A		Go Cong		
109	C-48-46-B		Can Gio		
110	C-48-47-A		Vung Tau		
111	F-48-83-A		Ha Long		rpt
112	D-49-14-D		Quang Ngai	rw	
113	F-48-69-D		Pha Lai		rpt
114	F-48-70-C		Mao Khe		rpt
115	F-48-70-D		Uong Bi		rpt
116	F-48-71-C		Dong Mo		rpt
117	E-48-8-D		Sam Son		rpt
118	E-48-20-B+D		Tinh Gia	rw	rpt
119	E-48-45-A		Hung Hoa		rpt
120	C-48-22-D		Uyen Hung		rpt
121	C-48-23-C		Vinh An		rpt
122	C-48-33-B		Duc Hoa		rpt
123	C-48-33-D		Tan An		rpt

Source: VITRANSS 2 Study Team

The table including each maps number as listed in Vietnam's 1:50,000 scale topographic series key map

4.3 Conclusion and Recommendations

1) Conclusion

The VITRNASS 2 covered optimal development of all relevant transport sectors so as to be sustainable. In this regard, all efforts has been made to realize multi modal transport with due focus on energy efficient transport modes like railways and waterways including coastal shipping, in particular to link the north and south of Vietnam. The expressway developments have been optimized to primarily focus on the north-south expressway to link all major coastal cities along the way with Hanoi and HCMC. The route selection also focused to avoid extremely near coastal area to avoid potential adverse effects due to future rise in sea level. Also the mountainous route for the north-south expressway though theoretically a possible option is avoided since it would not only effectively serve the intended purpose of the socio-economic beneficial effect since population centers are located more near the eastern coastal area but also the mountainous terrain would be more disaster prone due to landslide and others in addition to the high construction costs related to excavation, tunneling and other mountainous terrain related construction works.

Moreover, while every effort shall be made in all transport sub-sector strategic plans to minimize involuntary resettlement of population, still it would be inevitable and could be significant in particular for the ROW (right of way) oriented sub-sectors of roads and railways (including expressways and NSHSR). In all such cases of involuntary resettlement, the minimum target of RAP (resettlement action plan) implementation should be “no decline in living condition of the PAPs (project affected persons) should occur consequent to the involuntary resettlement”.

2) Recommendations

(1) Roads (including expressways)

In selecting the road route alignments utmost attention shall be paid to minimize interference with ecologically important nature reserve areas and national parks and also minimization of involuntary resettlement of population in developed areas. Possible mitigation measures in case passage through such an ecologically important area is unavoidable include preferably underground passage across such area or at-least over-head passage on viaduct. Moreover, road traffic safety enhancement is a very important issue to be given due attention.

Regarding future control of air pollutant emissions as well as green house gas emission and also to enhance energy efficiency of road transport, incentives to promote purchase of energy efficient vehicles like hybrids and also vehicles that use cleaner fuels like natural gas (CNG, LPG) is recommended to be promoted with favorable tax incentive and other refueling station related infrastructure development and regulatory measures.

(2) Railways (including NSHSR)

Regarding railways at least until the year 2030 the primary focus of VITRNASS 2 is the improvement of existing railways to improve safety, speed and frequency of service with minimization of on-grade level crossings and double tracking as appropriate. In addition a new connecting rail-line to link the major port city of Vung Tau in the South with the existing truck north-south railway (Hanoi-HCMC) is added as major new railway development. Still, NSHSR (north-south high-speed railway) is regarded as financially not a viable option due to its high investment cost at-least until the year 2030, even tough its development in long-term would be necessary to control the growth in air travel and also as an environmentally friendly energy efficient mass transport mode. In this regard two options were studied. The option 1 on totally

new alignment would be preferable if the project is slated for late investment both for its high speed and also the flexibility in selecting the alignment that could be planned to avoid entirely lowland areas potentially affected due to rise in future sea level. The option 2 is to provide the alignment of high-speed railway mostly parallel to the existing railway and hence has less flexibility in selecting the route alignment.

Similar to road of above, minimization of interference with ecologically important areas and also minimization of involuntary resettlement in developed areas in selecting the route alignment of NSHSR is also very important.

(3) Inland Waterways

The 2 major inland waterways, Me Kong (Cuu Long) Delta in the south and Red River Delta in the north will be continuously developed to facilitate this less capital intensive and energy efficient transport mode to the optimum extent. Still, in particular in the Me Kong Delta due attention shall be given in selecting the location of such port terminals so as not to interfere with ecologically important coastal areas and wetland ecosystems including protected and nature reserve areas. Also in planning the port terminals potential future rise in river water stage due to rise in sea level has to be given due attention to the extent possible. Raising the level of port terminal to the extent possible while without affecting the safe functional requirement under the existing condition is regarded as the conceivable mitigation measure to cope with rise in rive stage at least in the medium term.

(4) Port and Coastal Shipping

Port and shipping is essential for international trade. Also domestic coastal shipping could be promoted to the extent possible for bulk cargo transport between north and south as energy efficient transport mode that would also relive pressure on long distance road transport trucks. Still, in planning port locations due attention shall be given to protect the ecologically important coastal zones and estuaries including the protected coastal areas (like mangrove forests and coral reefs) abundant along the eastern coast. In particular, Halong Bay is a world heritage site. Accordingly port development in these northern coastal areas of Hai Pong and Ha Long is recommended to avoid large-scale terminals to handle oil and noxious liquid carried in bulk as important safety risk mitigation measure against coastal pollution due accidental oil and noxious (liquid chemical) spills. Moreover, similar to inland waterway port terminals, raising the level of port terminals and related port protection structures like breakwaters to the extent possible while without affecting the safe functional requirement under the existing condition is regarded as the conceivable mitigation measure to cope with potential rise in sea level at least in the medium term and hence to be given due consideration in port designs.

(5) Civil Aviation

Civil aviation is indispensable as the fastest mode of transport for international and as well for domestic passenger travel and transport of cargo. The major civil aviation related development plan until 2030 is the construction of new Long Thanh International Airport in the south to serve HCMC and hence to replace the existing Tan Son Nhat Airport located near the city center of HCMC. Accordingly, the plan is in overall environmentally beneficial principally with respect to mitigation of noise nuisance in developed near city centre area. Moreover, navigation safety is incorporated as component of the civil aviation development strategy. Still, in deciding the location of future airports near coastal areas, potential future rise in sea level shall be given due consideration. This could be achieved with selecting a location at relatively high natural land elevation like 2m above sea level for new airports.

APPENDIX 3A

List of National Standards on Environment Quality

Appendix 3A

List of National Standards on Environment Quality

1 TCVN 5937-2005: Air Quality–Ambient Air Quality Standards

Unit: Microgram per cubic meter (µg/m^3)

Parameter	1 hour Average	8 hour Average	24 hour Average	Yearly average (Arithmetic Average)	Defined Measurement Method
SO_2	350	-	125	50	Pararosalin or ultra-violet fluorescent
CO	30000	10000	-	-	Non-dispersive Infrared (NDIR)
NO_2	200	-	-	40	Chemical gas mixed fluorescent
O_3	180	120	80	-	Ultraviolet Photometry
Total suspended particulate matter (TSP)	300	-	200	140	Collect large volume of sample-Mass Analysis
Dust ≤ 10µm (PM10)	-	-	150	50	Mass analyzing or Inertial separating
Pb	-	-	1.5	0.5	Collect large volume sample and atomic absorb fluorescent

Note: PM10: Total (fine) suspended particulate matter with aerodynamic size less 10µm;
Dash (-): Not regulated

2 TCVN 5938-2005: Air Quality–Maximum Allowable Concentration of Hazardous Substances in Ambient Air

Unit: Microgram per cubic meter (µg/m^3)

TT	Parameter	Chemical formula	Average Time	Allowable Concentration
Inorganic Substances				
1	Arsenic (inorganic compound calculated by As)	As	1 hours	0.033
			Year	0.005
2	Arsenic hydride (Asin)	AsH_3	1 hours	0.33
			Year	0.055
3	Hydrochloric Acid	HCl	24 hours	60
4	Nitric Acid	HNO_3	1 hours	400
			24 hours	150
5	Sulfuric Acid	H_2SO_4	1 hours	300
			24 hours	50
			Year	3
6	Dust with oxide silica > 50%		1 hours	150
			24 hours	50
7	Dust with asbestos: Chrysotil		8 hours	1 fibre/m^3
8	Cadmium (smoke including oxide and metal) as Cd	Cd	1 hours	0.4
			8 hours	0.17
			Year	0.005
9	Chlorine	Cl_2	1 hours	100
			24 hours	30
10	Hexavalent Chromium VI	Cr	1 hours	0.0067
			24 hours	0.003
			Year	0.0023
11	Hydrogen Fluoride	HF	1 hours	20
			24 hours	5
			Year	1
12	Hydrogen Cyanide	HCN	1 hours	10
			24 hours	10
13	Manganese and compounds (as MnO_2)	Mn/MnO_2	1 hours	10
			24 hours	8

TT	Parameter	Chemical formula	Average Time	Allowable Concentration
			Year	0.15
14	Nickel (metal and compounds)	Ni	24 hours	1
15	Mercury (metal and compounds)	Hg	24 hours	0.3
			Year	0.3
16	Acrolein	CH_2=CHCHO	1 hours	50
17	Acrylonitril	CH_2=CHCN	24 hours	45
			Year	22.5
18	Aniline	$C_6H_5NH_2$	1 hours	50
			24 hours	30
19	Acrylic Acid	C_2H_3COOH	Year	54
20	Benzene	C_6H_6	1 hours	22
			Year	10
21	Benzedrine	$NH_2C_6H_4C_6H_4NH_2$	1 hours	KPHT
			8 hours	KPHT
			24 hours	KPHT
			Year	KPHT
22	Chloroform	$CHCl_3$	24 hours	16
			Year	0.043
23	Hydrocarbon	C_nH_m	1 hours	5000
			24 hours	1500
24	Formaldehyde	HCHO	1 hours	20
			Year	15
25	Naphthalene	$C_{10}H_8$	8 hours	500
			24 hours	120
26	Phenol	C_6H_5OH	1 hours	10
			24 hours	10
27	Tetrachloroethylene	C_2Cl_4	24 hours	100
28	Vinyl chloride	$ClCH=CH_2$	24 hours	26
Substances with Unpleasant Smell				
29	Ammonia	NH_3	1 hours	200
			24 hours	200
30	Acetaldehyde	CH_3CHO	1 hours	45
			Year	30
31	Propionic Acid	CH_3CH_2COOH	8 hours	300
32	Hydrogen Sulfide	H_2S	1 hours	42
33	Methyl mecarpton	CH_3SH	1 hours	50
			24 hours	20
34	Styrene	$C_6H_5CH=CH_2$	1 week	260
			Year	190
35	Toluene	$C_6H_5CH_3$	30 minutes	1000
			1 hours	500
			Year	190
36	Xylene	$C_6H_4(CH_3)_2$	1 hours	1000
			Year	950

Note: Yearly average value as arithmetic average value;
KPHT: undetected

3 TCVN 5939-2005: Air Quality–Industrial Emission Standards for Inorganic Substances and Dusts (Suspended Particulate Matter)

Unit: Microgram per cubic meter (µg/m^3)

TT	Parameter	Allowable Concentration	
		A (Applicable to the Emission of Gases in Existing Sources)	B (Applicable to New Sources)
1	Particulate in smoke	400	200
2	Dust containing silica	50	50
3	Ammonia and ammonium compounds as NH_3	76	50
4	Antimony and compounds as Sb	20	10
5	Arsenic and compounds, as As	20	10
6	Cadmium and compounds as Cd	20	5
	Lead and compounds as Pb	10	5
8	CO	1000	1000
9	Chloride	32	10
10	Copper and compounds as Cu	20	10
11	Zinc and compounds as Zn	30	30
12	HCl	200	50
13	Fluoride (any source) as HF	50	20
14	H_2S	7.5	7.5
15	SO_2	1500	500
16	NO_x as NO_2	1000	850
17	NOx (acid manufacturing)	2000	1000
18	H_2SO_4 (or SO_3) as SO_3	100	50
19	HNO_3 (acid manufacturing) as NO_2	2000	1000
20	HNO_3 (other sources) as NO_2	1000	500

4 TCVN 5940-2005: Air Quality–Industrial Emission Standards for Organic Substances

No	Parameter	CAS	Chemical Formula	Allowable Concentration
1	Acetylene tetrabromide	79-27-6	$CHBr_2CHBr_2$	14
2	Acetaldehyde	75-07-0	CH_3CHO	270
3	Acrolein	107-02-8	CH_2=CHCHO	2,5
4	Amylacetate	62-53-3	$C_6H_5NH_2$	19
5	Aniline	628-63-7	$CH_3COOC_5H_{11}$	525
6	Benzidine	92-87-5	$NH_2C_6H_4C_6H_4NH_2$	KPHD
7	Benzene	71-43-2	C_6H_6	5
8	Chlorobenzyl	100-44-7	$C_6H_5CH_2Cl$	5
9	1,3 Butadiene	106-99-0	C_4H_6	2200
10	Butylaxetate	123-86-4	$CH_3COOC_4H_9$	950
11	Butylamine	109-73-9	$CH_3(CH_2)_2CH_2NH_3$	15
12	Cresol	1319-77-3	$CH_3C_6H_4OH$	22
13	Chlorobenzene	108-90-7	C_6H_5Cl	350
14	Chloroform	67-66-3	$CHCl_3$	240
15	ß-Chloroprene	126-99-8	CH_2=CClCH=CH_2	90
16	Chloropicrin	76-06-2	CCl_3NO_2	0,7
17	Cyclohexane	110-82-7	C_6H_{12}	1300
18	Cyclohexanol	108-93-0	$C_6H_{11}OH$	410
19	Cyclohexanone	108-94-1	$C_6H_{10}O$	400
20	Cyclohexene	110-83-6	C_6H_{10}	1350

No	Parameter	CAS	Chemical Formula	Allowable Concentration
21	Diethylamine	109-89-7	$C_2H_5)_2NH$	75
22	Difluorodibromomethane	75-61-6	CF_2Br_2	860
23	o-Dichlorobenzene	75-34-3	$C_6H_4Cl_2$	300
24	1,1-Dichloroethane	75-34-3	$CHCl_2CH_3$	400
25	1,2-Dichloroethylene	540-59-0	ClCH=CHCl	790
30	1,4 Dioxane	123-91-1	$C_4H_8O_2$	360
31	Dimethylaniline	121-69-7	$C_6H_5N(CH_3)_2$	25
32	Dichloroethyl ether	111-44-4	$(ClCH_2CH_2)_2O$	90
33	Dimethylformamide	68-12-2	$(CH_3)_2NOCH$	60
34	Dimethyl sulfate	77-78-1	$(CH_3)_2SO_4$	0.5
35	Dimethylhydrazine	57-14-7	$(CH_3)NNH_2$	1
36	Dinitrobenzene	25154-54-5	$C_6H_4(NO_2)_2$	1
37	Ethylacetate	141-78-6	$CH_3COOC_2H_5$	1400
38	Ethylamine	75-04-7	$CH_3CH_2NH_2$	45
39	Ethylbenzene	100-41-4	$CH_3CH_2C_6H_5$	870
40	Ethylbromide	74-96-4	C_2H_5Br	890
41	Ethylenediamine	107-15-3	$NH_2CH_2CH_2NH_2$	30
42	Ethylenedibromide	106-93-5	CHBr=CHBr	190
43	Ethylacrylate	140-88-5	$CH_2=CHCOOC_2H_5$	100
44	Ethylenechlorohydrin	107-07-03	CH_2ClCH_2OH	16
45	Ethyleneoxide	75-21-8	CH_2OCH_2	20
46	Ethylether	60-29-7	$C_2H_5OC_2H_5$	1200
47	Ethylchloride	75-00-3	CH_3CH_2Cl	2600
48	Ethylsilicate	78-10-4	$(C_2H_5)_4SiO_4$	850
49	Ethanolamine	141-43-5	$NH_2CH_2CH_2OH$	45
50	Furfural	98-01-1	C_4H_3OCHO	20
51	Formaldehyde	50-00-0	HCHO	20
52	Furfuryl (2-Furfuryl methanol)	98-00-0	$C_4H_3OCH_2OH$	120
53	Fluorotrichloromethane	75-69-4	CCl_3F	5600
54	n-Heptane	142-82-5	C_7H_{16}	2000
55	n-Hexane	110-54-3	C_6H_{14}	450
56	Isopropylamine	75-36-0	$(CH_3)_2CHNH_2$	12
57	Isobutanol	71-36-3	$(CH_3)_2CHCH_2OH$	360
58	Methylmercaptan	74-93-1	CH_3SH	15
59	Methylacetate	79-20-9	CH_3COOCH_3	610
60	Methylacrylate	96-33-3	$CH_2=CHCOOCH_3$	35
61	Methanol	67-56-71	CH_3OH	260
62	Methylacetylene	74-99-7	$CH_3C=CH$	1650
63	Methylbromide	74-83-9	CH_3Br	80
64	Methylcychlohexane	108-87-2	$CH_3C_6H_{11}$	2000
65	Methylcychlohexanol	25639-42-3	$CH_3C_6H_{10}OH$	470
66	Methylcychlohexanone	1331-22-2	$CH_3C_6H_9O$	460
67	Methylchloride	74-87-3	CH_3Cl	210
68	Methylenecloride	75-09-02	CH_2Cl_2	1750
69	Methylchloroform	71-55-6	CH_3CCl_3	2700
70	Monomethylaniline	100-61-8	$C_6H_5NHCH_3$	9
71	Methanolamine	3088-27-5	$HOCH_2NH_2$	31
72	Naphthalene	91-20-3	$C_{10}H_8$	150
73	Nitrobenzene	98-95-3	$C_6H_5NO_2$	5
74	Nitroethane	79-24-3	$CH_3CH_2NO_2$	310
75	Nitroglycerin	55-63-0	$C_3H_5(NO_2)_3$	5
76	Nitromethane	75-52-5	CH_3NO_2	250

No	Parameter	CAS	Chemical Formula	Allowable Concentration
77	2-Nitropropane	79-46-9	$CH_3CH(NO_2)CH_3$	1800
78	Nitrotoluene	1321-12-6	$NO_2C_6H_4CH_3$	30
79	2- Pentanone	107-87-9	$CH_3CO(CH_2)_2CH_3$	700
80	Phenol	108-95-2	C_6H_5OH	19
81	Phenylhydrazine	100-63-0	$C_6H_5NHNH_2$	22
82	Pyridine	110-86-1	C_5H_5N	30
83	Pyrene	129-00-0	$C_{16}H_{10}$	15
84	p- Quinone	106-51-4	$C_6H_4O_2$	0,4
85	Styrene	100-42-5	$C_6H_5CH=CH_2$	100
87	1,1,2,2-Tetrachloroethane	79-34-5	$Cl_2HCCHCl_2$	35
88	Tetrachloroethylene	127-18-4	$CCl_2=CCl_2$	670
89	Tetrachloromethane	56-23-5	CCl_4	65
90	Tetranitromethane	509-14-8	$C(NO_2)_4$	8
91	Toluene	108-88-3	$C_6H_5CH_3$	750
92	Toluidine	95-53-4	$CH_3C_6H_4NH_2$	22
93	Toluene-2,4-diisocyanate	584-84-9	$CH_3C_6H_3(NCO)_2$	0,7
94	Triethylamine	121-44-8	$(C_2H_5)_3N$	100
95	1,1,2-Trichloroethane	79-00-5	$CHCl_2CH_2Cl$	1080
96	Trichloroethylene	79-01-06	$ClCH=CCl_2$	110
97	Xylene	1330-20-7	$C_6H_4(CH_3)_2$	870
98.	Xylidine	1300-73-8	$(CH_3)_2C_6H_3NH_2$	50
99	Vinylchloride	75-01-04	$CH_2=CHCl$	150
100	Vinyltoluene	25013-15-4	$CH_2=CHC_6H_4CH_3$	480

5 TCVN 6438-2005: Air Quality–Road Vehicle Emission Standards (for Vehicles in Use)

Pollutants In Exhaust Gas	Vehicles Fitted with Spark Ignition Engines					Vehicle Fitted with Compression Ignition Engines		
	Automobiles			Mopeds Motorcycle				
	Limit 1	Limit 2	Limit 3	Limit 1	Limit 2	Limit 1	Limit 2	Limit 3
CO (% volume)	4.5	3.5	3.0	4.5	-	-	-	-
HCC (ppm volume)								
• Four stroke engines	1,200	800	600	1,500	1,200	-	-	-
• Two stroke engines	7,800	7,800	7,800	10,000	7,800	-	-	-
• Special engines	3,00	3,00	3,00			-	-	-
Smoke opacity (% HSU)	-	-	-	-	-	72	60	50

6 TCVN 5950-1995: Noise Standards for Vehicles

Vehicle Type	Permitted Noise (dBA)	
	New Vehicle	Old Vehicle
2-wheel vehicle, engine under 125 cc	79	92
2-wheel vehicle, engine over 125 cc and 3 –wheel motor vehicle	83	92
Tourist car under 12 seats	83	92
Light – lorry	84	92
Lorry and bus under 10,000 cc	87	92
Lorry and bus over 10,000 cc	89	92

7 TCVN 5951-1995: Permitted Vibration Standards

Category	Permitted Acceleration (m/s^2)		Permitted Line Acceleration (m/s^2)
	Vertical Vibration	Horizontal Vibration	
Category V	0.081 (78dBA)	0.057	0.066
Category W	0.054 (75dBA)	0.038	0.045

Note:
Category V: Vibration from industrial workshops, from surrounding areas and 15 meters from main roads.
Category W: Vibration in areas besides those under Category V.

8 TCVN 5949-1999: Maximum Permitted Noise Level for Residential and Public Areas

Area (*)	Time		
	6h–18h	18h–22h	22h–6h
1. Areas in need of special quietness			
Hospitals, libraries, nursing houses, kindergartens, schools, churches, pagodas, temples	50	45	40
2. Residential areas, hotels, guest houses, offices	60	55	50
3. Mixed areas (residential, commercial, production)	75	70	50

9 QCVN 08:2008-BTNMT: National Technical Regulation on Surface Water Quality

No	Parameters	Unit	Allowable Concentration			
			A		B	
			A1	A2	B1	B2
1	pH		6-8.5	6-8.5	5.5-9	5.5-9
2	DO (dissolved oxygen)	mg/l	≥6	≥5	≥4	≥2
3	TSS	mg/l	20	30	50	100
4	COD	mg/l	10	15	30	50
5	BOD_5 (20^0C)	mg/l	4	6	15	25
6	Ammonium (NH_4^+) as N	mg/l	0.1	0.2	0.5	1
7	Chloride (Cl^-)	mg/l	250	400	600	-
8	Fluoride (F^-)	mg/l	1	1.5	1.5	2
9	Nitrite (NO_2^-) as N	mg/l	0.01	0.02	0.04	0.05
10	Nitrate (NO_3^-) as N	mg/l	2	5	10	15
11	Phosphate (PO_4^{3-}) as P	mg/l	0.1	0.2	0.3	0.5
12	Cyanide	mg/l	0.005	0.01	0.02	0.02
13	Arsenic (As)	mg/l	0.01	0.02	0,05	0.1
14	Cyanide (CN^-)	mg/l	0.005	0.01	0.02	0.02
15	Arsenic (As)	mg/l	0.01	0.02	0.05	0.1
16	Chromium III (Cr^{3+})	mg/l	0.05	0.1	0.5	1
17	Chromium IV (Cr^{6+})	mg/l	0.01	0.02	0.05	0.05
18	Copper	mg/l	0.1	0.2	0.5	1
19	Zinc	mg/l	0.5	1.0	1.5	2
20	Nickel	mg/l	0.1	0.1	0.1	0.1
21	Iron	mg/l	0.5	1	1.5	2
22	Mercury	mg/l	0.001	0.001	0.001	0.002
23	Surfactant detergent	mg/l	0.1	0.2	0.4	0.5
24	Oil and grease	mg/l	0.01	0.02	0.1	0.3
25	Phenol (total)	mg/l	0.005	0.005	0.01	0.02
26	Pesticide (Organic Chlorine)					
26.1	Aldrin + Dieldrin	µg/l	0.002	0.004	0.008	0.01
26.2	Endrin	µg/l	0.01	0.012	0.014	0.02

No	Parameters	Unit	Allowable Concentration			
			A		B	
			A1	A2	B1	B2
26.3	BHC	µg/l	0.05	0.1	0.13	0.015
26.4	DDT	µg/l	0.001	0.002	0.004	0.005
26.5	Endosunfan (Thiodan)	µg/l	0.005	0.01	0.01	0.02
26.6	Linden	µg/l	0.3	0.35	0.38	0.4
26.7	Chlordane	µg/l	0.01	0.02	0.02	0.05
26.8	Heptachlor	µg/l	0.01	0.02	0.02	0.05
27	Pesticide (Organic Phosphorus)					
27.1	Parathion	µg/l	0.1	0.2	0.4	0.5
27.2	Malathion	µg/l	0.1	0.32	0.32	0.4
28	Gross alpha activity	Bq/l	0.1	0.1	0.1	0.1
29	Gross beta activity	Bq/l	1.0	1.0	1.0	1.0
30	E.Coli	MNP/100 ml	20	50	100	200
31	Coliform	MNP/100 ml	2500	5000	7500	10000

Note:
Values in the column A1 are applied to the surface water used for source of domestic water supply and other uses such as A2, B1 and B2
Values in the column A2 are applied to the surface water used for source of domestic water supply with appropriate treatments, protecting water for aquatic life
Values in the column B1 applied to irrigation or other uses
Values in the column B2 applied to water way and other sources with minimum water quality

10 QCVN 09: 2008/BTNMT: National Technical Regulation on Underground Water Quality

No	Parameters	Unit	Allowable Concentration
1	pH	-	5.5–8.5
2	Hardness (as $CaCO_3$)	mg/l	500
3	Total hardness	mg/l	1500
4	COD ($KMnO_4$)	mg/l	4
5	Ammonia (as N)	mg/l	0.1
6	Chloride (Cl^-)	mg/l	250
7	Fluoride (F-)	mg/l	1.0
8	Nitrite (NO_2^-) as N	mg/l	1.0
9	Nitrate (NO_3^-) as N	mg/l	15
10	Sulfate (SO_4^{2-})	mg/l	400
11	Cyanide (CN^-)	mg/l	0.01
12	Phenol	mg/l	0.001
13	Arsenic (As)	mg/l	0.05
14	Cadmium (Cd)	mg/l	0.005
15	Lead (Pb)	mg/l	0.01
16	Chromium VI (Cr^{6+})	mg/l	1.0
17	Copper (Cu)	mg/l	0.05
18	Zinc (Zn)	mg/l	3.0
19	Manganese (Mn)	mg/l	0.5
20	Mercury (Hg)	mg/l	0.001
21	Iron (Fe)	mg/l	5
22	Selenium (Se)	mg/l	0.01
23	Gross alpha activity	Bq/l	0.1
24	Gross beta activity	Bq/l	1.0
25	E-Coli	MPN/100 ml	Undetected
26	Coliform	MNP/100 ml	3

11 QCVN 14: 2008/BTNMT: National Technical Regulation on Domestic Wastewater

(1) Maximum Allowable Concentration of Pollutants in Domestic Wastewater

Maximum allowable concentration pollutants of domestic wastewater discharged into water bodies shall not exceed Cmax value which calculated as follows:

$$Cmax = C \times K$$

In which:

Cmax: Maximum allowable concentration pollutants of domestic wastewater discharged into water bodies (mg/l);

C: Concentration pollutants presented in Table 1;

K: Coefficient as a scale, service types, public facility and apartment provided in section 2;

This formula is not applicable for pH and total coliforms in wastewater.

(2) C Values of Pollutant Parameters for Calculating Maximum Allowable Concentration in Domestic Wastewater

Table 1 Pollutant Parameters Values for Calculating Maximum Allowable Concentration in Domestic Wastewater

No.	Parameters	Unit	C Value	
			A	B
1	pH	-	5 - 9	5 - 9
2	BOD_5 (20^0C)	mg/l	30	50
3	Total suspended solids (TSS)	mg/l	50	100
4	Total dissolved solids	mg/l	500	1000
5	Sulfide (as H_2S)	mg/l	1.0	4.0
6	Ammonia (as N)	mg/l	5	10
7	Nitrate (NO_3^-) (as N)	mg/l	30	50
8	Animal-vegetable fat and oil	mg/l	10	20
9	Total surface active substances	mg/l	5	10
10	Phosphate (PO_4^{3-}) (as P)	mg/l	6	10
11	Total Coliforms	MPN/ 100ml	3,000	5,000

In which:

- C values of pollutant parameters specified in the Column A are used to calculate maximum allowable values in domestic wastewater. This will be discharged into water bodies using for sources of domestic water (its water quality is equal to the values specified in the A1 and A2 column of National technical regulation on surface water)
- C values of pollutant parameters specified in the Column B are used to calculate maximum allowable values in domestic wastewater. This will be discharged into water bodies not using for sources of domestic water (its water quality is equal to the values specified in the B1 and B2 column of National technical regulation on surface water or coastal water quality).

(3) K Coefficient

Depending on types, scales and using area of service types, public facility and apartment,

residential area, K values are applied as given in the following table:

Table 2 K Coefficient Values

Type	Scale, Using Area	K Coefficient Value
1. Hotel, hostel	> 50 rooms or 3 stars hotel	1
	< 50 rooms	1.2
2. Office, school, Institute	≥ 10,000m^2	1.0
	< 10,000m^2	1.2
3. Department stores, supermarket	≥ 5,000m^2	1.0
	< 5,000m^2	1.2
4. Market	≥ 1,500m^2	1.0
	< 1,500m^2	1.2
5. Restaurant, food store	≥ 500m^2	1.0
	< 500m^2	1.2
6. Production facilities, army campus	> 500 persons	1.0
	< 500 persons	1.2
7. Apartment, residential area	> 50 apartments	1.0
	< 50 apartments	1.2

12 QCVN 10: 2008/BTNMT: National Technical Regulation on Coastal Water Quality

Table 1 Maximum Allowable Concentration of Coastal Water

No.	Parameters	Unit	Allowable Concentration		
			Aquaculture, Aquatic Conservation Zones	Seaside Resort, Aquatic Sport Zones	Other Areas
1	Temperature	^0C	30	30	-
2	pH		6.5-8.5	6.5-8.5	6.5-8.5
3	Total suspended solids (TSS)	mg/l	50	50	-
4	Dissolved oxygen (DO)	mg/l	≥ 5	≥ 4	-
5	COD ($KMnO_4$)	mg/l	3	4	-
6	Ammonium (NH_4^+) as N	mg/l	0.1	0.5	0.5
7	Fluoride (F^-)	mg/l	1.5	1.5	1.5
8	Sulfide (S^{2-})	mg/l	0.005	0.01	0.01
9	Cyanide (CN^-)	mg/l	0.005	0.005	0.01
10	Arsenic (As)	mg/l	0.01	0.04	0.05
11	Cadmium (Cd)	mg/l	0.005	0.005	0.005
12	Lead (Pb)	mg/l	0.05	0.02	0.1
13	Chromium III (Cr^{3+})	mg/l	0.1	0.1	0.2
14	Chromium VI (Cr^{6+})	mg/l	0.02	0.05	0.05
15	Copper (Cu)	mg/l	0.03	0.5	1
16	Zinc	mg/l	0.05	1.0	2.0
17	Manganese (Mn)	mg/l	0.1	0.1	0.1
18	Iron (Fe)	mg/l	0.1	0.1	0.3
19	Mercury (Hg)	mg/l	0.001	0.002	0.005
20	Oil and fats film	mg/l	No trace	No trace	-
21	Mineral oil	mg/l	Undetected	0.1	0.2
22	Total Phenol	mg/l	0.001	0.001	0.002
23	Plant protection -Organic Chlorine chemicals				
	Aldrin + Dieldrin	µg/l	0.008	0.008	-
	Endrin	µg/l	0.014	0.014	-
	B.H.C	µg/l	0.13	0.13	-
	DDT	µg/l	0.004	0.004	-

No.	Parameters	Unit	Allowable Concentration		
			Aquaculture, Aquatic Conservation Zones	Seaside Resort, Aquatic Sport Zones	Other Areas
	Endosunfan	µg/l	0.01	0.01	-
	Linden	µg/l	0.38	0.38	-
	Chlordane	µg/l	0.02	0.02	-
	Heptachlor	µg/l	0.06	0.06	-
24	Plant protection - Organic Phosphorus chemicals				
	Parathion	µg/l	0.40	0.40	-
	Malathion	µg/l	0.32	0.32	-
25	Herbicide				
	2.4D	mg/l	0.45	0.45	-
	2.4.5T	mg/l	0.16	0.16	-
	Parquet	mg/l	1.80	1.80	-
26	Gross alpha activity α	Bq/l	0.1	0.1	0.1
27	Gross beta activity β	Bq/l	1.0	1.0	1.0
28	Coliform	MPN/ 100ml	1000	1000	1000

Note: (-) means not defined

13 QCVN 15: 2008/BTNMT: National Technical Regulation on the Pesticide Residues in the Soils

Table 1 Maximum Allowable Concentration Pesticide Residues in the Top Soils

Unit: mg/kg dry soil

No.	Formula	General Name	Maximum Allowable Concentration	Main Purpose of Use
1	Atrazine ($C_8H_{14}ClN_5$)	Atra 500 SC, Atranex 80 WP, Co-co 50 50 WP, Fezprim 500 FW, Gesaprim 80 WP/BHN, 500 FW/DD, Maizine 80 WP, Mizin 50 WP, 80 WP, Sanazine 500 SC	0.10	Herbicide
2	Benthiocarb ($C_{16}H_{16}ClNOS$)	Saturn 50 EC, Saturn 6 H	0.10	Herbicide
3	Cypermethrin ($C_{22}H_{19}Cl_2NO_3$)	Antiborer 10 EC, Celcide 10 EC	0.10	Forest product preservation
4	Cartap ($C_7H_{15}N_3O_2S_2$)	Alfatap 95 SP, Cardan 95 SP, Mapan 95 SP, 10 G, Padan 50 SP, 95 SP, 4G, 10 G, Vicarp 95 BHN, 4 H …	0.05	Insecticide
5	Dalapon ($C_3H_4Cl_2O_2$)	Dipoxim 80 BHN, Vilapon 80 BTN	0.10	Herbicide
6	Diazinon ($C_{12}H_{21}N_2O_3PS$)	Agrozinon 60 EC, Azinon 50 EC, Cazinon 10 H; 40ND; 50ND; Diazan 10 H; 40EC: 50ND; 60 EC …	0.05	Insecticide
7	Dimethoate ($C_5H_{12}NO_3SP_2$)	Dimethoate	0.05	Insecticide
8	Fenobucarb ($C_{12}H_{17}NO_2$)	Anba 50 EC, Bassan 50 EC, Dibacide 50 EC, Forcin 50 EC, Pasha 50 EC …	0.05	Insecticide
9	Fenoxaprop - ethyl ($C_{16}H_{12}ClNO_5$)	Whip'S 7.5 EW, 6.9 EC; Web 7.5 SC	0.10	Herbicide
10	Fenvalerate ($C_{25}H_{22}ClNO_3$)	Cantocidin 20 EC, Encofenva 20 EC, Fantasy 20 EC, Pyvalerate 20 EC, Sumicidin 10 EC, 20 EC ..	0.05	Insecticide
11	Isoprothiolane ($C_{12}H_{18}O_4S_2$)	Caso one 40 EC, Fuan 40 EC, Fuji - One 40 EC, 40 WP, Fuzin 40 EC …	0.05	Fungicide
12	Metolachlor ($C_{15}H_{22}ClNO_2$)	Dual 720 EC/ND, Dual Gold ®960 ND	0.10	Herbicide
13	MPCA ($C_9H_9ClO_3$)	Agroxone 80 WP	0.10	Herbicide
14	Pretilachlor ($C_{17}H_{26}ClNO_2$)	Acofit 300 EC, Sofit 300 EC/ND, Bigson-fit 300EC …	0.10	Herbicide
15	Simazine ($C_7H_{12}ClN_5$)	Gesatop 80 WP/BHM, 500 FW/DD, Sipazine 80 WP, Visimaz 80 BTN …	0.10	Herbicide
16	Trichlorfon ($C_4H_8Cl_3O_4P$)	Sunchlorfon 90 SP	0.05	Insecticide
17	2,4-D($C_8H_6Cl_2O_3$)	A.K 720 DD, Amine 720 DD, Anco 720 DD, Cantosin 80 WP, Desormone	0.10	Herbicide

No.	Formula	General Name	Maximum Allowable Concentration	Main Purpose of Use
		60 EC, 70 EC, Co Broad 80 WP, Sanaphen 600 SL, 720 SL …		
18	Aldrin ($C_{12}H_8Cl_6$)	Aldrex, Aldrite	0.01	Prohibited
19	Captan ($C_9H_8Cl_3NO_2S$)	Captane 75 WP, Merpan 75 WP …	0.01	Prohibited
20	Captafol ($C_{10}H_9Cl_4NO_2S$)	Difolatal 80 WP, Flocid 80 WP …	0.01	Prohibited
21	Chlordimeform ($C_{10}H_{13}ClN_2$)	Chlordimeform	0.01	Prohibited
22	Chlordane ($C_{10}H_6Cl_8$)	Chlorotox, Octachlor, Pentichlor	0.01	Prohibited
23	DDT ($C_{14}H_9Cl_5$)	Neocid, Pentachlorin, Chlorophenothane…	0.01	Prohibited
24	Dieldrin ($C_{12}H_8Cl_6O$)	Dieldrex, Dieldrite, Octalox	0.01	Prohibited
25	Endosulfan ($C_9H_6Cl_6O_3S$)	Cyclodan 35EC, Endosol 35EC, Tigiodan 35ND, Thasodant 35EC, Thiodol 35ND…	0.01	Prohibited
26	Endrin ($C_{12}H_8Cl_6O$)	Hexadrin…	0.01	Prohibited
27	Heptachlor ($C_{10}H_5Cl_7$)	Drimex, Heptamul, Heptox…	0.01	Prohibited
28	Hexachlorobenzene (C_6Cl_6)	Anticaric, HCB…	0.01	Prohibited
29	Isobenzen ($C_9H_4OC_{18}$)	Isobenzen	0.01	Prohibited
30	Isodrin ($C_{12}H_8Cl_6$)	Isodrin	0.01	Prohibited
31	Lindane ($C_6H_6Cl_6$)	Lindane	0.01	Prohibited
32	Methamidophos ($C_2H_8NO_2PS$)	Monitor (Methamidophos)	0.01	Prohibited
33	Monocrotophos ($C_7H_{14}NO_5P$)	Monocrotophos	0.01	Prohibited
34	Methyl Parathion ($C_8H_{10}NO_5PS$)	Methyl Parathion	0.01	Prohibited
35	Sodium Pentachlorophenate monohydrate $C_5Cl_5ONa.H_2O$	Copas NAP 90 G, PMD_4 90 bột, PBB 100	0.01	Prohibited
36	Parathion Ethyl ($C_7H_{14}NO_5P$)	Alkexon, Orthophos, Thiopphos …	0.01	Prohibited
37	Pentachlorophenol (C_6HCl_5IO)	CMM7 liquid oil	0.01	Prohibited
38	Phosphamidon ($C_{10}H_{19}ClNO_5P$)	Dimecron 50 SCW/DD…	0.01	Prohibited
39	Polychlorocamphene $C_{10}H_{10}Cl_8$	Toxaphene, Camphechlor, Strobane..	0.01	Prohibited

APPENDIX 4A

Estimation of GHG and Other Air Pollutant Emissions in Road Transport Sub-Sector

Appendix 4A

Estimation of GHG and Other Air Pollutant Emissions in Road Transport Sub-Sector

The emissions of GHG and other local pollutants, by a type of vehicle depend on the distance leveled by the vehicle and type and intensity of energy used in catering to travel demand. The following equation is used to estimate emission of type i by vehicle k in year t

$$Pkit = Ekit \times VKTikt$$

Where,

Pkit = Emission (tones) of type i from vehicle type k in year t
Ekit: Emission factor (g/km) of type i from vehicle type k in year t
VKTkt: Vehicle km travel by vehicle type k in year t

No information and/or parameter of CO2 emission factor are summarized in Viet Nam, yet. Accordingly, emission factors used in this report are referred to similar cases like in Bejing (China) and other countries in Asia assuming that vehicle age, maintenance of vehicles in Vietnam are the same as in Bejing and other countries in Asia. It is assumed that no significant change in the vehicular condition will occur until year 2030. In general, the order of the magnitude of CO2 emission factor of old vehicles tends to be larger than those of new ones.

Table 1 Emission Factors Used (g/km)

Pollutants (g/km)	Car[1]	Bus[2]	Truck[1]
NO_x	1.5	10.25	5.5
CO	44.2	99.55	19.99
HC	5.2	17.55	16.6
CO_2	60.5	182	490
PM	0.15	0.95	0.255

[1] Using emission factors in "Study on air emission of road transport of Beijing City" (http://www.iges.or.jp/en/ue/activity/mega-city/article/htm/far43.htm)
[2] Using emission factors in Feasibility research on public transport in Da Nang City 2008–2015

Table 2 Vehicle km Travel by Car, Bus and Truck in Year 2030 in Road Transportation

No.	Scenario	Vehicle_km per year in road transportation (million)		
		Passenger Car	Bus	Truck
1	Do nothing scenario	15,675,066.0	8,525,427.0	38,682,360.0
2	Base Network	14,138,646.0	5,354,123.0	25,842,540.0
3	Do Maximum scenario	14,089,920.0	6,810,404.0	15,109,296.0

(Source: VITRANSS 2, 2009)

Table 3 Estimate Total Air Pollutant Emission of Road Transport Sector (ton/year) 2030 for Scenarios

No.	Scenario	CO_2	NOx	HC	PM	CO
1	Do nothing scenario	21,454,325.6	323,651.2	873,258.8	20,314.4	2,314,804.6
2	Base Network	14,492,683.0	218,221.7	596,472.0	13,797.1	1,674,523.4
3	Do Maximum scenario	9,495,489.6	174,042.5	443,604.5	12,436.2	1,602,785.0

APPENDIX 4B

Environmental Themes for Specific Consideration in EIA of Transport

Appendix 4B

Environmental Themes for Specific Consideration in EIA of Transport

Sub-Sector Projects Having Potentially Significant Impacts

No	Types of Project	Themes Need Special Consideration		
		Pre-Construction Stage	During Construction Stage	Operation Stage
Road sub-sector (Including North-South Expressways)				
1.	Construction projects of expressway, national, provincial and district road	• Impacts to natural ecosystem • Impacts arising from land acquisition and resettlement • Long–term impacts of climate change on project location	• Air pollution • Noise and vibration pollution • Impact on important natural ecosystems in particular fauna and flora in nature reserves, national parks and protected areas. • Changing landscape, flooding • Solid and liquid waste, daily human waste during construction process	• Air pollution by using fuel, dust... • Noise pollution
Railway sub-sector				
1	Improving the existing line for capacity expansion to provide 50 trains/day frequency of service on a single truck in Hanoi – Saigon line	• Land acquisition for the project; • Geological survey to identify location of settlement and landslide potentiality; • Computation and examination of vibration; • Long–term impacts of climate change on project location	• Local air pollution at construction area • Noise impact from construction machine operations • Water pollution when the railway passes through rivers or streams • Changes of landscapes, flowing current, flood	• Noise pollution • Air pollution • Solid waste and wastewater management
2	Construction a new railway between Trang Bom and Vung Tau.	• Impacts of project location on natural ecosystem; • Resettlement impacts; • Social–economic impacts if station planning is inappropriate; • Long–term impacts of climate change on project location.	• Air pollution; • Noise pollution; • Water pollution when the railway passes through rivers or streams; • Changes of landscapes, flowing current, flood	• Noise pollution; • Air pollution; • Solid waste and wastewater management.
High-speed Railways (NSHSR)				
1	Construction of high-speed railway	• Land acquisition and resettlement plan for the project • Geological survey to identify location of settlement and landslide potentiality • Computation and examination of vibration • Impacts of project location on natural ecosystem • Impacts from ground clearance and resettlement • Long-term influences of climate change on project location	• Local air pollution at construction area • Noise impact from construction machine operations • Water pollution when the railway passes through rivers or streams • Changes of landscapes, flowing current, flood; • Land occupied in construction period.	• Noise and vibration impact • Safety and ride comfort of high-speed train operations
2	Construction of high-speed train stations	• Impacts of project location on natural ecosystem • Waste receiving and self-purification (waste bearing)	• Local air pollution at construction area • Noise impacts	• Waste treatment for large number of passengers of the stations

No	Types of Project	Themes Need Special Consideration		
		Pre-Construction Stage	During Construction Stage	Operation Stage
		capacity • Impacts from ground clearance and resettlement • Impacts on socioeconomics when the stations is not properly planned		
Port and shipping				
1	Developing gateway ports and improvement of current ports	• Effects of project location on natural ecosystem. • Waste carrying capacity and self-purification abilities of project area. • Effects from resettlement and site clearance	• Environment pollution, in particular dredging and dredted material management • Change hydrographic system, deposition, • erosion (forecasting model) • Effects to ecosystems: marine, sea grass, cuphorbia, salt-marsh, mangrove forest.	• River, sea, bay water pollution (shipping activity including illegal discharge and maintenance dredging). • Oil (and noxious chemical) spill risk, affect to coastal water, marine, aquatic quality. • Effect to (in particular offshore) national park, natural preservation area.
Inland waterway transport (IWT)				
1	Improving water transportation infrastructure	• Effects of project location on natural ecosystem. • Accepting waste ability, self-clearing (self-transporting ability) of project area. • Effects from clearing the ground– Resettlement • Total effects to lower section	• Sand, water environment pollution. • Erosion, coastal zone depositing. • Effect to aquatic ecosystems in project area and lower section protected areas and estuaries including mangrove forests	• River water, lower section environment pollution • Environment problem: oil, harmful matter flow. (Both accidents and illegal discharge) • Effects to lower section community living
Aviation				
1	Extension of runway, construction of new airplane parking field, construction of terminal	• Occupation of land for the project • Computation and examination of noise and vibration	• Local air pollution at construction area • Noise impact from construction machine operations	• Indirect impacts due to increase of passenger amount • Air pollution and noise due to increase in frequency of landing and takeoff of airplanes • Pollution mitigation with proper management of solid and liquid wastes at airports. • Air navigation safety

APPENDIX 4C

Public Consultation with Relevant Stakeholders

Appendix 4C

Public Consultation with Relevant Stakeholders

1 Logistical Details

Public consultation and information disclosure during SEA are the requirements of Vietnam government and JICA for all investment strategies and plans. The main purpose of the public consultation is aimed at giving chance for relevant agencies involved into the all phases of project planning implementation by informing them about the strategies, plans and projects and relevant environmental issues and consulting them to make sure that all environmental impacts will be taken into account and proposed mitigation measures will be carried out in appropriate manner so that the benefits of subsequent investment projects, thus, could be maximized.

A national consultation meeting was conducted in Enery Hotel, Hanoi on July 17th 2009, during SEA works. The meeting focused on discussing with relevant national agencies about potential environmental impacts, alternative development and proposal mitigating measures to protect environment and avoid negative impacts. The feedbacks from the meetings have been used as a useful source of information for improving SEA works. However, the questions will be divided into two kinds of questions; the first one regards to the information on questions about project and environmental impacts, for this kind of questions the answers have be explained clearly by SEA consultants. The second one refers to the additional information, which have to be considered by SEA team to improve final SEA report.

2 Consultation and Information Disclosed

Participants of the meeting were representatives of relevant agencies at the national level. They included Representatives of Ministry of Natural Resource and Environment (MONRE); Ministry of Transport; Ministry of Civil Construction; National Environment Agency; Inland Water Transport Administration, Road Administration; Transport Development Strategy Institute; National Natural Resource Institute; National Center for GIS and Land Use; Rail Way Administration; Hanoi National University, TERI and representative of JICA's consultant (List of participant is shown in Annex).

A printed summary of project is delivered for participants to inform them about project information. The report on estimated potential environmental impacts and proposed mitigating measures also are presented to obtain feedbacks and fulfill any missed environmental considerations. Hard copy of presented documents has been also distributed during the meetings. However, the most important part of meeting was discussion with stakeholders about environmental issues and mitigation measures of transport strategies of VITRANSS 2.

The main information presented in the meetings are:

(i) Outline of VITRANSS 2

(ii) Potential environmental issues that might arise consequent to the implementation of transport development strategies and the related projects

(iii) Propose mitigating measures and environmental management approaches.

(iv) Comments about the environmental issues and mitigation measures

3 Summary of Comments by Participants

The environmental impact assessment presentation provided the overall of potential environmental impacts of project. In general, participants agreed that strategic environmental assessment (SEA) of VITRANSS 2 plays very importance role in maximizing the project benefits of transport development strategies. Since VITRANSS 2 is long-term master plan of transport strategies and system development in Vietnam, the proposed development in the study is very large and overall, thus the potential environmental problems as well as mitigation measurements are also considered, analyzed and determined to the extent possible in large overall sense. But the most expected finding outs of the SEA are proposing possible alternative arrangements and adjustments to minimize impacts on environment and promoting sustainable development of transport system in Vietnam. The comments by participants could be summarized as below:

(i) The participants agreed that SEA of VITRANSS 2 has been followed Vietnam legal regulations and since VITRANSS 2 has been prepared on overall large national scale, the SEA is also carried out with very large overall scope. At this time, Ministry of Civil Construction prepared and published a guideline for SEA preparation of development activities in the civil construction field, thus she strongly suggested that MOT also should consider formulating an SEA's guideline for transport development activities and SEA of VITRANSS 2 could be considered to serve as orientation for formulating future SEA guidelines for transport sector. She also suggested that multi-choice analysis method could be added as reference method as applied in the SEA report.

(ii) The participant from Vietnam Road Administration concurred that air pollution from road activities are very important. However, could targets and priorities the projects of improving bottlenecks improvement be identified and analysis in the VITRANSS 2. Referring to reducing noise pollution, not only tree plantation measure, but also building up noise-resistant walls also should be considered as useful measures to control noise pollution for the VITRANSS 2.

(iii) Regarding to time frame of VITRANSS 2 (to 2030), the participant think that it is seem quite short, the transport strategies should be proposed at least to 2050 due to the fact in Vietnam’s rapidly increasing in transport volume. She also point out that VITRANSS 2 also should pay some attention to develop alternative fuel in Vietnam.

(iv) The feedbacks from participants also focused on consulting other master plans such as water supply master plan; drainage system master plan; electricity supply master plan; and telecommunication master plan as well during making the comprehensive study in the sustainable development of transport system in Vietnam in order to avoid the conflicts between several development activities which could lead to waste of resources and also to achieve the sustainable development goals.

(v) Referring to controlling solid waste and wastewater from public transport terminals (bus stops, bus terminals, ports, airports, and railway station), public awareness raising could be considered and proposed as effective measures in the SEA report to encourage community (people) participation in environmental pollution.

(vi) The participants also suggested that the SEA team could use climate change

scenarios for Vietnam of IPCC when identify the impacts transport development activities on local and national flooding, as well as effect on climate change on transport infrastructure development.

(vii) The participant recommended that SEA team could consider to calculate the total emission of inland water transportation, railway in order to making the comparison of pollution emission from all transport modals, then could giving out the best alternative development scenarios in term of environmental friendly, pollution reduction and sustainable development promotion.

(viii) Beside, the suggestions also concern on the social impact assessment due to social impacts and resettlement activities could be significant in most transport projects. Especially, North-South expressway and high-speed rail could cause a lot of serious negative social impacts such community split, ethnic minority cultural erosion. The report needs to pay more attention on social impact assessment.

(ix) The feedbacks also refer to land use conversion. In fact that transport infrastructure development will use a large area of natural land. Therefore, to minimize of this issue, the SEA report also considered calculating and classifying types of occupied land, such as loss of agricultural land, forestry land, aquaculture land and others.

(x) The participants from Transport Development Strategy Institute (TDSI) strongly emphasized that SEA works need to carry out parallel and integrated into strategy making process and main objectives of SEA works are identifying the environmental issues of transport development activities in the very early stage of strategy phase, and alternative adjustment could be make in the strategy phase in order to reduce environmental impacts, environmental conflicts and then to achieve the sustainable development goals. The participants strongly recommended that any alternative adjustments proposed in the SEA should be carefully considered by plan making team and to be integrated into the final report of VITRANSS 2.

4 Summary of Reply by SEA Study Team

Most of the reply from SEA team during the public consultation meeting focused on clarifying environmental issues trends, which may occur when future VITRANSS 2 implementation. The environmental consultants confirmed that until now, Ministry of Transport has not formulated and published a guideline for SEA preparation of development activities in transport sector. The participants appreciated the efforts of the SEA Study Team for proposing SEA of VITRANSS 2, which could serve as oriental study for formulating future technical guideline for the conduct of SEA in transport sector. The environmental consultants explained about the methodologies applied to do SEA report such as checklist, matrix, spatial analyses: overlay maps and GIS, expert judgments, Delphi technique, modeling, impact networks and flow diagrams, rapid assessment of pollution load through emission factors, limited time frame of VITRANSS 2 and other issues during presentation. Measures for reducing noise pollution are proposed in report as installing noise barriers, planted trees, noise retaining sign. Until now, social–economic forecast are proposed to 2020 therefore the transport strategies are only proposed to 2020. The report has referred to climate change scenarios for Vietnam as of IPCC to identify the impacts of transport development activities on local and national flooding as well as effect of climate change on transport infrastructure development. Regarding to replying all comments from participants, most of comments have been considered by SEA team to the possible content within the scope of this SEA study. The SEA team also

strongly agreed that all alternative adjustments and recommendation have been proposed in SEA report should be taken care by VITRANSS 2 team to forward a sustainable transport development trend in Vietnam.

Annex

RECORD OF SEA PUBLIC CONSULTATION MEETING

Preparing for the Comprehensive Study on the Sustainable Development of Transport System in Vietnam

I Time and Location:

Time: July 17th 2007 (from 08h30' to 11h30')

Location: VIP Room, Enery Hotel, 30 Ly Thai To, Hoan Kiem District, Hanoi.

II List of Participants

- Representatives of JICA's Consultant
- Representatives of Transport Sustainable Development and Environment Research Institute
- Representatives of Ministry of Transport
- Representatives of Ministry of Environment and Natural Resources
- Representatives of National Environment Protection Agency
- Representatives of Inland Water Transport Administration
- Representatives of Road Administration
- Representatives of National Natural Resource Institute
- Representatives of National Center for GIS and Land Use;
- Representative of Rail Way Administration;
- Representative of Hanoi National University
- Representatives of Transport Development Strategy Institute
- Representatives of Ministry of Civil Construction
- VITRANSS2's SEA Consultants

III Content of the Meeting

- Presenting about VITRANSS 2 and relevant environmental issues
- Presenting about Vietnam legal regulation relative to SEA
- Forecasting impacts on environment during VITRANSS 2 implementation
- Presenting proposed mitigate measurements.
- Recommendation of alternative adjustments and suggestion

List of Participants of Public Consultation Meeting

No.	Name	Position	Agency
1	Bui Thi Hue	Environmental Specialist	Vietnam Inland Water Transport Administration
2	Nguyen Khac Son	Environmental Specialist	Vietnam Inland Water Transport Administration
3	Tong Thi Chau Loan	Environmental Specialist	Vietnam Road Administration
	Do Viet Nga	Environmental Specialist	Ministry of Environment and Natural Resource
4	Pham Hong Phong	Environmental Specialist	National Center for GIS and Land Use
5	Nguyen Duc Anh	Environmental Specialist	National Natural Resource Institute
6	Nguyen Thuy Hang	Environmental Specialist	Ministry of Civil Construction
7	Nguyen Duc Hanh	Environmental Specialist	National Environment Protection Agency
8	Thach Thi Thuy	Student	Environment Faculty Economic University
9	Phung Thi Ngoc Minh	Student	Environment Faculty Economic University
10	Ninh Thi Thu Hang	Student	Environment Faculty Economic University
11	Nguyen Thi Diem Hang	Environmental Specialist	Natural Resource and Environment Center, TDSI
12	Le Anh Tuan	Environmental Specialist	Ministry of Transport
13	Nguyen Thi Phuong Hien	Director	Natural Resource and Environment Center, TDSI
14	Vu Thi Hoang Yen	Environmental Specialist	Natural Resource and Environment Center, TDSI
15	Nguyen Phuc Tri	Staff	Transport Sustainable Development and Environment Research Institute
16	Tran Thi Tuyet Thu	Lecturer	Environment Faculty, Hanoi National University
17	Osamu Isoda	Environmental Consultant	Orient Consultant
18	Pham Thi Minh	Staff	Transport Sustainable Development and Environment Research Institute
19	Nguyen Thi Hong Thuong	Staff	Transport Sustainable Development and Environment Research Institute
20	Nguyen Quang Bau	Director	Transport Sustainable Development and Environment Research Institute