

Environmental Assessment Report

Summary Environmental Impact Assessment
Project Number: 33307
July 2007

Socialist Republic of Viet Nam: The Greater Mekong Subregion: Kunming-Hai Phong Transport Corridor–Noi Bai-Lao Cai Highway Project

Prepared by Vietnam Expressway Corporation for the Asian Development Bank (ADB)

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CURRENCY EQUIVALENTS

(as of 15 June 2007)

Currency Unit	–	dong (D)
D1.00	=	\$0.000063
\$1.00	=	D16,200

ABBREVIATIONS

ADB	–	Asian Development Bank
CO	–	carbon monoxide
COD	–	chemical oxygen demand
CSC	–	construction supervision consultant
DO	–	dissolved oxygen
DONRE	–	Department of Natural Resources and Environment
EIA	–	environmental impact assessment
EMP	–	environmental management plan
ES	–	Environmental Section (of Vietnam Expressway Corporation)
GDP	–	gross domestic product
HIV/AIDS	–	human immunodeficiency virus/acquired immune deficiency syndrome
MC	–	management consultant
MONRE	–	Ministry of Natural Resources and Environment
MOT	–	Ministry of Transport
NO ₂	–	nitrogen dioxide
PIU	–	project implementation unit
PRC	–	People's Republic of China
QL	–	National Highway
RP	–	resettlement plan
SEIA	–	summary environmental impact assessment
SO ₂	–	sulfur dioxide
SS	–	suspended solids
TA	–	technical assistance
TSP	–	total suspended particulates
VEC	–	Vietnam Expressway Corporation

WEIGHTS AND MEASURES

ha	–	hectare
km	–	kilometer
km ²	–	square kilometer
m	–	meter
m ³	–	cubic meter

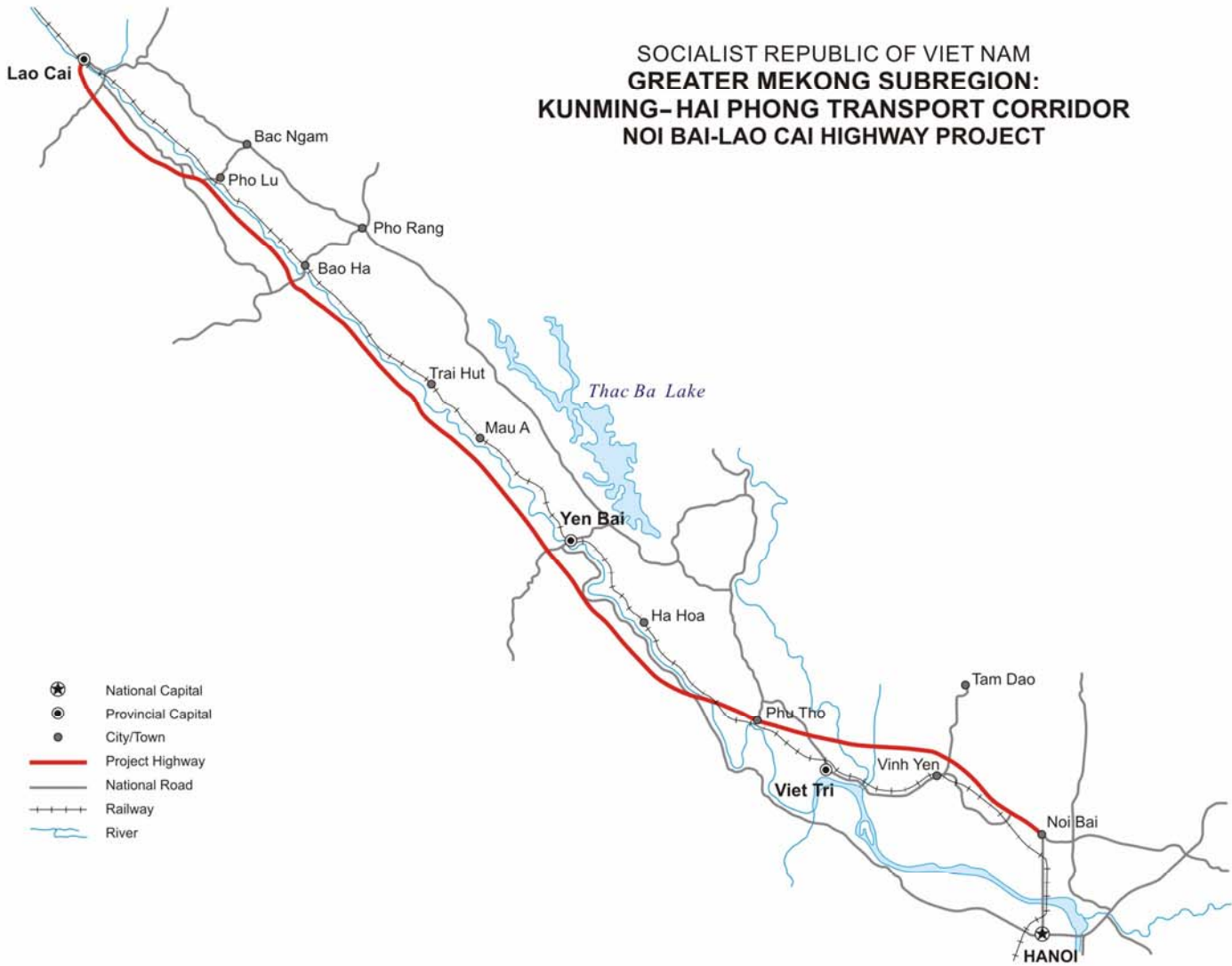
NOTE

In this report, "\$" refers to US dollars.

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SOCIALIST REPUBLIC OF VIET NAM
**GREATER MEKONG SUBREGION:
KUNMING-HAI PHONG TRANSPORT CORRIDOR
NOI BAI-LAO CAI HIGHWAY PROJECT**



I. INTRODUCTION

1. The Noi Bai–Lao Cai Highway Project of the Government of Viet Nam has received technical assistance (TA) from the Asian Development Bank (ADB) for project preparation. The scope of the TA, which is partially financed by Loan 2222-VIE,¹ consists of (i) the detailed engineering design of a 263 kilometers (km) highway, (ii) updated economic and financial studies, (iii) social and environmental studies, and (iv) procurement assistance for civil works. The Implementing Agency for the TA is the Vietnam Expressway Corporation (VEC).

2. The TA consultant is Pacific Consultants International (PCI) of Japan, in association with PCI Asia of the Philippines and with Apeco and the Hafico Group, both of Hanoi, Viet Nam. The consultant began work on 16 January 2007 and was expected to complete the feasibility study review and the detailed design within 12 months.

3. In January–May 2007 the consultant prepared an environmental impact assessment (EIA). It was based on the requirements of (i) Vietnamese environmental protection law, (ii) Decree No. 80 on Detailed Regulations and Guidelines for Implementing Environmental Protection Law, and (iii) Circular No. 8 of the Ministry of Natural Resources and Environment (MONRE) on the Guidelines for Strategic Environmental Assessment, EIA, and Environmental Protection Commitment.

4. This summary environmental impact assessment (SEIA) report was produced in June 2007 after the feasibility study review was completed and the horizontal alignment finalized. It summarizes the findings of the EIA, and follows ADB's *Environment Policy* (2002) and *Environmental Assessment Guidelines* (2003).

5. The SEIA also draws on information from the feasibility study reports and the work of the ADB TA team. During its preparation under the TA, government officials and the EIA authors were interviewed. The government officials came from MONRE, the Department of Natural Resources and Environment (DONRE) in each city or province covered by the Project, and the Ministry of Agriculture and Rural Development.

6. This study defines the environmental impact zone as follows:

- (i) The *direct impact area* is land to be acquired for the Project.
- (ii) The *potential impact area* is a zone 500 meters (m) wide, i.e., 250 m on each side of the highway centerline, extending downstream at watercourses and covering borrow pits and cuttings as required.

II. DESCRIPTION OF THE PROJECT

A. Overview

7. The Project develops part of the Greater Mekong Subregion North–South Economic Corridor linking Kunming in the People's Republic of China (PRC) with Hanoi and Hai Phong port in Viet Nam. It will contribute significantly to the regional road network development by constructing a new highway link between Noi Bai and Lao Cai. The highway will pass through

¹ ADB. 2005. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the Socialist Republic of Viet Nam for the Greater Mekong Subregion: Kunming-Haiphong Transport Corridor–Noi Bai–Lao Cai Highway Technical Assistance Project*. Manila. (Loan 2222 for \$6 million, approved on 19 December 2005).

the Soc Son district of Hanoi city, and the provinces of Vinh Phuc, Phu Tho, Yen Bai, and Lao Cai.

8. The Project will be implemented in two phases, both of which are covered by this SEIA. In Phase 1, 244 km of highway will be built—123 km of four-lane highway from Noi Bai to Yen Bai, and 121 km of two-lane highway from Yen Bai to Lao Cai. In Phase 2 the Noi Bai–Yen Bai highway will be widened to six lanes and the Yen Bai–Lao Cai highway to four lanes. The final 19 km of the Lao Cai bypass will also be built in Phase 2.

9. To build the highway, about 2,000 hectares (ha) of land will have to be acquired and 2,100 households relocated.

10. Nineteen interchanges, around 110 bridges, and five tunnels will be built. The tunnels will have an aggregate length of 2.3 km. Earthworks for embankment will total 31 million cubic meters (m³), and about 3 million m³ of surplus material in Lao Cai province is likely to require disposal.

11. About 255 underpasses and over-bridges are planned to reestablish crossing roads and to maintain links between communities and access to socioeconomic activities. These will be spaced about 500 m apart in more densely populated areas, and served by frontage roads where required. In mountainous or more sparsely populated areas the underpasses and over-bridges will be spaced more widely, but located according to existing patterns of movement.

12. An estimated 15,000 people are expected to work on the construction of the highway over 40 months. Construction is projected to start in late 2008, and the highway to be opened in 2012.

B. Alignment Selection

13. The existing transport corridor to the PRC border comprises two routes on the left bank of the Red River: (i) the railway running immediately adjacent to the river, and (ii) the National Highway (QL) 2 and QL70 route, which is 15–25 km away from the river and runs parallel to it.

14. Lao Cai and Yen Bai provinces are generally mountainous, with topography that is highly unfavorable for road or railway construction. The aforementioned existing transport routes partly follow geological fault zones aligned northwest to southeast, which have been eroded by the Red and Chay rivers and offer relatively gentle topography along the river valleys.

15. In the 1990s the Ministry of Transport considered upgrading the access to Yunnan province in the PRC by widening and improving the QL2 and QL70 route to Lao Cai. A prefeasibility study was done in 2000, but it soon became apparent that the winding route through hilly areas was not suitable for improvement because of the difficulty of stabilizing the high-cut slopes and the large impact on people living along the road.

16. On the other hand, the railway corridor running in the river valley on the left bank of the Red River has topographical and hydrological conditions that favor the development of a new route, with small catchment areas and no large rivers. This is presumably why it was chosen as the route of the railway that was built in 1910. However, the width of low-relief terrain in the river valley is limited, and there are many population centers along the railway line. Hence, the river valley on the left bank is unfavorable for the development of a highway.

17. Accordingly, the feasibility study developed an alignment on the right bank of the Red River valley, where the topography is similar to that on the left bank but the hydrological conditions are relatively worse, with larger catchment areas and larger rivers. The main advantage is the low number of residents, and, hence, the reduced requirements for resettlement.

18. This alignment was reviewed through a study of satellite images and a field walkover by four teams. The review was based on several key criteria. The alignment had to

- (i) minimize the resettlement requirements;
- (ii) avoid sensitive cultural and environmental areas;
- (iii) avoid steep terrain, likely soft ground areas, or other unfavorable natural conditions;
- (iv) integrate with the provincial master plans or other planned developments;
- (v) avoid particular features such as apatite mines in Lao Cai province;
- (vi) minimize the cost of major structures such as bridges and tunnels; and
- (vii) balance cut and fill volumes.

19. The original alignment and proposed modifications were presented on maps at a scale of 1:25,000 at meetings in each province in March 2007. Representatives of the people's committees and all related government agencies attended the meetings and expressed their appreciation for the efforts of the project team to reduce the social and environmental impact of the Project.

20. The final alignment, including 45 modifications, was agreed on in a meeting on 5 April 2007 attended by representatives of the people's committee of each province and the Vice Minister of Transport. The full results of the alignment review are set out in the separate Horizontal Alignment Review Report.² This EIA is based on the final alignment.

III. DESCRIPTION OF THE ENVIRONMENT

A. Physical Environment

1. Climate

21. The Project is in the northeast climatic region of Viet Nam. This region has a tropical monsoon climate, with temperatures reaching as high as 40°C in summer. The rainy season, which accounts for 80–85% of total rainfall, runs from May to September, and the dry season from November to March. The average annual rainfall in the project area ranges from 1,600 to 2,100 millimeters. Average humidity is 83–86% and attains its maximum in late winter.

2. Topography, Geology, and Soils

22. The first 56 km of route in Soc Son district and Vinh Phuc province is mainly on the level alluvial plains of the Red and Lo rivers. Ground elevations range from +8.5 m to around +20 m above mean sea level. The area was historically subject to flooding from the Red River, whose level reached up to +14 m in Hanoi in 1971. Much of Hanoi city and the surrounding area lies below such flood levels, but an extensive system of dikes and sluice gates protects against 100-year floods.

² Ministry of Transport and Vietnam Expressway Corporation. 2007. *Horizontal Alignment Review Report*. Hanoi

23. The section from Km 56 to Km 76 in Phu Tho province passes through low hills up to around 50 m elevation of highly weathered granite and gneiss. After crossing the Red River at Km 78 the alignment follows the valley of the Red River and until Km 120 passes through hills of deposits of various eras comprising generally conglomerate, sandstone, and shale, interspersed with level plains of quaternary deposits. The elevations of the hills are higher, up to around 300–400 m. The elevation of the alignment rises to around +50 m.

24. The section from Km 120 to Km 244 continues to follow the valley of the Red River and passes through steeper hills, which are the foothills of the Hoang Lien Son Range. The deposits are generally highly weathered schist, quartzite, and sandstone. The elevations of the hills are around 300–400 m. The alignment rises to around +90 m.

25. The alignment lies within the Red River fault zone running southeast to northwest.

3. Hydrology

26. The alignment crosses 41 rivers, a canal, and 30 streams. Surface water resources crossing the alignment are predominantly used for irrigation, aquaculture, and other domestic purposes. The Red River is also used for the transport of goods and people.

4. Surface and Groundwater Quality

27. Baseline analyses of water quality show that surface water quality in 14 tributaries of the Red River and Lo River is quite good (Table 1), although levels of chemical oxygen demand (COD), oil and grease, coliforms, and suspended solids in 13 of 14 sampling locations exceed the Viet Nam Standard for Category A (for domestic use). The high levels of COD are suspected to be due to runoff from residues of chemical fertilizers and pesticides used in farms within the catchment area. The detectable levels of oil and grease are from domestic discharge from residential areas. The values for suspended solids are characteristic of the existing condition in the watershed of the Red River, which is subject to erosion and sediment transport, heightened by human activity. Other parameters such as levels of nitrate, cyanide, heavy metals (copper, zinc, cadmium, iron, and mercury), sulfur, and dissolved oxygen, are within the Viet Nam standards for surface water quality (TCVN 5942–1995).

28. Around 420 surface and shallow wells along the riverbanks are used for domestic purposes by households along the banks of the Red River.

Table 1: Surface Water Quality at Sampling Points

Location Province/Commune		pH			SS (mg/l)			DO (mg/l)			COD (mg/l)		
		Season			Season			Season			Season		
		Dry		Wet	Dry		Wet	Dry		Wet	Dry		Wet
		Mar	Apr	May	Mar	Apr	May	Mar	Apr	May	Mar	Apr	May
Ha Noi	Thanh Xuan	7.2	7.5	7.2	38	32	28	7.4	6.8	6.2	32	35	31
Vinh Phuc	An Hoa	7.1	7.0	6.7	25	28	29	8.9	7.7	6.9	32	34	30
	Hoang Dan	7.0	7.3	7.1	25	28	23	6.5	7.8	7.0	29	29	25
	Tu Yen	7.1	7.1	7.5	28	28	37	7.9	7.9	6.9	24	18	28
Phu Tho	Phu Ninh	6.9	7.1	7.5	6	8	15	6.3	7.8	8.0	20	21	26
	Thanh Xa	6.7	6.9	7.2	6	9	22	6.2	6.4	6.7	29	18	20
	Minh Coi	7.0	7.3	7.4	31	25	18	6.2	6.5	6.9	32	29	21
Yen Bai	Minh Quan	7.1	6.9	7.2	33	39	35	6.5	6.2	6.5	35	28	20
	Minh Tien	7.3	7.0	7.4	45	39	33	6.8	6.4	6.6	33	41	35
	Yen Hop	7.5	7.3	7.0	46	43	36	6.9	6.5	6.1	32	34	24
	Dong An	6.9	7.1	7.5	30	46	37	6.4	6.8	6.2	26	21	31
Lao Cai	Son Ha	6.7	6.9	7.2	29	32	43	6.5	6.8	6.5	30	29	22
	Gia Pho	7.1	7.2	7.4	34	23	38	6.9	6.4	6.8	34	33	30
	Bac Cong	7.3	6.7	6.6	36	34	36	6.5	6.7	6.3	30	30	26
TCVN 5942–1995													
Category A		6–8.5			20			≥ 6			< 10		
Category B		5.5–9			80			≥ 2			< 35		

COD = chemical oxygen demand, DO = dissolved oxygen, mg/l = milligrams per liter, pH = measure of acidity or alkalinity, SS = suspended solids, TCVN 5942–1995 = Viet Nam standards for surface water quality.

Note: Category A is applied to domestic use and Category B is applied to agricultural use.

Source: Consultant's field survey.

5. Air Quality

29. The project area is situated amid paddy fields, and in hilly and mountainous rural areas with good background air quality. Generally speaking, the baseline concentrations of all air pollutants such as total suspended particulates, carbon monoxide, sulfur dioxide, nitrogen dioxide, and hydrocarbons are well within the Viet Nam standards (Table 2).

Table 2: Air Quality at Sampling Points

Location Province/Commune		TSP ($\mu\text{g}/\text{m}^3$)			CO ($\mu\text{g}/\text{m}^3$)			SO ₂ ($\mu\text{g}/\text{m}^3$)			NO ₂ ($\mu\text{g}/\text{m}^3$)		
		Season			Season			Season			Season		
		Dry		Wet	Dry		Wet	Dry		Wet	Dry		Wet
		Mar	Apr	May	Mar	Apr	May	Mar	Apr	May	Mar	Apr	May
Ha Noi	Thanh Xuan	309	315	250	237	243	240	85	85	84	90	90	90
Vinh Phuc	Tam Hop	269	261	249	280	182	275	128	125	119	98	98	97
	Kim Long	225	238	220	148	144	142	108	108	105	61	60	59
Phu Tho	Dao Tu	256	253	216	234	234	229	203	202	196	130	130	127
	Phu Ninh	160	161	153	206	206	206	87	88	87	78	77	76
	Ha Loc	220	226	188	196	195	195	114	114	112	42	42	40
Yen Bai	Minh Coi	175	173	151	228	229	226	204	202	196	166	167	164
	Hien Luong	215	216	200	400	410	390	100	100	99	100	130	130
	Au Lau	230	240	220	300	360	250	100	140	150	91	90	89
	Dong An	179	169	198	241	240	239	143	142	146	71	72	71
Lao Cai	Chau Que Thuong	230	250	240	450	451	450	120	120	121	70	70	70
	Tan Thuong	200	200	199	532	530	528	60	60	60	131	130	130
	Xuan Giao	108	118	134	280	281	276	96	95	97	49	49	46
	Quang Kim	225	221	249	148	149	159	108	109	111	61	62	61
TCVN 5937–1995		300			3,000			350			200		

CO = carbon monoxide, $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter, NO₂ = nitrogen dioxide, SO₂ = sulfur dioxide, TCVN 5937–1995 = Viet Nam standards for air quality, TSP = total suspended particulates.

Source: Consultant's field survey.

6. Noise and Vibration

30. The baseline noise generators in the project area are mainly the local socioeconomic activities and traffic. Noise sampling locations were established about 600 m from the alignment in communes assessed by the consultant to be potentially sensitive areas because of the potential noise impact. The recorded noise levels at the 14 noise monitoring locations (Table 3) showed very low values, indicative of the generally rural condition.

Table 3: Noise Levels at Sampling Points

Location Province/Commune		L _{eq} (dB[A])					
		Season					
		Dry				Wet	
		March		April		May	
		Day	Night	Day	Night	Day	Night
Ha Noi	Thanh Xuan	61.3	56.8	61.4	57.3	62.4	55.7
Vinh Phuc	Tam Hop	62.7	56.1	63.4	57.2	64.4	60.8
	Kim Long	62.0	55.2	62.1	57.4	63.2	58.0
	Dao Tu	61.0	53.2	61.4	54.9	62.0	57.0
Phu Tho	Phu Ninh	59.4	49.6	60.8	52.3	62.4	54.4
	Ha Loc	62.6	54.0	63.8	54.2	63.9	58.1
	Minh Coi	60.8	55.5	62.6	56.9	63.0	56.7
Yen Bai	Hien Luong	62.6	52.9	62.9	57.5	60.7	57.8
	Au Lau	63.3	54.5	64.5	53.7	64.9	56.4
	Dong An	60.5	50.7	59.4	53.3	58.5	53.0
	Chau Que Thuong	61.7	55.7	62.5	52.9	62.5	57.2
Lao Cai	Tan Thuong	61.9	52.9	62.7	54.8	61.4	53.9
	Xuan Giao	56.7	53.9	58.5	52.9	62.0	57.7
	Quang Kim	58.1	48.0	57.0	52.5	59.8	55.7
TCVN 5937–1995		75	70	75	70	75	70

dB(A) = A-weighted decibel scale, L_{eq} = equivalent continuous noise level,
TCVN 5937-1995 = Viet Nam standards for air quality.

Source: Consultant's field survey.

B. Ecological Environment

1. Ecosystems

31. The Project is largely situated in an agro-ecosystem with two distinct typologies (floodplains and midland areas) wherein the land area has been cleared and devoted to agricultural use and the surface water regime is managed for agricultural production and flood control. Agricultural cultivation involves the regular use of chemical and organic inputs, which alter surface water and runoff quality. The section from Noi Bai to Viet Tri is on a large, flat area surrounded by intensively cultivated farm lots and paddy fields along the floodplains of the Red River where maize, peanut, bean, sesame, potato, sweet potato, cassava, and vegetables are grown. From Viet Tri to Lao Cai, as the alignment rises to gently undulating hills and mountains, human activities have likewise modified the natural ecosystem with industrial tree plantation and the farming of tea, palm, coffee, sugarcane, cotton, and wax trees. The fruit trees in the area consist of orange, lemon, clementine, pomelo, longan, lychee, banana, pineapple, apple, and persimmon trees planted in home gardens. The dominant fauna in the environs are domesticated species, mainly poultry fowl, buffalo, cow, pig, duck, goat, and horse.

32. Within the region natural tropical forest ecosystems exist at higher elevations 700–1,300 m above sea level. Examples of these ecosystems are protected in Tam Dao National Park, at least 8 km north of the alignment in Vinh Phuc province; Bavi National Park, 25 km south of the alignment in Son Tay district of Ha Tay province; Xuan Son National Park, 40 km southwest of the alignment in Phu Tho province; Thac Ba Lake, 15 km east of the alignment in Yen Bai province; and Hoang Lien National Park, 15 km west of the alignment in Lao Cai

province. The Hung Temple historical relic is in a protected area adjacent to the alignment in Phu Tho province that includes 13 ha of natural forest and 24 ha of man-made forest.

2. Forest Resources

33. The project area, except Soc Son district in Hanoi city, has extensive forest resources, which account for about 46% of the total land area. The major part of the forest area is plantation, although natural forests are preserved in national parks and reservations.

34. The project route passes through low- to mid-level land close to rivers and served by roads; hence, the natural forest has long been exploited for its timber. There remains a significant portion of forested land in the direct impact area, although this is almost entirely mixed planted agro-forest, for timber, pulp, and fruit production.

35. The closest area of natural forest lies within the Hung Temple Historical Relic protected area of the adjacent to the alignment in Phu Tho province.

3. Wetland Resources

36. In the project provinces the important wetland resources are those of the Thac Ba reservoir in Yen Bai province, Chinh Cong in northwestern Vinh Phuc (3 km from the alignment), and Vac Swamp in Vinh Phuc (2 km from the alignment).

37. The Thac Ba reservoir, 15 km east of the alignment in Yen Bai province, is an important stopover of waterfowl along the Asian avian migration route. It is a large water storage reservoir created in 1963 by a dam on the Chay River. Some reed beds, marsh grasses, and low shrubs grow along its banks. The Thac Ba is also used for irrigation, recreation, and fishery, producing 100–150 tons of fish annually.

38. Within the direct impact area, there are two principal categories of wetland resource: man-made ponds and lakes, and the river floodplains, which are subject to seasonal flooding. The alignment passes through the land of the Red River corridor that has been inhabited for thousands of years, and has strongly developed agricultural systems. The first category includes many ponds, lakes, and reservoirs; all the ponds are fishponds, and the lakes and reservoirs are used for flood control, irrigation, and water supply. The second category is the extensive floodplain areas of the Lo and Red rivers, in which water levels are controlled by levees and drainage networks; all are intensively farmed.

39. Within the secondary impact area, of particular note are (i) the Chu reservoir in Phu Tho province, and (ii) a small lake of 14 ha straddling the boundary of Phu Tho and Yen Bai. The Chu reservoir is a registered wetland and a stopover for migrating birds. It is 1 km upstream of the alignment.

4. Flora and Fauna

40. One of the most significant reservations within the Project provinces is the Tam Dao National Park in Vinh Phuc province (8 km from the alignment), which hosts five types of forests and 904 plant species belonging to 478 genera. Important species present in the protected areas include the black gibbon (*Hylobates concolor*), Phayre's leaf monkey, Owston's civet (*Chrotogale owstoni*), Tam Dao toadfish (*Paramesotriton deloustali*), and beautiful nuthatch (*Sitta formosa*).

41. However, wild animals (reptiles, amphibians, fish, and birds) are rarely encountered in the area around the Project. Illegal hunting by local people has decreased the wildlife population.

5. Fisheries and Aquatic Biology

42. The lands flanking the alignment near the Red River delta enjoy seasonal infusion of nutrients carried by river drainage during the monsoon season. Thirty-eight species of fish belonging to 16 families and six groups have been reported in the Red River.³ Most have been significantly reduced in recent years by overfishing. No rare or endangered species listed in the Red Book of Viet Nam are found in the direct or secondary impact areas of the Project. Shrimp and species of herbivore carp, black carp, and mud carp are raised in the rivers around the project site. According to official statistics, in certain periods in 2002–2004, carp and tilapia appeared in the Red River around the Thanh Liet estuaries. The sources of fishery income in that river segment have been exhausted.

C. Socioeconomic Environment

1. Cultural, Historical, and Tourist Sites

43. Hung Temple historical relic protection area lies close to the alignment and was a control point in alignment selection during the feasibility study. Hung Temple is a valuable cultural site in a protection area of about 2 km x 2 km and the temple itself is about 2.5 km from the alignment.

44. There are six temples or religious facilities within the secondary impact area. The closest to the highway centerline is 80 m away. These were control points during alignment selection.

45. National parks are recognized for their natural and tourist value and are actively protected. Therefore, these were also control points in alignment selection. The nature reserves of Tam Dao, Mu Cang Chai, Xuan Son, Hoang Lien Son mountains, Bao Thang, Van Ban Lake, and Thac Ba reservoir are not close to the alignment.

2. Socioeconomic Profile

46. The project provinces and Hanoi city have a population of 6,987,700, including the 2,269,219 residents of the 19 districts through which the alignment passes. The average population density in the project provinces is 976 persons per square kilometer, or 9.8 persons per hectare (See Table 4).

³ Ngo Kiem Son. 2005. *Diversity of Fish Species in Red River. Report for Institute of Ecology and Biological Resources.*

Table 4: Socioeconomic Profile

Province	Area (km²)	Provincial Population (2005)	Average Population Density (/km²)	Annual Per Capita GDP (\$)	Poverty Rate (2005) (%)	Poverty Rate (2006) (%)
Hanoi	921	3,182,700	3,455	1,381		
Vinh Phuc	1,372	1,169,100	851	503	18.0	15.0
Phu Tho	3,520	1,328,400	377	327	31.1	26.6
Yen Bai	6,883	731,800	106	266	34.7	30.7
Lao Cai	6,357	575,700	90	313	43.0	33.6
Total	19,053	6,987,700	Ave. 976	Ave. 355	Ave. 29.6	

GDP = gross domestic product, km² = square kilometer.

Source: Data based on poverty lines of the Ministry of Labor, Invalids and Social Affairs.

47. The alignment passes through 77 communes. Most of these communes are rural except for short sections in Soc Son district, Hanoi, and in the outskirts of Lao Cai. Among the affected areas, only Lao Cai is a Class 3 city.

48. At the official Vietnamese poverty income threshold of D270,000 (\$16.7) per capita per month, the average poverty rate in the provinces traversed by the Project was 18% in 2006.

49. Phu Tho, Yen Bai, and Lao Cai provinces have per capita gross domestic product (GDP) of \$270–\$330, and poverty rates of 27–34%. Vinh Phuc province and Soc Son district in Hanoi city have higher levels of economic activity because of their proximity to the capital. Vin Phuc has per capita GDP of \$503, and Soc Son \$1,381.

50. The average 5-year population growth rate in the affected districts is 1.26%. The average ratio of males to females is 0.97.

51. Ethnic minority groups—mainly Tay, Nung, Dao, Mong, Hoa, Cao Lan, and San Chi—live in the project provinces. Of these the Tay are the most numerous, making up around 60% of the population of indigenous groups. Those living in highland areas have generally maintained their traditional customs, while those closer to lowlands and population centers have been incorporated into mainstream life and culture. In the mountain areas educational levels are low.

3. Local Economy

52. Agriculture, forestry and fisheries make up over 50% of the economic output in Phu Tho, Yen Bai and Lao Cai provinces. Industrial production contributes 85% of output in Vinh Phuc province and 60% in Hanoi. The service sector makes up 33% of economic output in Hanoi, and 13% in Lao Cai. (See Table 5.)

Table 5: Output Value of Main Sectors, in 2005 Prices
(D billion)

City/Province	Agriculture	Forestry	Fishery	Industry	Services	Total
Hanoi	2,062	8	122	20,517	11,254	33,963
	(6.1%)	(0.0%)	(0.4%)	(60.4%)	(33.1%)	(100.0%)
Vinh Phuc	3,016	45	170	22,090	821	26,142
	(11.5%)	(0.2%)	(0.7%)	(84.5%)	(3.1%)	(100.0%)
Phu Tho	3,079	312	96	2,250	548	6,286
	(49.0%)	(5.0%)	(1.5%)	(35.8%)	(8.7%)	(100.0%)
Yen Bai	1,363	398	65	1,128	265	3,218
	(42.4%)	(12.4%)	(2.0%)	(35.1%)	(8.2%)	(100.0%)
Lao Cai	1,186	256	21	936	345	2,744
	(43.2%)	(9.3%)	(0.8%)	(34.1%)	(12.6%)	(100.0%)

Source: Provincial Statistical Yearbooks, 2005

4. Major Economic Resources of the Project Area

53. The main agricultural products are high-quality rice, peanut, maize, beans, and vegetables. Food animals consist mainly of livestock and poultry.

54. The main forest products are timber for the paper industry, firewood, and bamboo. Other forest products are bamboo shoots, cat's-ear, and mushrooms.

55. Industries that have been growing rapidly are food processing, which supplies markets in the PRC; beverage; textile; fashion; tanning; timber processing; paper production; chemical production; rubber; plastics; power and water; nonmetal minerals; products from metal; machinery and equipment; electrical equipment; radio and television manufacturing; transport equipment; furniture; and materials recovery facilities.

56. Mining is a major activity in the project provinces. Vinh Phuc and Phu Tho provinces produce kaolin, limestone and construction materials are quarried in the mountainous areas, and Lao Cai province is a major producer of both apatite and copper, and also has iron ore and graphite mines.

57. There has been rapid expansion in trade and tourism, especially in Lao Cai province, where the sector has grown by more than 50% yearly over the past 5 years. The mountain resort town of Sapa is especially popular with domestic and international visitors including tourists from the PRC, who have been arriving in fast-growing numbers.

58. The 5-year development plans of all of the project provinces include the establishment of economic and industrial zones. By 2004, Vinh Phuc province had 10 industrial complexes in four industrial zones, and had begun 40 industrial development projects outside the zones.

5. Delivery of Basic Services

59. The delivery of medical services in the Project provinces has expanded, and mortality from serious contagious diseases has been reduced.

6. Land Use

60. The inventory-of-losses survey for the acquisition of land showed that the land is mainly agricultural and forest. Agricultural landholdings are small on average and distributed over valleys and foothills. Larger lots 3–4 ha in area are usually found along rivers and streams. Midland and upland areas have mostly been cleared by slash-and-burn agriculture. Because of the steep slopes, poor cultivation methods, and the general absence of soil conservation measures, severe erosion upland causes soil degradation and runoff acidification, resulting in very low crop yields.

IV. ALTERNATIVES

61. **No-Action Alternative.** The do-nothing alternative would be to rely on the existing road network using QL32C, QL2, and QL70. Though classified as national highways, these are winding roads with ribbon development alongside, resulting in long journey times, frequent traffic accidents, and high economic cost. The current journey time from Noi Bai to Lao Cai is 8 hours by car, and 16 hours for heavy trucks. The lack of high-standard transport infrastructure is the major constraint on economic development in the project provinces.

62. **Other Transport Modes.** The railway provides an important alternative route for passengers and freight and serves the major population centers along the route. Journey time by overnight express from Hanoi to Lao Cai is 8 hours. The railway will be improved under ADB Loan 2302-VIE.⁴ But because the railway gauges on the PRC and Viet Nam sides of the border are incompatible, transshipment at the border is necessary. Bulk goods are often ferried by river, especially in the section from Hanoi to Yen Bai.

63. **Alternative Alignments.** Alternative alignments were considered at the feasibility study stage. One alternative route crossed the Lo River around 45 km further upstream, and the Red River close to Yen Bai province. This route was rejected because it did not serve the major population centers of Vinh Phuc and Phu Tho provinces. Another alternative was the same as the chosen alignment until Phu Tho town, but crossed the Red River around 30 km further upstream. This route would pass through relatively more developed land, affect more people, and entail a higher cost; therefore, it was not adopted.

64. The review of the suggested alignment during detailed design, based on field inspection, resulted in 35 minor modifications that typically involved moving the alignment by up to 100 m, and 10 major realignments but generally still within a 2 km corridor. Around 80% of the changes were made to reduce the social impact including resettlement and the effect on cemeteries, temples, or public facilities, and the rest of the changes were made to conform to development master plans or for engineering reasons. All proposals were presented in detail to the people's committee of each province, through topographic maps, satellite photos, and joint site inspections, and were adopted only after full agreement was reached.

⁴ ADB. 2006. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the Socialist Republic of Viet Nam for the Greater Mekong Subregion: Kunming–Haiphong Transport Corridor: Yen Vien–Lao Cai Railway Upgrading Project*. Manila (Loan 2302, for \$60 million, approved on 19 December 2006).

V. ANTICIPATED ENVIRONMENTAL IMPACT AND MITIGATION MEASURES

A. Impact during Construction

1. Physical Impact

a. Water Pollution from Construction Works

65. Open land surfaces, excavations, and soil stockpiles will result in higher silt loading in runoff if proper mitigation measures are not taken. The contractors will be requested to prepare erosion control plans prior to the commencement of the civil works to minimize sedimentation in river bed. Sand extraction in rivers for road embankment works will be done at licensed areas, with care taken to minimize environmental impacts. By taking mitigating measures, water pollution from construction is expected to be moderate, short-term, temporary, and reversible. The mitigating measures recommended include: (i) limiting the period of construction by carrying out several contract packages at the same time; (ii) avoiding sand extraction within 100 m of water intake structures; (iii) providing temporary drainage during construction to reduce gully erosion; (iv) benching cuts; (v) installing sedimentation control measures (sediment trap, straw bale barriers) at points of discharge to watercourses; (vi) installing facilities to remove mud from the tires of construction vehicles; (vii) avoiding the storage and handling of lubricants, fuels, and other hydrocarbons within 50 m from water bodies; and (viii) ensuring the proper disposal of solid waste from construction activities and workers' camps.

66. Excavation works for drainage, bridge piles, box culverts, and other structures that go below the water table may have to be dewatered. The discharge will carry a significant amount of silt, sometimes as high as 250 milligrams per liter of suspended solids. Sandbag silt traps will be installed to retain the suspended solids.

b. Soil Erosion

67. During earthworks several activities can lead to soil erosion and loss of valuable topsoil. Site clearance will remove and stockpile topsoil, and, if not done correctly, will reduce the quality of the topsoil. Uncontrolled runoff from the site can also lead to soil erosion on neighboring land. The mitigating measures recommended are to plan the stockpile locations well, to pile up topsoil only up to 2 m high, and to provide correct drainage at the construction site.

c. Change in Hydrological Situation

68. The construction of temporary embankments for access routes could block watercourses leading to ponding on roads or flooding of nearby houses. In areas prone to flooding, especially in Soc Son district in Hanoi city, and in Vinh Phuc and Phu Tho provinces, particular caution is required. Temporary works should be planned with the possible effects on drainage flows and flood levels in mind, and should provide adequate drainage openings. Extraction of river sand for construction will have positive impacts as it will counteract accumulation of sediment. However, it will only be carried out at approved locations and so as not to undermine flood protection structures of water intakes.

d. Impact on Groundwater

69. The excavation of deep cuttings will change groundwater flows and drain perched water tables. Shallow wells near cuttings may need to be deepened or relocated. No impact on groundwater quality is, however, expected.

e. Disposal of Surplus Soil

70. The disposal of soil, if done carelessly or illegally, can cause loss of productive land, and increased discharge of sediment into watercourses, among other things. The total volumes of cuttings and fillings for the Project will be almost balanced, with a soil surplus of around 1 million m³. The earthworks balance will be further adjusted during detailed design. If the disposal of soil is properly planned, local residents may be able to use the surplus earth materials for land development. At the start of construction, the contractors will be required to make the filling materials available to local district leaders. VEC's environmental officer will coordinate with the Provincial Land Survey and Natural and Environmental Management offices of DONRE in evaluating requests for farm fill or housing development land. The sites will be assessed before use.

f. Air Pollution and Noise

71. Project construction is expected to generate a short-term and temporary increase in ambient dust and noise. The increased dust level may disturb some people. The increased sulfur dioxide and carbon monoxide concentrations in the area are not, however, expected to exceed environmental standards because the construction equipment working on each section of highway will be few. Among the air pollution control measures for the Project are: (i) regular monitoring to ensure the use of fuel-efficient and well-maintained equipment to minimize exhaust emissions and noise; (ii) control of concrete batching, asphalt, and crusher activities according to Vietnamese emission standards; and (iii) location of asphalt hot-mix facilities downwind of sensitive receptors such as schools and hospitals, or at least an adequate distance upwind.

72. Construction dust is one nuisance expected from project construction. But this phase is short-term, temporary, and limited in spatial extent. The rainy season is longer than the dry season in the project area; thus, any dust impact will be short-term. Tender documents will include requirements for limiting ambient dust to government standards at identified sensitive areas (residential areas close to the alignment, schools, hospitals, churches, and pagodas). Mitigating measures include: (i) avoiding the location of borrow sites near sensitive areas, (ii) regularly sprinkling excavated areas and open road sections on dry days, (iii) covering hauling trucks with tarpaulin, (iv) locating sand and earth stockpiles away from sensitive areas or at least providing adequate wind breakers between the stockpile and sensitive areas, and (v) limiting vehicle speeds to 20 kilometers per hour on unpaved roads in dry weather.

73. Pile-driving and blasting operations will create annoying noise and vibration, as will the passage of trucks and heavy equipment. But the construction noise is not expected to exceed the allowable levels for residential or industrial areas. And the flora and fauna in the nature reservations, which are some distance away from the project alignment, will not be disturbed. Sensitive areas such as residential areas, schools, pagodas, churches, and hospitals within 50 m of the construction limits will be provided with noise bunds of adequate height. As a rule: (i) heavy equipment should be operated only in the daytime; (ii) hammer-type pile-driving operations should be avoided at night; (iii) construction equipment that generates excessive noise should be enclosed; (iv) blasting activities should be allowed only in the daytime, blasting intensities controlled, and nearby residents notified beforehand; and (v) the effectiveness of mitigation measures should be monitored regularly through noise level measurements at sensitive sites. Projected noise levels should not exceed Viet Nam standards.

2. Ecological Impact

a. Local Ecosystems

74. The project area is an agro-ecosystem. Humans have settled and managed the area for centuries, for agricultural production. The construction of the highway will not cause any major change in the present ecological situation.

b. Trees

75. About 220,000 trees of all species, including tea, longan, lychee, mango, fruit, and other trees, will be removed from the right-of-way. The trees have no ecological significance, and their removal will have negligible impact on the agro-forest ecosystem.

c. Flora and Fauna

76. No habitats of vulnerable, threatened, or endangered flora or fauna have been identified within the secondary impact area of the Project. The removal of vegetation in preparation for construction will cause common animals (insects, rodents, frogs, small reptiles) in agricultural lands to move to nearby habitats within the same corridor. These animals reproduce quickly and readily adjust to the presence of humans. The following mitigating measures will be implemented during construction: (i) minimizing the clearing of areas to what is absolutely necessary for construction, (ii) using construction equipment that creates less noise, (iii) promptly replanting grasses to protect embankment slopes, and (iv) prohibiting workers from taking local animals for food.

3. Social Impact

a. Resettlement and Interruption of Public Life

77. Around 2,100 households will have to be resettled, and around 5,500 households will lose some assets. Long-established patterns of life will be disturbed, and the ability of the families to earn a living could be drastically reduced. The recommended mitigation measures involve timely land acquisition and compensation according to the resettlement plan, reflecting the high priority given by ADB and the Government of Viet Nam to fair and equitable land acquisition.

78. The construction works will form a physical barrier to movement, and could cut into established pedestrian or vehicle routes. To mitigate this effect, clearly marked and protected passageways should be provided and maintained while construction is in progress, and safety awareness programs conducted near construction sites with signs and posters warning the public of the dangers.

b. Cultural Property

79. No valuable cultural property will be directly affected by the Project. The alignment has been selected to exclude direct impact on cultural property.

c. Employment Opportunities due to the Project

80. About 15,000 workers (mostly local people) will be employed directly or indirectly by the Project, for varying durations. The Project will increase job opportunities in the area, as well as local economic activities for the supply of food and miscellaneous supplies at the job sites and the purchase of goods and services by the workers' families. However, as the husbands and fathers will be at work, the mothers will have to take on a greater share of the household chores and tasks; these concerns will be treated under the gender strategy. The significant employment impact on the host populations will be for the duration of the Project and will be temporary.

d. Indigenous Peoples

81. Social safeguards to protect indigenous communities from adverse effects of the Project are required under ADB's *Policy on Indigenous Peoples* (1998). These safeguards are presented in detail under the specific actions in the assessment of the social impact of the Project.

e. Public Health Impact

82. Vector-borne and communicable diseases including HIV/AIDS could spread during construction. To make this health impact less likely, a health education campaign and training should be conducted for the construction workers in safety and health protection measures.

f. Fuel and Oil Handling Operations

83. The contractor will need to handle bulk fuel on-site during construction. Without mitigating safety measures, if the fuel facility fails it could spill hazardous material into the surrounding area. To control risks and hazards in this respect, the contractors will be required to: (i) institutionalize an emergency and contingency plan for fuel and oil spillage, (ii) obtain appropriate permits for the transport and handling of hazardous materials, (iii) locate the refueling facility at the motor pool site on a cement pavement with a surrounding canal leading to an oil and grease separator to facilitate the capture and removal of spilled oil, (iv) place reflectorized signs on fuel tanks for night visibility, and (v) have protective posts that can withstand the accidental backup of heavy equipment.

B. Impact during Operation

1. Physical Impact

a. Air Pollution and Noise

84. Air quality during the operation of the highway will suffer from increased levels of sulfur dioxide and carbon monoxide, but will remain within Vietnamese air quality standards because the emissions will be dispersed and the topography does not lend itself to a concentration of pollutants. Vehicle emissions in tunnels are concentrated and discharged as a point source at the tunnel entrances. However, the tunnels are short, with shallow gradients, and are located away from residential areas; hence, no significant impact is predicted. Vibration will also emanate from the highway, but can be controlled through correct maintenance of the pavement. Studies show that at a distance of 50 m, the noise and vibration of a highway meets the United States standards for residential noise and vibration levels. Noise buffers for sensitive areas within 100 m from the edge of the highway slope are included in the project design. Members of the public who raise concerns about noise will be encouraged to plant a buffer zone of closely spaced trees, which can reduce the noise level by up to 10 (A-weighted) decibels

(dB[A]). This vegetative barrier will also arrest the spread of airborne particles to residential areas and neutralize greenhouse gases.

b. Altered Hydrological Conditions

85. The completed embankment could block the flow of drainage and thus overload streams. Flooding could worsen as a result. These issues will be addressed during the design phase, but if they are found to occur during operation the capacity of the drains must be increased.

c. Differential Settlement

86. If embankment is built on soft ground, subsidence could occur and cause damage to nearby buildings and structures. The process could be slow and could continue for many years after construction while the clay soils consolidate. Mitigation measures should be carried out in design to ensure that such conditions do not occur, and if they are found to occur during operation, the affected households should be relocated or underpinning done as a remedial measure.

2. Ecological Impact

a. Local Ecology

87. The host ecosystem, being an agro-ecosystem, will not experience significant ecological changes from the operation of the Project.

b. Water Quality

88. Surface runoff from the highway carriageway will contain oil and grease from vehicles and precipitates from diesel emissions, and will alter the pH of water and disturb the balance in surrounding wetlands. Service areas are the most likely locations where such contamination occurs because of the concentration of parked vehicles and fuel stands. They should therefore be equipped with an interceptor tank to remove oil and fuel grease from surface water before discharge.

c. Impact of Air Pollution and Noise on Flora and Fauna

89. There are no vulnerable ecosystems or rich areas of fauna such as birds and animals nearby. Therefore, no significant impact is anticipated.

d. Disruption of Migratory Routes

90. Important wetlands are at least 1 km away from the project alignment, except for Chu Lake in Phu Tho province, where the alignment passes within 100 m or so downstream of the dam. However, the lake extends over many square kilometers and the portion subjected to increased noise levels would be very limited; hence, no impact on migrating birds is anticipated.

3. Social Impact

a. Separation of Communities

91. Communities will be split and isolated areas created by the interruption of transport routes and the construction of interchanges. Mitigation measures to allow the safe passage of residents will include the construction of over-bridges and underpasses where pedestrians and vehicles can cross. For reasons of economy it is impossible to reestablish every traditional footpath, particularly in areas like paddy fields. In such locations, several traditional paths may be served by a single crossing, and a frontage road can provide access to the nearest crossing point. The optimum location of crossing points will be determined during the design phase in consultation with local communities and their representatives.

b. Indigenous Peoples

92. Better access to the project area could lead to an influx of Kinh people, who would purchase plots in lowland areas, driving the indigenous people higher into the hills to less productive land. This tendency has already been observed in the project area: there are very few indigenous peoples in the direct impact area. Mitigation measures include ensuring that indigenous people are given particular attention and support during land acquisition and resettlement, and can benefit from income restoration programs to increase their access to economic opportunities.

c. Employment and Economic Opportunities

93. About 500 people will be hired to operate and maintain the highway. The highway will also open up new opportunities for trade and stimulate further growth in economic production. Moreover, there will be new cultural influences from interaction with other cultures in the process of trade and commerce—as well as the possibility of criminal elements coming in. Mitigating measures to be implemented will include, among others: (i) strengthening and enhancing Vietnamese cultural and moral values through the local school curriculum and in religious teaching, to guide conduct and perspectives in trade, commerce, and the service industries; and (ii) orienting and training the local police to handle and manage the possible increase in local disobedience or delinquency and cross-border crimes. Vietnamese cultural values and institutions are strong and can resist the negative influences of urbanization, and the police have enough authority and power to manage the situation. The negative impact in this regard is expected to be insignificant. The economic advantages from the Project will outweigh the disadvantages.

d. Public Health

94. The rate of spread of HIV/AIDS could increase during the operation of the highway. Long-distance traffic will increase, bringing the risk of increased prostitution around service areas or rest areas. Public health education campaigns in schools and poster campaigns on safe sex and the risks of HIV/AIDS should be implemented at locations identified to be at risk.

e. Change of Landscape

95. The constructed highway risks creating a scar on the landscape particularly if cut slopes are left untreated and bare of vegetation. The planting of grass (sodding), possibly through

hydro-seeding, and the revegetation of cut slopes will improve the visual appearance of the highway.

VI. ECONOMIC ASSESSMENT

96. **Cost.** The civil works construction cost of the highway is estimated at \$726 million. The total environmental mitigation and monitoring costs (both capital and recurrent costs) are estimated at \$5.1 million (0.7% of the civil works cost), including capital investment and inspection during construction. The cost of environmental monitoring and operations over 15 years of operation is estimated at \$1.78 million (see Appendix 1).

97. **Environmental Benefit.** By shortening the travel distance and providing smoother alignment the Project will result in fuel consumption savings and the corresponding environmental benefit of reduced emissions. This factor will, however, be offset by the increased number of journeys that will be made. The highway will be safer because the use of grade-separated intersections and divided carriageways, and the elimination of low-speed traffic and motorbikes, will lead to fewer accidents per vehicle-kilometer. On the other hand, the generated traffic on the highway network could result in more accidents overall.

98. **Economic Analysis of Environmental Impact.** The construction of the highway will result in economic cost from the loss of productive forest and arable land, together with the investment cost of the construction and land acquisition. The economic benefits of vehicle operating cost savings, and time savings for users, however, far outweigh the losses, resulting in a calculated overall economic internal rate of return of around 18%.

VII. ENVIRONMENTAL MANAGEMENT PLAN

A. Environmental Management Plan

99. An environmental management plan (EMP) has been prepared (Appendix 2) and will be updated during detailed design. VEC will ensure that the contractors prepare a site-specific EMP based on this EMP and the actual situation on-site. VEC will monitor the implementation of the EMP, and will report twice a year on EMP compliance.

100. The bidding documents for construction contracts will be based on standard ADB documents for international competitive bidding, and will include contract clauses requiring the contractor to implement the relevant clauses of the EMP. The construction specifications will incorporate the EMP requirements.

B. Environmental Monitoring Plan

101. During construction, compliance monitoring will be completed as the work is carried out by VEC or by consultants contracted by VEC. The construction monitoring will be done every 3 months.

102. No later than 6 months before the completion of the construction work, VEC will gather compliance monitoring information from all contractors and provide a completion report on construction mitigation to ADB. The report will show the timing, extent, and success of the completed mitigation measures, and the maintenance and monitoring needs during operations. Since VEC is also responsible for the operation of the highway, smooth transition of environmental responsibility is assured.

103. VEC will strengthen and continue to improve its capacity by implementing environmental programs for its managers and staff well before the start of construction, to make them better aware of the required mitigation actions before the contractors mobilize.

104. Monitoring during operation will focus on maintaining the mitigation measures begun during construction, and on monitoring air quality and noise levels. Annual environmental reports during the operating period will be prepared by VEC and discussed with MONRE and DONREs. These discussions will form the basis for needed adjustments in the program.

C. Institutional Requirements

105. VEC has formed a project implementation unit to implement the Noi Bai–Lao Cai Highway Technical Assistance Project. The unit was established in January 2006, and as of June 2007 it had a staff of eight—a director, two deputies, a highway engineer, a bridge engineer, a financial specialist, an environmental specialist, and a resettlement specialist.

106. VEC is a relatively new institution, which is expanding rapidly as it undertakes projects to develop the expressway network in Viet Nam. It plans to begin construction of at least six expressway development projects in the next 5 years. This will lead to a requirement for an environmental specialist in project design, construction supervision, and monitoring during operations. VEC in 2007 has established an Environmental Section within the Technical Project Department. This acts as a skills center to supply resources and advice to project teams during the various stages of design, construction, and operations, and is responsible for ensuring that VEC regulatory and loan covenants are met. Specialist monitoring work and the preparation of EIAs will continue to be carried out by specialist environmental institutions.

107. At the design stage, the ES environmental specialists and highway engineers of VEC will ensure that environmental protection is incorporated into the design.

108. During construction, the contractors will ensure that mitigation measures are implemented and sustained throughout the construction period. In turn, environmental specialists will be hired to join the construction supervision consultant team and to oversee and monitor the implementation of all mitigating measures required by the EMP in accordance with ADB's *Environment Policy* (2002) and *Environmental Assessment Guidelines* (2003). VEC environmental specialists will oversee the work of the consultant. The duties of the consultant will be to: (i) supervise the implementation of the environmental protection and impact mitigating measures by the contractors, (ii) supervise construction activities to ensure minimum impact on the natural and socioeconomic environment, (iii) monitor the impact of the construction works, and (iv) prepare the necessary remedial actions.

109. ES/VEC will lead government counterparts at all levels in environmental compliance monitoring. ES/VEC will (i) confirm that the contractors' contracts specify their environmental mitigation responsibilities, (ii) distribute copies of the SEIA and its EMP to the contractors, (iii) appoint environmental monitoring teams, and (iv) ensure that semiannual monitoring and construction monitoring completion reports are prepared and submitted in a credible and timely fashion to VEC and ADB, as required.

110. Environmental compliance monitoring requires the presence of the following work elements within VEC, the consultant, and contractors: (i) administrative and managerial commitment to mitigation and monitoring; (ii) completely translated SEIA and EIA, including the

EMP and monitoring plan, with copies available to VEC staff members and contractors; (iii) skilled environmental monitoring specialists or analysts within VEC; and (iv) systematic and credible data collection, organization, and reporting.

111. Air quality and noise levels will be monitored by the consultant during construction and by VEC during operation. VEC will also periodically conduct independent checking through a specialist company. It will invest in equipment and training to develop its capability to carry out routine monitoring, interpretation, and reporting. The results of monitoring at both construction and operation stages will be submitted by the consultant or the specialist company to VEC, which will review them and, if necessary, decide on further mitigating actions. The results, including additional mitigating actions taken and the results of those actions, will also be periodically reported to the DONREs of the provinces and cities involved, as well as to MONRE and ADB. These institutions may also request further actions for environmental mitigation that they deem necessary.

VIII. PUBLIC INVOLVEMENT AND DISCLOSURE

112. Information pertinent to environmental impact was documented and disclosed to the public in Vietnamese during public consultations. During alignment selection, a consultation attended by people's committee leaders and representatives of related agencies was held in each province in March 2007. The results of the consultations were taken into consideration in the detailed design of the Project and in the preparation of the EMP.

113. Public consultation specifically for the EIA was also undertaken twice in each province during the preparation of the Project, for a total of 10 meetings. It was held for the first time in the early stage of the EIA in May 2007, and again in June 2007, when the draft EIA report was available. Those invited to attend were representatives of province, district, and commune peoples' committees, and local nongovernmental organizations like the Fatherland Front, the Women' Union, and the Farmers' Union. At the meetings the Project was described and timetables were communicated, the alignment location and land requirements were presented in detail, and the participants' concerns were discussed in question-and-answer sessions.

114. While the EIA was being prepared, focus group meetings were also held at the commune level together with household surveys as part of the socioeconomic survey and inventory-of-losses survey for resettlement planning.

115. Most of the participants in the consultations were in favor of the Project but provided useful suggestions that were incorporated into the design of the Project and into the EMP.

116. Participants' opinions differed by province. In the mountainous areas, especially in Yen Bai and Lao Cai provinces, resettlement was the most important concern. The loss of agricultural land would have significant impact, the participants said, as their economic activities depended on the land, and they might have no chance to take up another occupation. On the other hand, hydrological conditions were the main concern of participants in lowland areas, especially those in Vinh Phuc province and Soc Son district in Hanoi city, which are vulnerable to flooding. The participants in Vinh Phuc and Soc Son also stressed the importance of minimizing the duration of construction noise, air pollution, and traffic disruption. Detailed opinions on quarries, borrow pits, and disposal areas were received as well in Soc Son, which has a long history of development including the construction of the Noi Bai International Airport and other road projects.

117. The potential breakup of communities and disruption of irrigation and drainage were brought up by participants in all areas. These issues have been addressed through the provision of an adequate number of underpasses and over-bridges in the project design, and the reestablishment of irrigation and drainage facilities.

IX. CONCLUSIONS

118. If the measures defined in the EMP and monitoring plan are carried out on time and properly before and during construction, and throughout its operation, the Project can proceed without serious environmental effects.

119. For the effective implementation of the EMP, environmental training, supervision, and monitoring will be crucial. Therefore, the training costs associated with the implementation and maintenance of environmental mitigation measures have been included in the project cost estimates. VEC is urged to contract with DONREs, MONRE, professional companies, or individual consultants to conduct a training workshop for the contractors before construction.

DETAILS OF ENVIRONMENTAL MITIGATION COSTS

Table A1.1: Summary of Environmental Costs and Benefits
(D million)

Item	Cost
Nonrecurring Project Costs	38,320
Monitoring during Construction (2008–2011: 3 years)	15,148
Monitoring during Operation (2011–2026: 15 years)	28,795
Mitigation and Monitoring Costs	82,263

Source: Consultant estimates.

Table A1.2: Estimated One-Time (Nonrecurring) Mitigation Costs for the Project
(D million)

Mitigation Measure	Details	Unit Cost	Total Cost
Design and Construction Stage			
Environmental Plans	Planning of mitigation and monitoring measures and timetable preparation	200	200
Installation of Solid Barriers	Solid barriers (height 2.5 m, thickness 12 cm, length 200 m) to prevent noise and dust at 6 sensitive areas	60	33,010
Soil Conservation and Silt Control	About 50 storm-water settling ponds as silt traps	20	1,000
Sewage Treatment Facilities	Construction at work camps (35 camps)	40 per tank	1,400
Training of Personnel	Highway construction units, management units, and emergency units (included in other consulting service costs)	850	850
Monitoring	Technical equipment for water, noise, and air quality monitoring 2 monitoring vehicles	80	80
		400 per vehicle	800
Operation Stage			
Sewage Treatment Facilities	At tollgates (1 septic tank at each of the 19 toll stations)	20 per station	380
	At service areas (4 full-service areas)	100 per station	400
Spill Management Plan	Preparation of a hazardous materials spill prevention plan	200	200
Total Nonrecurring Mitigation Costs			38,320

Source: Consultant estimates.

Table A1.3: Estimated Recurring Environmental Costs Construction Stage, 2008–2011
(D million)

Item	Details	Unit Cost	Total Cost
Air Quality Monitoring	Air quality (TSP) at two replicates per sample in 6 sensitive areas Sample taken quarterly for 3 years	23 per sample	3,312
Noise Monitoring	Noise level at 6 sensitive areas to be monitored quarterly for 3 years	0.5 per sample	36
Septic Tanks	Maintenance of 35 septic tanks (D4.6 million per tank per year) for 3 years	161 per year	483
Solid Waste Management	Maintenance of recycling or reuse program (D35 million per camp per year) at 35 work camps, each with five recycling bins	1,225	3,675
Dust Suppression	Water truck operations involving road dust spraying (200 days per year, three times a day for 3 years); construction will be managed by five contractors	0.8 per day per contract	7,200
Environmental Supervision	Supervision of five proposed contracts; other operating costs per year, including audit	20 per contract per year 44 per year	300 132
Total Costs at Construction Stage			15,148

TSP = total suspended particulates

Source: Consultant estimates.

Table A1.4: Estimated Recurring Environmental Costs Operation Stage, 2011–2026
(D million)

Item	Details	Unit Cost	Total Cost
Annual Maintenance Cost	For protection of environmental facilities and mitigating measures installed during construction	100 per year	300
Air Quality Monitoring	Air quality (TSP) at two replicates per sample in 6 sensitive areas Sample taken twice a year for 15 years ^a including reporting	23 per sample	8,280
Noise Monitoring	Noise level at 6 sensitive areas to be monitored twice a year for 15 years ^a including reporting	0.5 per sample	90
Environmental Operations	Implementation of mitigating measures scheduled for operation stage and maintenance of equipment, including solid waste management	600 per year	9,000
Training	Short environmental training courses (first 5 years)	20 per year	100
Environmental Protection Staff Salaries	10 staff members for maintenance 5 staff members for supervision	35 per member per year 77 per member per year	5,250 5,775
Total Costs at Operation Stage			28,795

^a The proposed monitoring program will be reviewed after 5 years and adjusted on the basis of the review results.

Source: Consultant estimates.

ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

Table A2.1: Environmental Management Plan

Environmental Concern	Objectives	Mitigation Measures	Timing	Location	Reference	Responsibility	
						Implementation	Monitoring/Supervision
A. Preconstruction Stage							
1. Social impact	Ensure that any adverse impact due to additional property acquisition and resettlement is mitigated	<p>Social preparation is basically completed. Impact is not likely unless unforeseen circumstances occur. If there is unforeseen need for additional land, the following mitigation measures should be adopted:</p> <ul style="list-style-type: none"> • Complete acquisition of land to minimize the uncertainty of people • Complete implementation of RP to provide compensation and assistance to those affected • Provide alternative land together with enough compensation to enable families to build and move to new house • Pay all payments/entitlements according to the RP 	Before removing houses and other structures Give affected people enough time, compensation money, and assistance to resettle satisfactorily	Unforeseen need for additional land	RP	VEC	MC
2. Impact on alignment design	Ensure that recommendations provided in conditional approval by MOT/VEC are followed by the design consultants	<p>The proposed final alignment is designed to avoid residential area, public facilities, and sensitive area; overpasses and underpasses have been designed, and existing irrigation and flood protection schemes identified</p> <p>The impact related to the aesthetic value of the local environment was considered and will be included and extended in the alignment design</p>	Before construction/during final design	Along the final alignment; the location of overpasses is included in plans	A list of agriculture and flood protection schemes has been prepared	VEC/MC	MC/CSC
3. Hydrological impact	Minimize hydrological and drainage impact during construction	<p>Most lakes and ponds were avoided in the final alignment design</p> <p>Complete the design of adequate major and minor drainage facilities</p> <p>Hydrologic flow in areas in paddy lands and lakes/ponds was facilitated through provision of permeable base layer in the road base with appropriate drainage structures including bridges and culverts</p>	Before construction/during final design	Along the final alignment, areas along paddy lands, lakes/ponds, water bodies	Drainage report	VEC/MC	VEC

Environmental Concern	Objectives	Mitigation Measures	Timing	Location	Reference	Responsibility	
						Implementation	Monitoring/Supervision
		Bridges and drainage structures over various water bodies in river basins, lakes/ponds have been designed to maintain existing flows					
4.Erosion control and temporary drainage	Improve erosion control and temporary drainage	Identify locations for erosion control and temporary drainage along all embankments to be expanded and at all culverts and cross-tunnels/metal structures	During design	Locations based on complaints and problems		VEC with the SC and design consultant	MC/CSC
5.Noise barriers	Ensure noise impact during operation is acceptable	Conduct detailed acoustic assessment for all residential areas, schools, and temples (and other sensitive structures) within 50 m of road If noise at sensitive receiver exceeds Vietnamese standards, design acoustic measures to control noise at source, e.g., solid barrier to reduce noise to within Vietnamese standards	During detailed design	Noise-sensitive locations		VEC/MC/CSC	MC/CSC
6.Exploitation, handling, transportation, and storage of construction materials	Minimize contamination of surroundings due to implementation of works, and asphalt, concrete, and aggregate crushing plants	Take measures to minimize or avoid adverse environmental impact from construction material exploitation, handling, transportation, and storage; consider the following: <ul style="list-style-type: none"> • Conditions that apply to selecting sites for material exploitation • Conditions that apply to timing and use of roads for material transport • Conditions that apply to maintenance of vehicles used in material transport or construction • Conditions that apply to selection of sites for material storage • Conditions that apply to rock blasting and aggregate production • Conditions that apply to the handling of hazardous or dangerous materials such as oil, explosives, and toxic chemicals Compile materials management plan monthly and include in progress report	Prepare list of borrow areas 1 month before construction Prepare list of routes of transport of construction materials for the contract; ensure agreement 1 month before construction	Borrow areas, access roads, transport routes, storage sites, construction areas	Contractor prepares a map of storage locations	Contractor and CSC to agree	VEC

Environmental Concern	Objectives	Mitigation Measures	Timing	Location	Reference	Responsibility	
						Implementation	Monitoring/ Supervision
7. Spoil disposal	Ensure adequate disposal options for unsuitable soils	Identify sufficient locations for disposal of spoils Designate disposal sites in the contract and cost unit disposal rates according to distance	During detailed design	Locations approved by relevant authorities and CSC		VEC/MC	MC/CSC
B. Construction Stage							
1. Hydrology and drainage aspects	Avoid deterioration of water quality, sedimentation, temporary flooding, creation of stagnant water bodies, and effects on groundwater level and quality	Prepare and implement a thorough plan (hydrology and drainage) including its review and updating; plan should be approved by CSC 1 month before construction, and reviewed and updated for implementation during construction Sand extraction (e.g., Red River and other sites) will only be carried out after securing proper permits. Appropriate mitigation measures shall be implemented to minimize environmental impacts Extractions shall be undertaken at least 100 m away from flood protection structures and downstream and upstream water intakes Use extensive erosion and sedimentation control measures at all construction sites (e.g., geotextiles, silt fencing, benching of cuts, sediment basins, sediment traps, filter fabric fences, straw bale barriers) Provide proper drainage systems at all construction, material exploitation, and storage sites before their use Consider weather conditions when particular construction activities such as cut operations are undertaken; cover stockpiles before heavy rains and do not locate them within 20 m of watercourses Install an intervening vegetated buffer to control any unexpected runoff Limit the depth of excavation for the use of recharge areas for material exploitation or spoil disposal Use landscaping as an integrated component of construction activity as an	Before and during construction	Along final alignment, flood-sensitive areas, runoff areas, along causeways and structures such as bridges and culverts; the engineer will list the location of each construction activity; the contractor will list the location of culverts; the contractor will provide the location of weather stations	Possible flood areas are identified in the Project's drainage report; Location of flood-sensitive areas, special locations to minimize disturbances to rainwater runoff and floodwater, causeways, and other structures are listed in the contractor's manual; construction sites of road bridges and river bridges that will be affected by drainage or flooding are shown on the map with the construction plans	Contractor	VEC and MC to actively supervise and enforce

Environmental Concern	Objectives	Mitigation Measures	Timing	Location	Reference	Responsibility	
						Implementation	Monitoring/ Supervision
		erosion control measure Minimize the removal of vegetative cover as much as possible and provide for its restoration where construction sites have been cleared of such areas					
2. Soil erosion and surface runoff	Prevent adverse water quality impact due to negligence Ensure unavoidable impact is managed effectively Minimize soil and rock erosion due to construction activities	Prepare a temporary erosion control plan 1 month before beginning works, and review monthly Plan cut and fill, land reclamation, etc., with climatic conditions in mind; the area can be subject to heavy rain Properly install temporary drainage and erosion control before works within 50 m of water bodies Provide meaningful water quality monitoring up- and downstream at all bridges during construction Ensure rapid reporting and feedback to the CSC Compact backfill according to design standards and grade to original contours where possible Treat cut areas against flow acceleration, and carefully design filled areas to avoid improper drainage Do not form stockpiles within such distances behind excavated or natural slopes that would reduce the stability of the slopes In the short term, provide either temporary or permanent drainage works to protect all areas susceptible to erosion Take measures to prevent ponding of surface water and scouring of slopes Backfill newly eroded channels and restore to natural contours Arrange to adopt suitable measures to minimize soil erosion during construction Consult agriculture societies and authorities in the area before deciding on mitigation measures Carry out surface protection measures	Before and during construction	Cut and fill, land reclamation, borrow areas, etc. Locations of all culverts, metal structure cross-tunnels and bridges for the pilot road and highway All locations based on complaints and problems		Contractor/ CSC	VEC/MC

Environmental Concern	Objectives	Mitigation Measures	Timing	Location	Reference	Responsibility	
						Implementation	Monitoring/ Supervision
		<p>such as turfing as early as possible; apply the protection in completed portions of surfaces, if such is possible without waiting for the entire section to be completed</p> <p>Minimize clearing of green surface cover during site clearing</p> <p>Replace removed trees with appropriate trees to ensure interception of rainwater and deceleration of surface runoff</p> <p>Locate large-scale nurseries with access to good water supply for the care and storage of appropriate vegetation to be reused on site</p>					
3. Water quality	<p>Prevent adverse water quality impact due to negligence and ensure unavoidable impact is managed effectively</p> <p>Minimize adverse impact on water quality caused by construction activities</p>	<p>Prepare a temporary drainage management plan 1 month before start of works</p> <p>Properly install temporary drainage and erosion control before works within 50 m of water bodies</p> <p>Provide meaningful water quality monitoring up- and downstream at all bridges during construction within 100 m of rivers</p> <p>Ensure rapid reporting and feedback to CSC of proper construction of temporary drainage and erosion control measures, maintenance, and management including training of operators and other workers to avoid pollution of water bodies by the operation of construction equipment</p> <p>Cover construction material and spoil stockpiles with a suitable material to reduce material loss and sedimentation</p> <p>Avoid stockpiling close to water bodies</p> <p>Do not store stripped material where natural drainage will be disrupted</p> <p>Store lubricants, fuels, and other hydrocarbons in self-contained dedicated enclosures >50m away from water bodies</p> <p>Ensure proper disposal of solid waste from construction activities and labor</p>	<p>Before and during construction</p> <p>Timing will depend on the construction timetable</p>	<p>Relevant locations indicated in the drainage report of the Project, e.g., ground and surface water locations indicated in the contractor's manual</p>	<p>Drainage report of Project and contractor's manual</p>	<p>CSC/MC to require contractor to check water and report to VEC/MONRE</p>	<p>VEC/MC to review results</p>

Environmental Concern	Objectives	Mitigation Measures	Timing	Location	Reference	Responsibility	
						Implementation	Monitoring/Supervision
		<p>camps</p> <p>Ensure borrow sites are not close to sources of drinking water</p>					
4. Air quality	Minimize and avoid complaints due to airborne particulate matter released to the atmosphere	<p>Control all dusty materials at source</p> <p>Regularly spray open areas with water</p> <p>Stockpile slightly wet soil and sand before loading, particularly in windy conditions</p> <p>Fit all heavy equipment and machinery in full compliance with national and local regulations</p> <p>Use fuel-efficient and well-maintained haul trucks to minimize exhaust emissions</p> <p>Cover vehicles transporting soil, sand, and other construction materials; limit speeds of such vehicles</p> <p>Concrete plants, asphalt, and metal crusher activities to be controlled (e.g., asphalt hot-mix plants should not be close downwind of sensitive receptors such as schools and hospitals)</p>	During construction	List of sensitive areas; most sensitive locations are in the contractor's manual; schedule for spraying of water is available		Contractor should maintain accepted standards, and engineer should supervise relevant activities	VEC/MC
5.Noise/Vibration	Minimize noise increases and vibrations during construction	<p>Strictly implement mitigation measures; the following requisite measures will be installed, maintained, and monitored per contract:</p> <ul style="list-style-type: none"> • Fit all heavy equipment and machinery in full compliance with national and local regulations • As a rule, operate heavy equipment in daylight hours • Avoid hammer-type pile-driving operations at night • Enclose construction equipment that generates excessive noise • Use well-maintained haul trucks with speed controls • Do not place borrow sites close to residential areas • Control blasting activities (e.g., daytime hours only, and with advance notice to nearby residents) • Conduct blasting at regular intervals 	During construction	Rock blasting locations to be updated monthly; potential noise impact locations	Relevant regulations	Contractor should maintain accepted standards; engineer should supervise relevant activities	VEC/MC

Environmental Concern	Objectives	Mitigation Measures	Timing	Location	Reference	Responsibility	
						Implementation	Monitoring/Supervision
		<p>and inform local residents; provide reasonable compensation for houses damaged by blasting effects</p> <ul style="list-style-type: none"> Take adequate measures to minimize noise nuisance in the vicinity of construction sites by adopting available acoustic methods 					
6. Impact on water bodies	Ensure that damage to water bodies and their ecosystems is minimized during construction	<p>Avoid disposal of wash water, solid waste, discarded packing, etc., in water bodies Do not dump or stockpile these materials near water bodies. Do not dump leftovers from concrete plants close to water bodies Avoid temporary structure or stockpiling on water bodies Totally stop use of pesticides during rainy periods; minimize use of fertilizers</p>	During construction	Areas close to wetlands and other water bodies (the final alignment avoids the major water bodies)		Contractor and engineer	VEC/MC
7. Exploitation, handling, transportation, and storage of construction materials	Minimize contamination of surroundings (due to implementation of works, asphalt concrete, and metal crushing plants)	<p>To minimize or avoid adverse environmental impact of construction material exploitation, handling, transportation, and storage, consider these conditions/recommendations:</p> <ul style="list-style-type: none"> Conditions that apply to selecting sites for material exploitation Conditions that apply to timing and use of roads for material transport Conditions that apply to maintenance of vehicles used in material transport or construction Conditions that apply to selection of sites for material storage Conditions that apply to rock blasting and aggregate production Conditions that apply to handling hazardous or dangerous materials such as oil, explosives, and toxic chemicals <p>Update materials management plan monthly and include in progress report Prepare a list of borrow areas 1 month before construction</p>	Before and during construction	Borrow areas, all construction and storage sites, asphalt concrete, and metal crushing plants	Contractor prepared a map of storage locations; report on vehicle conditions is available; environmental accident checklist and list of banned substances are included in contractor's manual	Contractor and CSC to agree	VEC/MC

Environmental Concern	Objectives	Mitigation Measures	Timing	Location	Reference	Responsibility	
						Implementation	Monitoring/Supervision
		Prepare a list of transport routes for construction materials for the contract and ensure agreement 1 month before construction					
8. Construction waste disposal	Minimize impact from the disposal of construction waste	<p>Prepare and implement a waste management plan to be submitted to the CSC and approved by the MC 1 month before construction; to be updated once a month</p> <p>Identify potential safe disposal sites close to the Project or those designated in the contract</p> <p>Investigate the environmental conditions of the disposal sites and recommend the most suitable and safest</p> <p>Establish proper drainage paths or drainage facilities</p> <p>Recover, reuse, or remove used oil and lubricants from the site in full compliance with national and local regulations; oil wasted must not be burned; a licensed disposal location should be agreed on with MONRE</p> <p>Properly maintain machinery to minimize oil spill during construction</p> <p>Dispose of solid waste at an approved solid waste facility; open burning is illegal and contrary to good environmental practice</p>	Before and during construction	A list of waste dumping areas is available; list of temporary dumping areas is to be prepared at the contract stage for agreement		Contractor; engineer should supervise and take action to complete contractor's relevant activities according to environmental standards	VEC/MC
9. Spoil (unusable soil) and waste disposal	Minimize environmental impact arising from the generation of spoil waste	<p>Investigate whether the waste can be reused by the Project or by other interested parties</p> <p>Identify potential safe disposal sites close to the Project</p> <p>Use designated spoil disposal areas where instructed (paid by unit/distance-rate)</p> <p>Investigate the environmental conditions of the disposal sites, and recommend the most suitable and safest sites</p> <p>Establish proper drainage paths or drainage facilities</p>	During construction and after completion of construction works	List of waste dumping areas is available; list of temporary dumping areas to be prepared at the contract stage for agreement		Contractor; engineer should supervise and take action to complete contractor's relevant activities according to environmental standards	VEC/CSC/MC

Environmental Concern	Objectives	Mitigation Measures	Timing	Location	Reference	Responsibility	
						Implementation	Monitoring/Supervision
		<p>Recover, reuse, or remove used oil and lubricants from the site in full compliance with national and local regulations; oil wasted must not be burned</p> <p>Properly maintain machinery to minimize oil spill during construction</p> <p>Adopt all approval conditions from MONRE, including drainage plans, before disposal</p>					
10. Work camp operation and location	Ensure that the operation of work camps does not adversely affect the surrounding environment and residents in the area	<p>The location will be subject to VEC approval; if possible, camps will not be located near settlements or near drinking water supply intakes</p> <p>Avoid cutting trees and minimize removal of vegetation</p> <p>Provide water and sanitary facilities for employees</p> <p>Manage solid waste and sewage according to national and local regulations; as a rule, solid waste must not be dumped, buried, or burned at or near the project site, but will be disposed of at the nearest sanitary landfill or site having and complying with the necessary permits; update waste management plan monthly</p> <p>Organize and maintain a waste separation, collection, and transport system</p> <p>Document separation, collection, and disposal of all liquid and solid hazardous and nonhazardous waste according to the given requirements and regulations</p> <p>After the construction, remove all debris and waste; remove all temporary structures, including office buildings, shelters, and toilets</p> <p>Plant exposed areas with suitable vegetation</p> <p>VEC and the supervising engineer will inspect and report that the camp has been vacated and restored to original condition</p>	During construction and after completion of works	Location map is prepared by the contractor		Contractor	VEC/MC

Environmental Concern	Objectives	Mitigation Measures	Timing	Location	Reference	Responsibility	
						Implementation	Monitoring/ Supervision
11. Loss of vegetation cover of the areas for temporary work space	Avoid negative impact due to removal of green surface.	<p>Minimize clearing of green surface cover for construction, borrow development, cutting of trees and other important vegetation during construction</p> <p>Landscape road verges</p> <p>Plant trees, shrubs, and ornamental plants to contribute to the aesthetic value of the area and compensate for the lost capability of the area to absorb carbon dioxide</p> <p>After the Project, remove all debris and waste</p> <p>Remove all temporary structures, including office buildings, shelters, and toilets</p>	During construction of relevant activities	List of locations with a map is available		Contractor and engineer	VEC/MC
12. Safety precautions for workers	Ensure safety of workers	<p>Provide adequate warning signs</p> <p>Provide workers with skull guards or hard hats</p> <p>Instruct workers on health and safety matters, and require them to use the safety equipment provided</p> <p>Establish all relevant safety measures as required by law and good engineering practices</p>	During construction	Construction sites		Contractor and engineer	VEC/MC
13. Traffic conditions	Minimize disturbance of vehicular traffic and pedestrians during hauling of construction materials, spoil, and equipment and machinery; blocking of access roads during blasting of rocks; damage/maintenance problems on roads and bridges used by the haul trucks;	<p>Formulate and implement a construction-related traffic management plan 1 month before construction</p> <p>Consider schools and hospitals in the vicinity</p> <p>Install traffic warning signs, and enforce traffic regulations during transportation of materials, equipment, and machinery</p> <p>Consider the condition of roads and bridges</p> <p>Conduct awareness programs on safety and proper traffic behavior in densely populated areas near construction sites</p> <p>Assign traffic control personnel</p>	Before and during construction	The most important locations, especially in the working area near the intersection under local traffic, to be identified and listed; relevant plans of the contractor for traffic arrangements are available		Contractor and engineer	VEC/MC

Environmental Concern	Objectives	Mitigation Measures	Timing	Location	Reference	Responsibility	
						Implementation	Monitoring/ Supervision
	dust nuisance to school and hospitals						
14. Institutional strengthening and capacity building	Ensure that VEC and PIU officials are trained to understand and to appreciate the EMP	Build capacity Set up an environmental management unit within PIU Develop a strengthening plan for the environmental management unit	Before and during construction	All senior VEC staff at senior engineer level and above in PIU and related units		VEC	MC
15. Social impact	Ensure that VEC and PIU officials are trained to understand and to appreciate the EMP	Build capacity Set up an environmental management unit within PIU Develop a strengthening plan for the environmental management unit	Initiate before construction and continue beyond completion of Project	Along final alignment		VEC	MC
C. Operation Stage							
1. Landslides and soil erosion	Minimize landslides due to excessive erosion of slopes and waterways with corresponding silting of the eroded soil	Maintain proper vegetation cover and erosion protection Ensure constant surveillance as part of routine maintenance	During operation and rainy seasons	Sensitive locations to be named		VEC	MONRE/ VEC
2. Air quality	Minimize air pollution from road usage (air pollution due to increased levels of TSP, NO ₂)	Enforce laws on vehicle condition, and other national measures regarding regulations on fuel type and purification of exhaust gases Promote mass transport and traffic management Establish vehicle emission regulations and standards Strictly enforce regulations after an awareness program Provide a vegetative barrier to arrest the spread of airborne particles to residential areas	During operation	Along final alignment		MONRE	MONRE
3. Noise	Minimize increased noise from road traffic; keep noise	Strictly enforce regulations including standards, after an awareness program	During operation	Sensitive locations to be named		MOT/VEC	MONRE

Environmental Concern	Objectives	Mitigation Measures	Timing	Location	Reference	Responsibility	
						Implementation	Monitoring/ Supervision
	pollution within tolerable levels						
4. Waste disposal	Control garbage disposal by road users that creates pollution and aesthetic discomfort	Provide information campaigns Charge fines for littering Regularly clean roadsides Place garbage bins along roadsides with signboards Work in collaboration with nongovernment organizations	During operation	Selected locations for garbage collection	VEC	VEC	MONRE/ VEC
5. Transportation of dangerous chemicals	Control transportation of dangerous chemicals and substances that may be hazardous to air and water quality	Respond in a timely manner to accidents and warn the public of environmental hazards Place warning signs on vehicles Require permits for the transport of dangerous goods Develop and implement an accidental spillage action plan	During operation	Along final alignment	Relevant rules and regulations of highway/motor traffic acts	VEC/relevant local authorities to be identified in accidental spillage action plan	MONRE/ VEC
6. Road accidents	Control serious and fatal accidents on the highway due to high speeds and increased number of accidents on access roads	Provide road user information/education, traffic signs, and road marking Enforce the law Provide emergency services Establish an accident review committee	During operation	Sensitive and accident-prone areas		Traffic police, relevant local authorities	MONRE/ Traffic police
7. Social impact	Control and minimize impact of traffic nuisances, such as dust, noise, and vibrations, on people in surrounding areas	Provide continuous air quality and noise monitoring Enforce regulations, and control and management systems for vehicle speed, noise, quality of vehicle, and emissions Provide necessary awareness-building programs for the general public	During operation	Along final alignment	Locations listed by VEC and other local authorities	MONRE/ VEC/relevant local authorities	MONRE/ VEC/ relevant local authorities

CSC = construction supervision consultant, EIA = environmental impact assessment, EMP = environmental management plan, MC = management consultant, MONRE = Ministry of Natural Resources and Environment, MOT = Ministry of Transport, NO₂ = nitrogen dioxide, PIU = project implementation unit, RP = resettlement plan, SS = suspended solids, TSP = total suspended particulates.

Source: Consultant's study

Table A2.2: Environmental Monitoring Program

	Air Quality		Noise Level	
	Construction	Operation	Construction	Operation
Parameter	TSP (dust) levels		L_{eq}	
Sampling Point	6 sensitive areas		6 sensitive areas	
Frequency (times/year)	4	2	4	2
Standards	300 $\mu\text{g}/\text{m}^3$		75 dB(A): day 70 dB(A): night	
Rate (D million/sample)	23		0.5	
Approximate Cost (D million)	3,312	8,280	36	90
Implementation	Contractor		Contractor	
Supervision	VEC, CSC		VEC, CSC	

CSC = construction supervision consultant, dB(A) = A-weighted decibel scale, L_{eq} = equivalent continuous noise level, $\mu\text{g}/\text{m}^3$ = micrograms per cubic meter, TSP = total suspended particulates, VEC = Vietnam Expressway Corporation.

Note: The rate per sample includes laboratory analysis, equipment, transportation, technical staff, and vehicle hire.

Source: Consultant's study