

13. PROJECT COST ESTIMATES

13.1 General

The estimate of the project cost was based on the results of preliminary engineering design, quantity take-off of each work item, and the studies on construction method and operation and maintenance of Highway No. 18 as described in the preceding chapters.

The basic premises in estimating the project cost are as follows :

- (1) All the construction work will be executed by contractor(s) to be employed for the highway improvement.
- (2) The unit price of each cost component was determined based on the economic conditions prevailing in January 1996 (USD \$ 1.0 = 10,950 Dong).
- (3) Engineering services cost is assumed to be 4% of the total of construction cost, land acquisition and resettlement cost.
- (4) Supervisory service cost is assumed to be 6% of construction cost.
- (5) Physical contingency is estimated to be 10% of the total of construction cost, land acquisition and resettlement cost, engineering services cost and supervisory services cost.

The project cost is estimated in financial cost.

13.2 Construction Cost

(1) Unit Costs of Construction Works

The unit cost of construction works are analyzed based on the labor cost, material cost, equipment cost, overhead and profit for major work items. The analyzed unit costs are compared with current bid prices and adjusted as required to obtain the most realistic prices.

1) Unit Cost of Labor

Table 13.1 shows the unit cost of labor applied in the construction cost estimate, which include such allowances as social benefits, insurance, etc. and are based on an eight-hour work day.

Table 13.1 Unit Cost of Labor

Classification	Unit Cost per Hour (Dong)
Senior Field Engineer	32,300
Junior Field Engineer	19,700
Foreman	22,700
Driver	10,800
Equipment Operator	14,700
Skilled Labor	21,000
Common Labor	9,000

2) Unit Cost of Materials

Table 13.2 shows the unit cost of major construction materials. The cost of imported materials is based on the CIF Hai Phong including port handling and clearance charges and import duties. The cost of local materials is based on the market prices in Ha Noi area.

Table 13.2 Unit Costs of Major Materials

Description	Unit	Unit Cost (Dong)	Tax/Duty Component (Dong)
Portland Cement	kg	900	90
Asphalt	ton	2,400,000	240,000
Reinforcing Steel	ton	3,500,000	350,000
Prestressing Strand	kg	26,700	2,670
Gasoline	liter	3,300	330
Diesel	liter	2,800	280
Fine Aggregate	cu.m	54,000	5,400
Coarse Aggregate	cu.m	70,200	7,020
Timber	cu.m	2,100,000	210,000

3) Unit Cost of Equipment

Table 13.3 shows the unit cost of major construction equipment. The cost of imported equipment are based on the CIF Hai Phong including port handling and clearance charges and import duties.

Table 13.3 Unit Cost of Major Equipment

Equipment	Capacity	Unit Cost (Million Dong)	Import Duty (Million Dong)
Dump truck	8 ton	968	88
Dump truck	10 ton	1,441	131
Truck crane	8 ton	1,320	120
Crawled crane	20 ton	4,818	438
Concrete pump truck	80m ³ /hr	3,619	329
Transit mixer	6m ³	1,441	131
Back hoe	1.2m ³	2,409	219
Motor grader	3.6m	1,804	164
Macadam road roller	10 ton	1,441	131
Asphalt finisher	3.5m	5,423	493
Asphalt mixing plant	40 t/hr	8,437	767
Concrete mixing plant	30m ³ /hr	4,213	383
Floating crane	60 ton	18,040	1,640

4) Overhead and Profit

Overhead and profit were estimated as 25% of the sum of labor, material and equipment costs (i.e., direct cost).

5) Unit Prices of Major Work Items

Table 13.4 shows with prices of major work items based on the cost mentioned above.

Table 13.4 Unit Costs of Major Work Item

Item	Unit	Unit Cost (Dong)
1. Earthwork		
Soil Excavation	cu.m	18,000
Embankment (Borrow Material)	cu.m	60,000
2. Pavement		
Aggregate Subbase Course	cu.m	100,000
Asphalt Treated Base Course	cu.m	750,000
Asphalt Concrete Surface (t = 10 cm)	sq.m	110,000
Overlay (t = 10 cm)	sq.m	130,000
3. Drainage Structures		
Pipe Culvert (D = 1.0 m)	l.m	1,200,000
Box Culvert (3.0 x 3.0)	l.m	10,300,000
4. Bridges		
RC Slab Bridge (L < 10 m)	sq.m	6,000,000
RC Slab Bridge (with Piling)	sq.m	8,000,000
RC T-Beam Bridge (10 m < L < 20 m)	sq.m	8,000,000
RC T-Beam Bridge (with Piling)	sq.m	10,000,000
PCI-Beam Bridge (20 m < L)	sq.m	11,000,000
PCI-Beam Bridge (with Piling)	sq.m	13,000,000

(2) Estimated Construction Cost

The summary of estimated construction cost by each construction section and by each construction stage is shown in Table 13.5.

Table 13.5 Summary of Estimated Construction Costs in 1996 Prices

Section No.	Section	Initial Stage (Million Dong)	Final Stage (Million Dong)
1	Noi Bai - Bac Ninh	517,789	488,516
2	Bac Ninh - Chi Linh	432,063	-
3	Hong Gai - Cua Ong	610,797	-
4	Cua Ong - Tien Yen	51,212	173,619
5	Tien Yen - Bac Luan	122,144	363,352

(3) Land Acquisition and Resettlement Cost

Land acquisition and resettlement cost is estimated based on the area of required land acquisition estimated in the preliminary engineering design and the estimated number of resettled families in the environmental study.

Unit costs are estimated in accordance with the following criteria :

- 1) Unit costs of land acquisition are decided based on the "Regulating Price Frame of Various Kinds of Land", Decrees No.87/CP, August 17, 1994.
- 2) Resettlement costs are estimated based on discussion with PMU 18 and houses up to 7.0m from the toe of embankment or upper edge of cut were counted.
- 3) Compensation cost for production is based on the following criteria:

$$2\text{kg paddy/sq.m/year} \times 1,800 \text{ dong/kg} \times 2 \text{ years} = 7,200 \text{ dong/sq.m}$$

- 4) Other compensation (cost for preparing new houselots, paying 3 months subsistence allowance, relocating house materials to new site, providing training for one person of each household) is estimated as follows :

$$(\text{Number of household}) \times 6,000,000 \text{ dong/each}$$

Unit costs of land acquisition and resettlement are shown in Table 13.6, and the summary of estimated land acquisition and resettlement cost by each section and by each improvement stage is shown in Table 13.7.

Table 13.6 Unit Costs for Land Acquisition and Resettlement

	Description	Unit	Unit Cost (Dong)
(1)	Land Acquisition/Compensation		
	Inhabited Land along Existing Road	m ²	150,000
	Inhabited Land in Rural Area	m ²	19,400
	Rice Field/Cultivated Area	m ²	12,100
	Forest Area	m ²	8,920
(2)	Crop Compensation		
	Rice	m ²	7,200
(3)	Resettlement/Compensation		
	Permanent House	m ²	1,300,000
	Temporary House	m ²	400,000
(4)	Other Compensation		
	Cost Relevant to Relocating House	nos.	6,000,000

(4) Estimated Project Cost

1) Estimated Project Cost in the Initial and Final Improvement Stages

The summary of project costs in 1996 prices is shown in Table 13.7 together with foreign and local currencies of financial cost shown in Table 13.8. The project cost is expressed in terms of financial cost and is divided into the investment cost in initial and final stages by each highway improvement section.

2) Additional Investment Cost

The additional investment costs are the cost of pavement overlay which are to take place every 6 years after the completion of construction.

Table 13.7 Summary of Estimated Project Costs in 1996 Prices

(Unit : Million Dong)

Section No.	Section	Initial Stage				Final Stage			
		Construction	ROW	Others	Total	Construction	ROW	Others	Total
1.	Noi Bai - Bac Ninh	517,789	33,090	113,500	664,379	488,516	-	102,589	591,105
2.	Bac Ninh - Chi Linh	432,063	7,553	91,822	531,438	-	-	-	-
3.	Hong Gai - Cua Ong	610,797	84,760	140,473	836,030	-	-	-	-
4.	Cua Ong - Tien Yen	51,212	-	10,754	61,966	173,619	8,313	37,657	219,589
5.	Tien Yen - Bac Luan	122,144	2,751	26,047	150,942	363,352	11,511	77,962	452,825

Table 13.8 Summary of Project Costs of Foreign and Local Currencies in 1996 Prices

(Unit : Million Dong)

Section	Stage	Financial Cost		
		Total	Foreign Currency	Local Currency
Section 1 : Noi Bai - Bac Ninh	Initial Stage	664,379	382,629	281,750 (75,338)
	Final Stage	591,105	360,037	231,068 (70,993)
Section 2 : Bac Ninh - Chi Linh	Initial Stage	531,438	318,664	212,774 (62,776)
Section 3 : Hong Gai - Cua Ong	Initial Stage	836,030	452,768	383,262 (89,135)
Section 4 : Cua Ong - Tien Yen	Initial Stage	61,966	37,743	24,223 (7,436)
	Final Stage	219,589	128,213	91,376 (25,253)
Section 5 : Tien Yen - Bac Luan	Initial Stage	150,942	90,105	60,837 (17,750)
	Final Stage	452,825	268,145	184,680 (52,820)

Note : () Tax amount included in Local Currency.

14. ECONOMIC PROJECT ANALYSIS

14.1 Estimation of Economic Project Cost

Economic costs were calculated by correcting distorted prices. (Refer to Table 14.1) Thus the current actual value of resources is expressed for imported materials, domestic materials, labors and right-of-way. This makes possible comparisons for optimum use of domestic resources.

Table 14.1 Items to be Corrected to Economic Price from Market Price

Resources	Market Price Distortion	Correction to Economic Price
1. Cost not related to project	Miscellaneous cost not related to project consumption such as taxes and subsidies	To be deleted because not related to competitive market economic activities
2. Foreign materials	Official foreign exchange rate and tariffs are distorted	To use international price in US \$ determined by international competitive market
3. Domestic materials	Price is distorted by regional difference, monopoly and partial competition	To remove influence of tax imposed on exports, to make price closer to international free competitive market.
4. Laborers	Wage is distorted by minimum wage, the unemployed, and labor union.	To apply shadow wage rate to unskilled laborers to bring the wage closer to real value of workers.
5. Right-of-Way	Land price and ground rent distorted by speculation and social policies	To calculate marginal productivity in order to make the price closer to free competition.
6. Capital market	Unsuitability of interest rate and financing for enterprise with good conditions limits selection of optimum capital investment.	To allocate optimum investment rescues by capital opportunity cost.

Cost-correction is conducted based upon the above-stated items and results shown in Table 14.2. Benefit - Cost Comparison analysis employs this economic cost. Annual allocation of costs will be calculated according to construction plan in Chapter 10.

Table 14.2 Financial and Economic Cost

(Unit : Million Dong)

Section	Initial Stage		Final Stage	
	Financial Cost	Economic Cost	Financial Cost	Economic Cost
Section 1: 2 + 2 lanes	664,379	554,082	591,105	487,210
Section 2: 2 + 2 lanes	531,438	439,509	533,003	444,408
Section 3: 2 lanes	531,438	439,509	-	-
Section 3: 4 lanes	836,030	705,676	-	-
Section 4: Overlay + 2 lanes	61,966	51,075	219,589	182,620
Section 5: Overlay + 2 lanes	150,942	124,950	452,825	375,488

14.2 Estimation of Economic Benefit

(1) Road Users and Benefits

A number benefits will result from highway construction, including those which are measurable and those which are non-measurable. For example, one measurable benefit would be saving of travel time. Other benefits, as well as some potential negative effects are indicated in Table 14.3.

Table 14.3 Effects by Constructing Project Road

1.	The project increases work for construction companies, construction material companies and truck transport companies.---Positive effect
2.	Driving time and cost will decrease.---Direct user effect
3.	Traffic accidents and casualties will decrease.---Prevention of loss
4.	Decrease of road maintenance cost; abandonment of ferry crossing.---Saving of capital
5.	Driving will be more comfortable.---Increase of Comfort
6.	Rice production, mining exploitation and tourism development will be enhanced.---Development effect
7.	Increase of employment, improvement of social level of life, enhancement of equitable income distribution, and increase of foreign currency.---Social and economic effect
8.	Decrease of rice production by the use of land for roads.---Negative economic effect
9.	Increase of air pollution and vibration due to increased traffic.---Negative environmental effect from road pollution

Measurable effects of the road project will be called "benefits" hereafter. Measurable benefits will be calculated according to the (1) beneficiaries, and (2) benefit units. The relationship between (1) and (2) is as the Table 14.4.

Table 14.4 Types of Benefits and Beneficiaries of Highway No.18 Project

1.Normal Traffic :	
Without project	Slow running speed, Higher running cost
With project	High running speed, Lower running cost
Types of Benefits	Savings in driving time and cost
2.Diverted Traffic :	
Without project	Use of other road, railroad, or ship
With project	Less distance, faster, less cost
Types of Benefit	Difference of saving compared with detoured route Difference of saving compared with railroad and ship
3.Generated and Induced Traffic :	
Without project	Bicycle and pedestrians could not use the road
With project	New potential users of road
Types of Benefit	Additional half of the normal traffic benefit
4.Development-Related Traffic :	
Without project	Resources remain undeveloped realizable
With Project	Production and development increase
Types of benefits	Development benefits
5. Ferry boat user:	
Without project	Not time-economic
With project	Time-economic
Types of benefits	Saving of ferry boat cost

(2) Time Cost Saving

Improvement of the project road will enhance driving speed, and save time for passengers of all vehicles. When saved time is used productively, it can be considered as a benefit brought about by the project.

(3) Vehicle Operating Cost Saving Benefit

There are ten types of vehicle operating cost (V.O.C) benefits (Refer to Table 14.5). V.O.C for project benefit calculation can be divided into two main groups; fixed and variable. The fixed cost does not vary according to the travel distance and speed, in short, this can be called a type of "Property Possession Fee".

Table 14.5 Types of Benefits of V.O.C Saving

Variable costs saving (Running costs)	(1) Fuel cost saving benefit (2) Lubricant oil cost saving benefit (3) Tyres cost saving benefit (4) Maintenance (spare parts) cost saving benefit (5) Maintenance (labor) cost saving benefit (6) Depreciation (distance related) cost saving benefit
Fixed costs saving	(7) Depreciation (time related) cost saving benefit (8) Interest cost saving benefit (9) Crew cost saving benefit (10) Overhead cost saving benefit

Table 14.6 shows economic V.O.C by vehicle type and by driving speed. Fuel consumption, lubricant oil consumption, tire wear, maintenance costs (parts, labor, depreciation, interest, crew wage, and overhead cost) are all related to driving speed.

Table 14.6 Composite Unit V.O.C (Economic)

(Dong)

Km/Hour	Passenger Car	Bus	Truck	Motorcycle
10.00	4,081.02	5,328.61	5,780.43	394.98
15.00	3,746.12	4,955.83	5,267.57	367.69
20.00	3,436.94	4,620.32	4,803.32	344.56
25.00	3,153.49	4,322.09	4,387.69	325.57
30.00	2,895.76	4,061.13	4,020.67	310.74
35.00	2,663.76	3,837.45	3,702.27	300.05
40.00	2,457.48	3,651.04	3,432.48	293.52
45.00	2,276.93	3,501.91	3,211.31	291.13
50.00	2,122.10	3,390.05	3,038.75	292.90
55.00	1,993.00	3,315.47	2,914.81	298.81
60.00	1,889.62	3,278.16	2,839.48	308.87
65.00	1,811.97	3,278.13	2,812.77	323.09
70.00	1,760.04	3,315.37	2,834.67	341.45
75.00	1,733.84	3,389.89	2,905.19	363.97
80.00	1,733.36	3,501.68	3,024.32	390.63
85.00	1,758.61	3,650.75	3,192.07	421.45
90.00	1,809.58	3,837.09	3,408.43	456.41
95.00	1,886.28	4,060.71	3,673.41	495.53
100.00	1,988.70	4,321.60	3,987.00	538.79

14.3 Economic Cost Benefit Analysis

(1) General

Economic cost and benefits are calculated by section and results seen in Table 14.7. Evaluation of each section is based on the results of analysis.

Table 14.7 Summary of Benefit Cost Comparison Analysis

(NPV = Million Dong)

Section	Project	IRR (%)	NPV	B/C
Section 1	2 lanes + 2 lanes	15.11	387,194	1.70
Section 2	2 lanes + 2 lanes	17.36	611,026	2.02
	2 lanes	15.42	274,826	2.00
Section 3	4 lanes	20.64	720,926	2.28
Section 4	Overlay + 2 lanes	19.74	183,501	2.67
Section 5	Overlay + 2 lanes	18.34	339,567	2.47

NPV and B/C were calculated based on discount rate of 10 % p.a.

(2) Section 1 : Noi Bai - Bac Ninh

The result is as shown in Table 14.7. IRR is higher than the opportunity cost of capital. Thus investment of 1,041.3 billion dong as the project cost is economically feasible.

(3) Section 2 : Bac Ninh - Chi Linh

The result of benefit cost analysis is shown in Tables 14.7 and 14.8. All alternatives resulted in IRR higher than the opportunity cost of capital. Therefore they are all economically feasible.

Basic two alternatives are as shown, according to considerations of different stage construction.

Table 14.8 Project Alternatives for Benefit Cost Analysis

Case	Stage	Condition
Case - 1	1st stage	Improvement of existing road to two-lane; construction will start in 1998.. open in 2001
	2nd stage	Widening of two-lane road to four-lane road; construction will start in 2004.. open in 2007
Case - 2	1st stage	Improvement of existing road to two-lane; construction will start in 1998.. open in 2001 Under the condition that the construction of the alternate four-lane highway will take place between 2004 and 2007.

(4) Sections 3, 4 and 5 (Hong Gai - Cua Ong - Tien Yen - Bac Luan)

According to the economic analysis is shown in Table 14.7, each IRR is higher than the opportunity cost of capital. Thus investment of 705.7 billion dong for Section 3, 233.7 billion for Section 4 and 500.4 billion for Section 5 as the project cost is economically feasible.

14.4 Sensitivity Analysis

(1) Selection Criteria for the Project

In order to select or prioritize a project in supposition of a certain amount of budget, there are three indicators : (a) Internal Rate of Return (IRR), (2) Net Present Value (NPV), (3) Benefit Cost Ratio (B/C).

NPV indicator and IRR indicator show different results depending upon which discount rate is to use, 10% or 12%. In the case of public facilities such as a road project, high benefit is not always necessary to decide investment priority. IRR which can obtain the indicator (%) automatically by the calculation is used as project selection and priority indicator in this report.

(2) Analysis of Investment Feasibility of Base Case

Table 14.9 Sensitivity Analysis by Using IRR (%)

Section	Base Plan	Cost + 10% up	Benefit - 10% down	Combination +10. -10%
Section 1 Noi Bai - Bac Ninh	15.11	14.07	13.97	13.03
Section 2 Bac Ninh - Chi Linh				
Case - 1 2 + 2	17.36	16.25	16.13	15.07
Case - 2 2	15.42	14.38	14.26	13.28
Section 3 Hon Gai - Cua Ong	20.64	18.50	18.37	17.14
Section 4 Cua Ong - Tien Yen	19.74	18.69	18.58	17.55
Section 5 Tien Yen - Bac Luan	18.34	17.37	17.27	16.33

Cases were analysed to find IRR for 10% increase of cost, for 10% decrease of benefit, and for the combination of 10% increase of cost and 10% decrease of benefit. The result is seen in Table 14.9.

In order to decide investment feasibility, opportunity cost of capital is used as an indicator. Opportunity Cost of Capital shows high figure when economic growth is high and when there is high investment demand of social infrastructure. Opportunity cost of capital in Japan is about 5%, while Vietnam is 10 - 12%. IRR is higher than opportunity cost of investment of all cases that were proven as economically feasible. The later the undertaking of the highway improvement project, the higher the IRR and Benefit Cost will become.

14.5 Conclusions

Results of benefit cost analysis according to the sensitivity statement are as follows:

- (1) Section 1 Noi Bai - Bac Ninh
 - 2-lane road to be completed for use by the year 2001
 - Additional 2 lanes to be completed for use by the year 2013.
- (2) Section 2 Bac Ninh - Chi Linh
 - In the first stage, 2-lane (widening of the present road) road to be completed by the year 2001, giving consideration to construction timing to connect both ends of the road.
 - The alternate highway is to be constructed by the year 2007, following a detailed feasibility study.
- (3) Section 3 Hon Gai - Cua Ong
 - 4-lane road construction will be undertaken from the outset of initial stage to be open in the year 2001.
- (4) Section 4 Cua Ong - Tien Yen
 - Construction for stage 1 and stage 2 is to be undertaken separately.
 - Stage 1 is to complete overlay and construction of presently-dangerous bridges by the year 2000.
 - Stage 2 is to complete widening to 2-lane road and remaining works by year 2010.
- (5) Section 5 Tien Yen - Bac Luan
 - Construction is to be undertaken in the same manner as section 4.

15. ENVIRONMENTAL STUDY

15.1 Study Purpose

The purpose of the Environmental Impact Assessment (EIA) is to identify the existing significant environmental elements that would have a high possibility of being affected by the implementation of the project and to formulate mitigation measures for the minimalization of adverse impacts.

The Environmental Investigation Area was covered by 200 m wide strips (i.e., area on both sides of road within 100m from road center) along the following stretches of existing highway.

15.2 Existing Environmental Conditions Survey

15.2.1 Social Environment

(1) Residences and Other Facilities of Affected Area

Since June 1995, most houses and building facilities along Highway No.18 have been set-back. These set-back houses and facilities had been illegally located within the area of the right-of-way according to the government road protection regulations of Decree 203/HDBT dated 21/12/1982. However, to maintain the proper width of right of way for the improvement of Highway No.18, additional set-back of approximately 2m on each side will be required for these houses and building facilities.

- Section 1 (Noi Bai -Bac Ninh) 23.00m x 2
- Section 2 (Bac Ninh - Chi Linh) 15.25 m x 2
- Section 3 (Hong Gai - Cam Pha, Cua Ong) 15.25 m x 2
- Section 4 (Cua Ong - Tien Yen) 13.75m x 2 (Mong Duong : 15.25 m x 2)
- Section 5 (Tien Yen - Mong Cai, Bac Luan) 13.75m x 2

On the basis of the existing route alignment for Highway No.18 improvement, there are 7129 residences affected which would be subject to relocation. Facilities such as temples, factories, schools, etc. are also affected. Note: The Regulation of Decree 203/HDBT requires 7 m area from bottom line of road embankment for clear area where no building facilities are permitted, and 20 m from bottom line of road embankment for land use area for the road which is right-of-way.

Table 15.1 Numbers of Facilities and Lots to be Affected by Widening along Existing route

Section	Location	Route length (Existing)	Affected Facilities									Clear Area
			House	Temple	Factory	School	Hospital	Hotel, Rst	Cemetery	Pub. Facility	Shop, Off	
1	Noi Bai - Bac Ninh	30.9 Km	1242	0	2	1	1	0	2	3	1	23.00x2
2	Bac Ninh - Chi Linh	36.9 Km	1153	0	1	0	1	0	0	5	3	15.25x2
3	Hong Gai - Cua Ong	39.8 Km	2232	1	16	10	7	1	0	72	24	15.25x2
4	Cua Ong - Tien Yen	43.5 Km	721	1	3	4	0	0	0	6	0	13.75x2
5	Tien Yen - Bac Luu	86.9 Km	1781	1	4	2	3	2	2	38	8	13.75x2
	Total	238.0 Km	7129	3	26	17	12	3	4	124	36	

(2) Social and Economic Activities

12 selected communities which are located along the study route were surveyed at random. The preliminary list of communities was selected based on proximity of the community to the study route, 120 samples were randomly selected to be interviewed.

The surveyed results indicate that there are two socio-economic zones along the study route. In the zone from Noi Bai to Chi Linh 85 % - 96 % of the people are farmers. Only in Bac Ninh and Sao Do town, approximately 100 % of the population works as non-agricultural sector. In the zone of Hong Gai, most of the people are non-agricultural sector with the 94 % - 100 % of the population running their own commercial activities such as shops, restaurants and hotels.

Inhabitants along the route generally accept the project, citing improved life-style and positive economic development impacts to their communities. However, land acquisition is cited as a major issue.

(3) Historical Remains and Cultural Properties:

Along the study route there are three (3) historical remains and cultural properties certificated by the state. These are Ngo Xa temple located at 35m from existing road at Section 1 (Phu Lo - Bac Ninh), Cam Pha church located at existing road at Section 3 (Hong Gai -Cua Ong), and Tien Yen church located at 35m from existing road at Section 5 (Cua Ong - Tien Yen).

(4) Water Rights

At present there are no local regulations for water resources in the area. All matters related to water resources are under state regulations. The Ministry of Water Resources has been preparing a draft water law to submit to parliament in the near future.

"Regulations of Protection and Development of Aquatic Resources" law was approved in 1989 by the government. The law consists of rules on governmental management for this resources, responsibilities and benefit of offices, organizations, individuals for exploitation, protection and development for this resource. It is forbidden to damage aquatic resources or cause pollution to their living environment.

Aquatic life within the study area is mainly fresh water fish at rivers, irrigation channels and ponds. There are several kinds of fish such as *Cyprinus carpio*, *Cirrhina molitorella*, *Spinibarichthys denticulatus* etc.,

15.2.2 Natural Environment

(1) Flora and Fauna

The project area from Noi Bai to Chi Linh through Bac Ninh where Highway No. 18 passes is located in the Red River delta. This delta area has been cultivated and civilized for thousands of years. Natural environmental conditions have been changed to the paddy-based agro-ecosystem environment, where nothing but common flora and fauna species exist.

As for Hong Gai to Mong Cai through Cua Ong and Tien Yen, these areas also have been civilized for many centuries due to the roads and marine ports. Since 19th century Hong Gai and its vicinity has been developed as coal mining industry zone. Therefore, today the natural ecological situation has been largely changed to an urban-type ecosystem. Lesser natural resources of flora and fauna exist.

Since the hillside forest has been also affected by people who cut the woods and clear the land, trees and shrubs have been used and the natural vegetation rich in the past has been mostly destroyed, with secondary vegetation is now growing in its place. Such poor natural vegetation on the hillsides can be observed. The Vietnamese government has made some effort to afforest pine and eucalyptus trees to rehabilitate the forest area.

Mangrove ecosystem is widely distributed along the coastal zone. From Bai Chay bay to Mong Cai there are dwarf-type mangrove vegetation zones along the shallow coastal area. In this coastal area mangrove trees of about 20m high once flourished, but these were cut down for charcoal and other uses. Today there are only dwarf-type mangrove species of about 1m high. These are strong and survive under the worst environmental conditions.

As for fauna, there were 18 species of wild mammals, 60 species of birds and 20 species of reptiles, but due to development of the agricultural ecosystem, industry, and roads, the natural primary forest vegetation as well as wildlife has disappeared from the study route area. They were either killed off or migrated to deeper places inland. In general, there is not much of ecological valuable.

(2) Borrow Pits for Embankment Materials

There are sufficient materials of embankment, fine and coarse aggregate along the Highway No. 18.

(3) Construction waste

The improvement of Highway No.18 project includes excavation and embankment (borrow) for which sites should be considered from an environmental viewpoint of environment, in particular disposed materials.

The section No.4 (from Cua Ong to Tien Yen) has a potential problem regarding construction waste sites due to the huge volume of excavation (Excavation 1,234,000m³, Embankment 204,000m³), but the excavation volume of the other sections is minimal or balanced with embankment volume.

The following measures should be undertaken for the excess waste material for the section 4;

- To carefully select disposal sites of excess materials concurred by the provincial authority;
- To limit construction processes which expose large amounts of soil to the intermediate (neither rainy or dry) seasons as much as possible;
- To limit the length and grade of slopes and keep bare soil exposed to a minimum;
- To establish ground cover planning on bare earth as soon as possible;
- To provide sufficient drainage ditches or culverts which should be connected with appropriate disposal river or creek; and
- To provide roads to the sites for hauling

15.2.3 Pollution

Existing pollution level surveys were conducted at important points along Highway No.18 in August and September, 1995. Air quality was monitored at 4 locations, 10 locations were chosen for measurement of noise level, 4 locations for vibration level and 12 locations for water quality level.

(1) Air Quality

In all surveyed 4 points, in the daytime, the concentrations of CO, SO₂, NO₂, O₃ and Pb are lower than the permission values, however the concentrations of total suspended particles (TSP) are higher than the permission value. At Cam Pha town, the average value surveyed is 0.60 mg/m³, which is 3 times higher than permission value. At peak hours, the concentration of TSP ranges from 0.88 mg/m³ to 1.18 mg/m³ which is 2.9 to 3.9 times higher than permission value. At Ha Long city, surveyed average value is 0.56 mg/m³, 2.8 times higher than permission value. At peak hours, the concentration of TSP ranges from 0.76 mg/m³ to 0.98 mg/m³, which is 2.5 to 3.3 times higher than permission value. At Vu Street, Bac Ninh town, the concentration of TSP is the smallest. The average value surveyed is 0.35 mg/m³, but 1.7 times higher than permission value.

The reason of such high level of TSP is mainly caused by insufficient paving conditions of the road, uneven surface and exposed condition of the shoulders of the road, all conditions which promote dusty situations. Especially in Section 3 area, coal mining areas are situated close to the highway. All stretches of the highway are highly affected by coal-mixed dusts and frequent movement of coal loaded trucks.

Section 3 (Hong Gai to Cam Pha - Cua Ong) has the highest amount of traffic, but, the CO concentration at any distance will still be much less than the 40mg/m³ at peak hour standard in Vietnam, but the NO₂ concentration will still be less than standard value (0.4 mg/m³) only at the point of 35m to 40m away from axis of the road.

(2) Noise

At monitoring location in Ha Long City, the day-sound level (Leq(d)) was 74.5 dBA, which is higher than the standard value at 5.4 dBA and the night-sound level (Leq(n)) was 70.7 dBA - higher than standard by 5.7 dBA.

Other high noise levels were measured at Cam Pha Town. The day-sound level (Leq(d)) was 74.8 dBA, which is higher than the noise criteria by 4.8 dBA. These 2 monitoring points are located at a rotary and a junction point of a main trunk route.

At another monitoring location of Highway No 18 the day-sound levels were generally in the range of 62 - 70 dBA and the night-sound levels were in the range of 55 - 65 dBA, which are about standard values.

(3) Vibration

The monitoring indicates that existing vibration levels are very low along the proposed route. The highest measurements were at Ha Long city. Maximum velocities and accelerations measured at 4 locations at 7.5m away from the road were generally below 0.09 mm/s.

(4) Water Quality

Analyses of existing conditions of water quality were conducted for pH, Salinity, Oil, DO, SO₄, COD, BOD₅, Zn, Cd, Hg, Cu and Pb concentration. The water quality of all surveyed locations were not higher than permissible value. Most canals and ponds have great capacity for self-purification, DO concentration values were high. In general, the quality of surface water resources in surveyed area meet the required standards for fishing and irrigation purposes.

15.3 Environmental Impact Assessment

15.3.1 Negative Environmental Impacts and Mitigation Measures

(1) Resettlement of Inhabitants

According to the site surveys 7,129 houses will be affected in case the existing roads are widened. As the result of comparative study efforts, the number of affected houses and other facilities was reduced to 3,732, as shown in Table 15.2.

Table 15.2 Numbers of Houses and Facilities to be Affected by Widening Along Alternative Route Alignment

Section	Location	Route length (Planned)	Affected Facilities									Clear Area
			Houses	Temples	Factories	Schools	Hospitals	Hotels	Cemeteries	Public Facilities	Shops	
1	Noi Bai - Bac Ninh	31.3 km	3	0	0	1	0	0	0	1	0	23.00 x 2
2	Bac Ninh - Chi Linh	36.4 km	425	0	3	0	1	0	1	3	1	15.25 x 2
3	Hon Gai - Cua Ong	38.7 km	1863	0	15	10	6	1	0	58	11	15.25 x 2
4	Cua Ong - Tien Yen	43.5 km	567	1	3	3	0	0	0	4	0	15.25/ 13.75 x 2
5	Tien Yen - Bac Luan	86.9 km	874	1	0	1	1	0	2	7	4	13.75 x 2
	Total	236.8km	3732	2	21	15	8	1	3	73	16	

According to the site survey, 3,060 houses (82.%) out of 3,732 affected were built after the issuance of Decree 203/HDBT, and only 672 houses (18%) were constructed before the Decree. Therefore, the 3,060 houses could be removed without compensation when the government widens Highway No. 18. Appropriate negotiations will be required for the relocation or demolition of the 672 houses for the widening of the Highway No.18.

(2) Natural Environment

Exceptional Flora or Fauna along the study route was not seen. Along the coastal zone of the study area the mangrove trees are only dwarf type species about 1m high.

(3) Aesthetics

There are very few trees planted along Highway No.18 except on urban streets. Tall mahogany trees grew in some places along the Highway. However these trees have been cut due to the narrow width of the existing road. Trees should be planted along the highway for environmental aesthetics. Tree planting is proposed as shown in Table 15.3.

Table 15.3 Number of Trees in Urban, Populated Areas and Areas Where are Aesthetically Important

Section	Location	Route Length	Planting Length	Tree Nos.	Planting Interval	Note	
						Clear Area	Location
1	Noi Bai - Bac Ninh	31.3 km	2.0 km	500	8.0 m	w=23.00x2	Major IS
2	Bac Ninh - Chi Linh	36.4 km	9.0 m	2,250	8.0 m	w=15.25x2	Major IS
3	Hong Gai - Qua Ong	38.7 km	22.0 km	5,500	8.0 m	w=15.25x2	Urban area IS
4	Qua Ong - Tien Yen	43.5 km	7.0 km	1,750	8.0 m	w=15.25/13.75x2	Major IS
5	Tien Yen - Bac Luan	86.9 km	8.0 km	2,000	8.0 m	w=13.75x2	Major IS
	Total	236.8 km	41.0 km	12,000			

(4) Pollution

1) Noise

The forecasted noise level for the year 2015 is shown in the (Table 15.4). The forecasted noise level is adjusted to reflect the slope factors as physical characteristics of the road, 0.5 to 1.0 dBA added. At 15.25 m from road center (Edge of the road/Clear area/Section 2 and 3), noise level exceeds the standard level of 70 dBA.

However at the edge of right-of-way (Section 1: approx. 38m, Section 2: approx. 30m, Section 3: approx. 34m, Sections 4 & 5: approx. 28m), Section 3 (Hong Gai -Cua Ong) exceeds allowable noise level. Therefore, area of Section 3 will require mitigation of noise. Following the opening of the alternative highway in 2007, the noise level in Section 2 (Bac Ninh - Chi Linh) will decrease due to diverted traffic.

Table 15.4 Forecasted Noise Level (dBA) from Road Center Line at Peak Hour in 2015

Section of route	Distance from road center line (m)						
	12	19	34	49	64	79	94
1. Noi Bai - Bac Ninh	74.2	71.2	68.2	66.4	65.2	64.2	63.4
2. Bac Ninh - Chi Linh	77.0	74.0	71.0	69.2	68.0	67.0	66.2
3. Hon Gai - Cam Pha, Cua Ong	78.8	75.8	72.8	71.0	69.8	68.8	68.0
4. Cua Ong - Tien Yen	75.2	72.2	69.2	67.4	66.2	65.2	64.4
5. Tien Yen - Mong Cai (Bac Luan)	74.6	71.6	68.6	66.8	65.6	64.6	63.8
Distance adjustment (dBA)	0	3	6	7.8	9	10	10.8

In Section 3 (Hong Gai - Cua Ong), the following lengths are needed to provide noise barriers to mitigate the noise level. These buffer structures are to be installed as parts of wall for each facility. The height of walls vary from 2 m to 3 m based on the conditions of each facility. Noise barrier wall with 3 m high can reduce the noise level by about 5 dBA. (see Table 15.5)

Table 15.5 Number of Buffer Structures

Facilities	No.	Affected Area (%)	No.
Temple	2	100 %	2
School	15	20 %	3
Hospital	8	100 %	8

- Temple, Pagoda 2 nos. x 25 m = 50 m
 - School 3 nos. x 30 m = 90 m
 - Hospital, Clinic 80 nos. x 10 m = 80 m
- Total 220 m in length

2) Cost for the Environmental Mitigation Measure

The cost of resettlement, land acquisition for the widening of the road and bypass route is included within construction cost. As environmental improvement and mitigation cost, the cost of noise barrier walls of 220m long and of 12,000 trees are included.

16. CONCLUSIONS AND RECOMMENDATIONS

16.1 Section No.1 : Noi Bai - Bac Ninh

Section No.1 from Noi Bai to Bac Ninh is planned for construction as a four-lane road in its final stage with a design speed of 120 km/hr. Two lanes are to be completed and opened to traffic by the year 2001, and two more lanes should be added in the year 2013.

16.2 Section No.2 : Bac Ninh - Chi Linh

The existing stretch of Highway No.18 between Bac Ninh and Chi Linh is to be widened to two lanes with a shoulder width of 2.0m on both sides, and opened to traffic in the year 2001. The present proposal does not include further widening because of the later opening (2007) of the parallel alternate highway.

16.3 Section No.3 : Hong Gai - Cua Ong

It is recommended that the construction of four-lane urban-type highway should be completed by the end of 2000 to meet traffic demands.

16.4 Section No.4 : Cua Ong - Tien Yen

It is recommended that the existing road should be widened to attain two-lane road with 6.0m carriageway width and 1.0m shoulders on both sides except for the Cua Ong - Mong Duong section which should have two-lane carriageways of 7.0m width with 2.0m shoulders on both sides. The initial stage construction should be completed by the end of 1999 including pavement overlay and the construction of 12 bridges. The final stage construction (2010 opening) is comprised of the widening to two (2) lane road and no bridge constructoin.

16.5 Section No.5 : Tien Yen - Bac Luan

The section between Tien Yen and Bac Luan is planned to be widened to attain the two-lane road with 6.0m wide carriageway and 1.0m wide shoulders on both sides for the most part of entire length of 86.9km. However, a two-lane urban highway with bicycle lanes and sidewalks is provided in Mong Cai for about a 1.3km stretch to meet urban conditions.

The construction is divided into two stages as follows:

- Initial stage :
(opening at 2000)
 - Pavement overlay;
 - 28 bridges;
 - Half of Tien Yen Bypass;
 - Dam Ha By-pass; and
 - Widening of access road of 700m to Ca Long bridge.

- Final stage : - Widening to two-lane road;
(opening at 2010) - 10 bridges;
- Remaining half of Tien Yen By-pass; and
- Realignment in Ha Coi Town.

16.6 Project Cost

The estimated project costs (in January 1996 prices) of each section are shown in Table 16.1.

Table 16.1 Estimated Project Costs in 1996 Prices

(Unit : Million Dong)

Section No.	Section	Length (Km)	Initial Stage	Final Stage	Total
1.	Noi Bai-Bac Ninh	31.3	664,379	591,105	1,255,484
2.	Bac Ninh - Chi Linh	36.4	531,438	-	531,438
3.	Hong Gai - Cua Ong	38.7	836,030	-	836,030
4.	Cua Ong - Tien Yen	43.5	61,966	219,589	281,555
5.	Tien Yen - Bac Luan	86.9	150,942	452,825	603,767
Total		236.8	2,244,755	1,263,519	3,508,274

Total Project Costs for initial stage in current prices, with 1.0% and 10.0% per annum escalation allowance for foreign and local currencies respectively are computed as shown in Table 16.2.

Table 16.2 Estimated Project Costs for Initial Stage in Current Prices

(Unit : Million Dong)

Section No.	Section	Length (Km)	Current Prices of Initial Stage
1.	Noi Bai - Bac Ninh	31.3	771,828
2.	Bac Ninh - Chi Linh	36.4	617,640
3.	Hong Gai - Cua Ong	38.7	970,659
4.	Cua Ong - Tien Yen	43.5	69,654
5.	Tien Yen - Bac Luan	86.9	169,583
Total		236.8	2,599,364

16.7 Organization, System, and Training

- (1) A maintenance/management office for Highway No. 18 should be set up at the soonest possibility. This will enable transfer of knowledge (technology) and on-the-job training through the construction/improvement project itself.

- (2) In order to be able to deal with daily maintenance and emergency repairs, re-organization of RMU No. 2 will be necessary. Intermediate/large-scale repair work should be contracted (this will lead to advancement of local contractors' skills) through a gradual changeover to a contract base, as a step in marketization. RMU will continue to play a vital role in data-gathering, and emergency repair work.

16.8 Environment

- (1) Buffer walls are required for certain facilities (religious, educational, and medical) along the Hong Gai - Cua Ong segment to reduce noise levels.
- (2) More than one million cubic meters of excess soil will be produced by construction in Section 4, in contrast to other sections where mainly fill becomes necessary or where cut and fill balance out. The following points need to be heeded in regards to selection of dumping sites.
 - Excavated soil should not be dumped or left as is in excessively rainy or dry seasons.
 - Dump sites in which exposed or graded surfaces of excavated soil can be minimized should be selected.
 - Planting or seeding of dumped soil should be undertaken immediately.
 - Proper drainage facilities should be supplied to prevent adverse environmental affects (e.g., water contamination, filling, maddness, etc.) down stream from the locations.
 - Access roads to dump sites should be supplied.

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