FIGURES

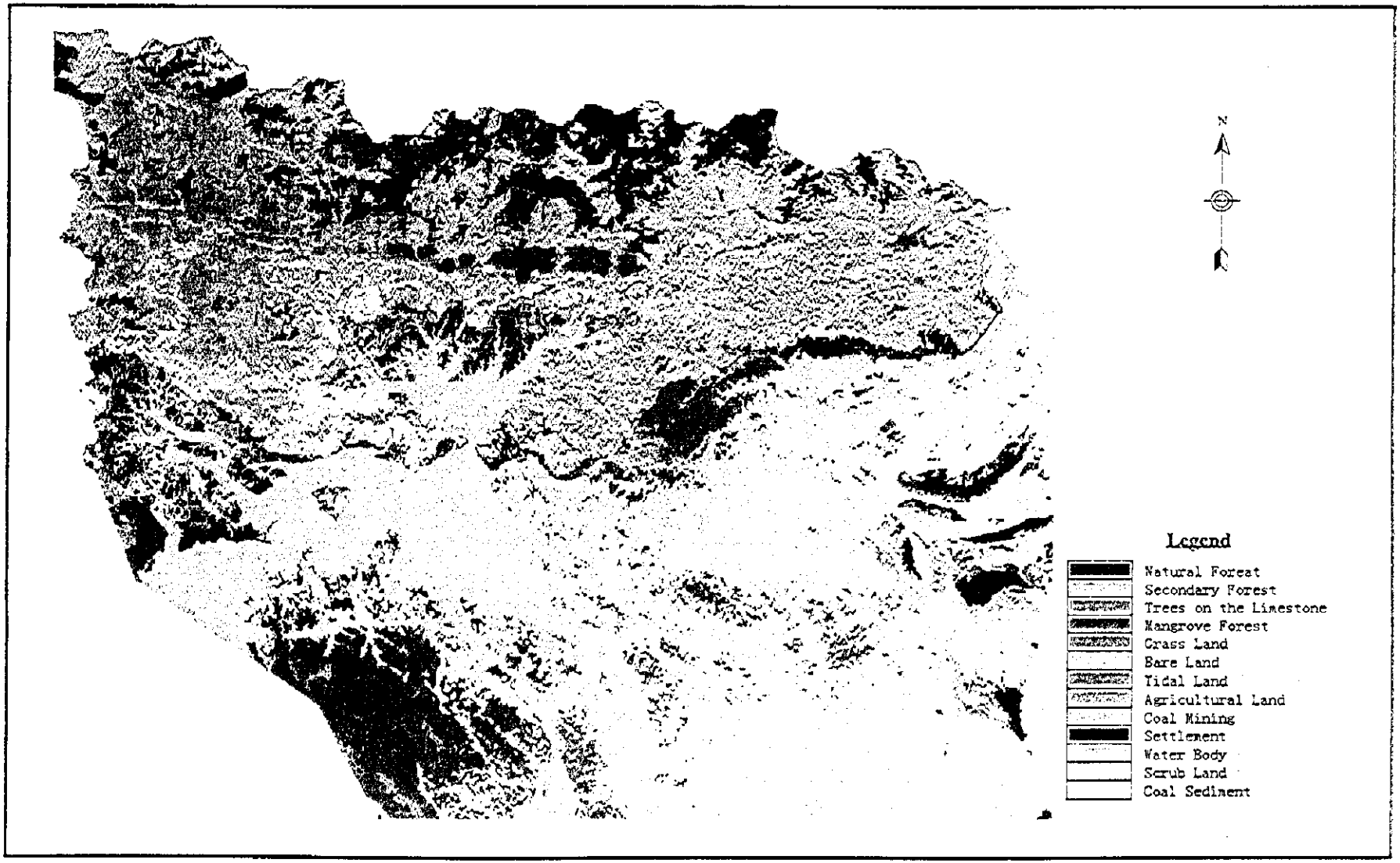


Figure 2.2.1 Latest Land Use Map by Satellite Image Analysis

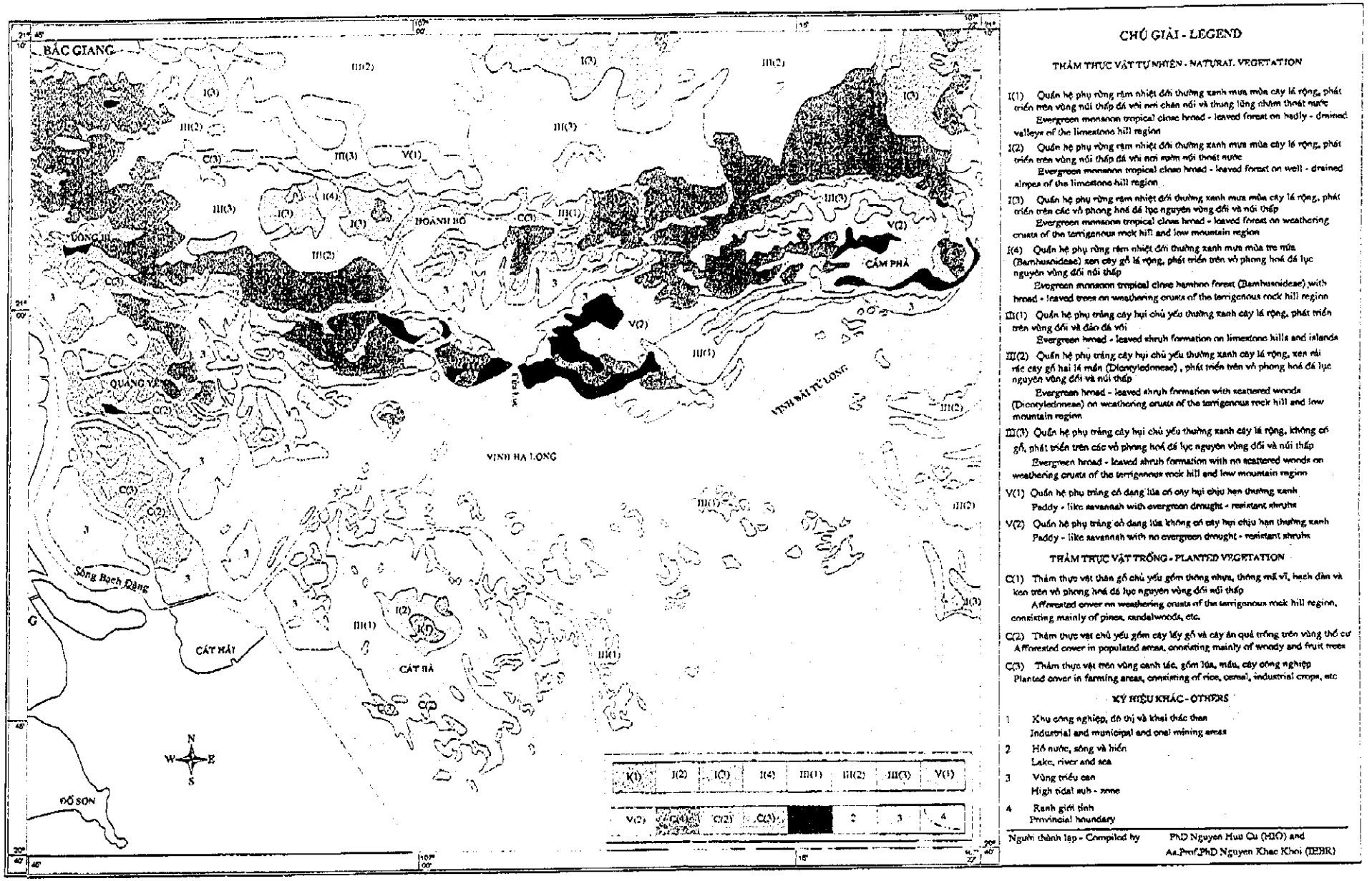
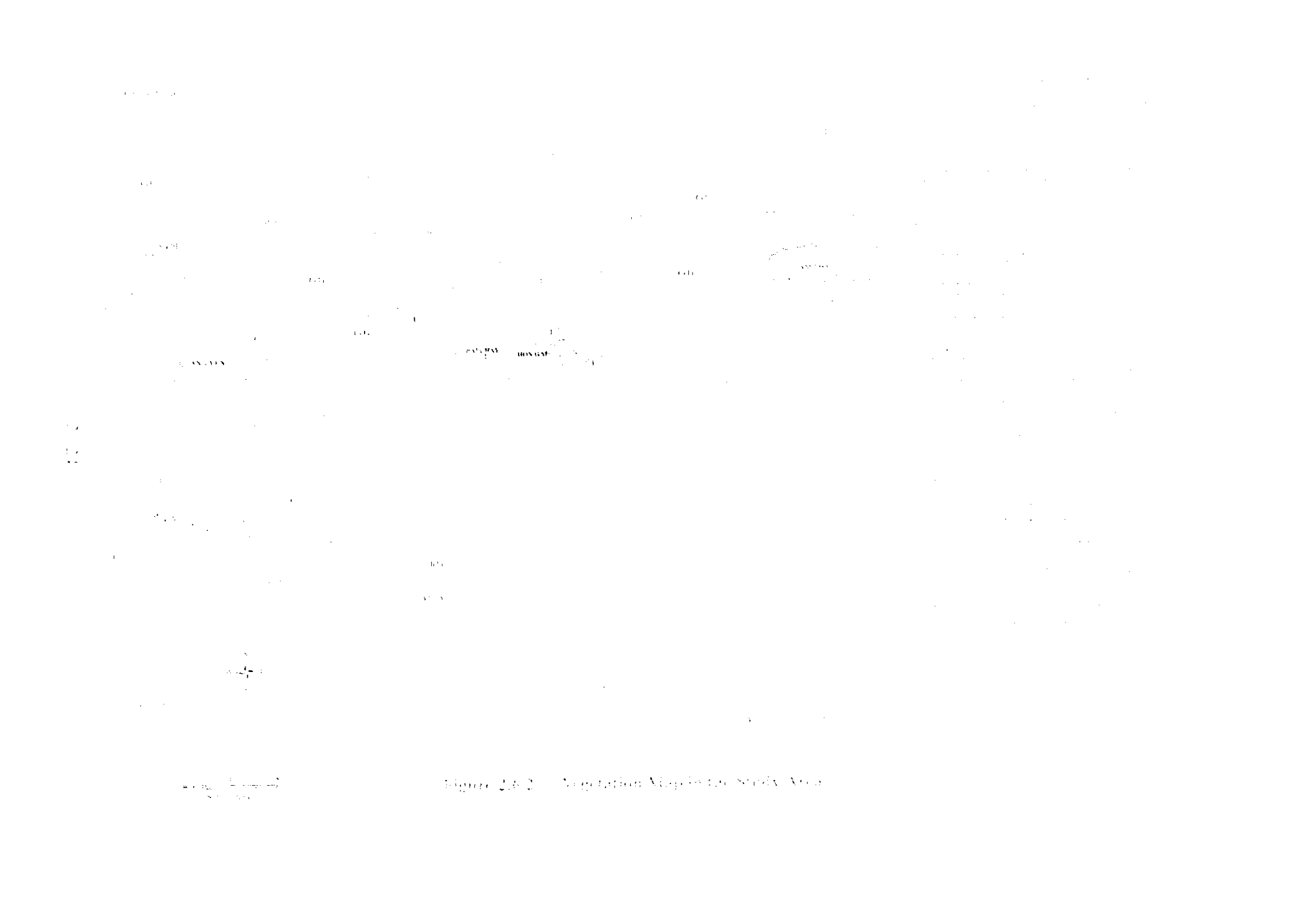


Figure 2.6.2 Vegetation Map in the Study Area



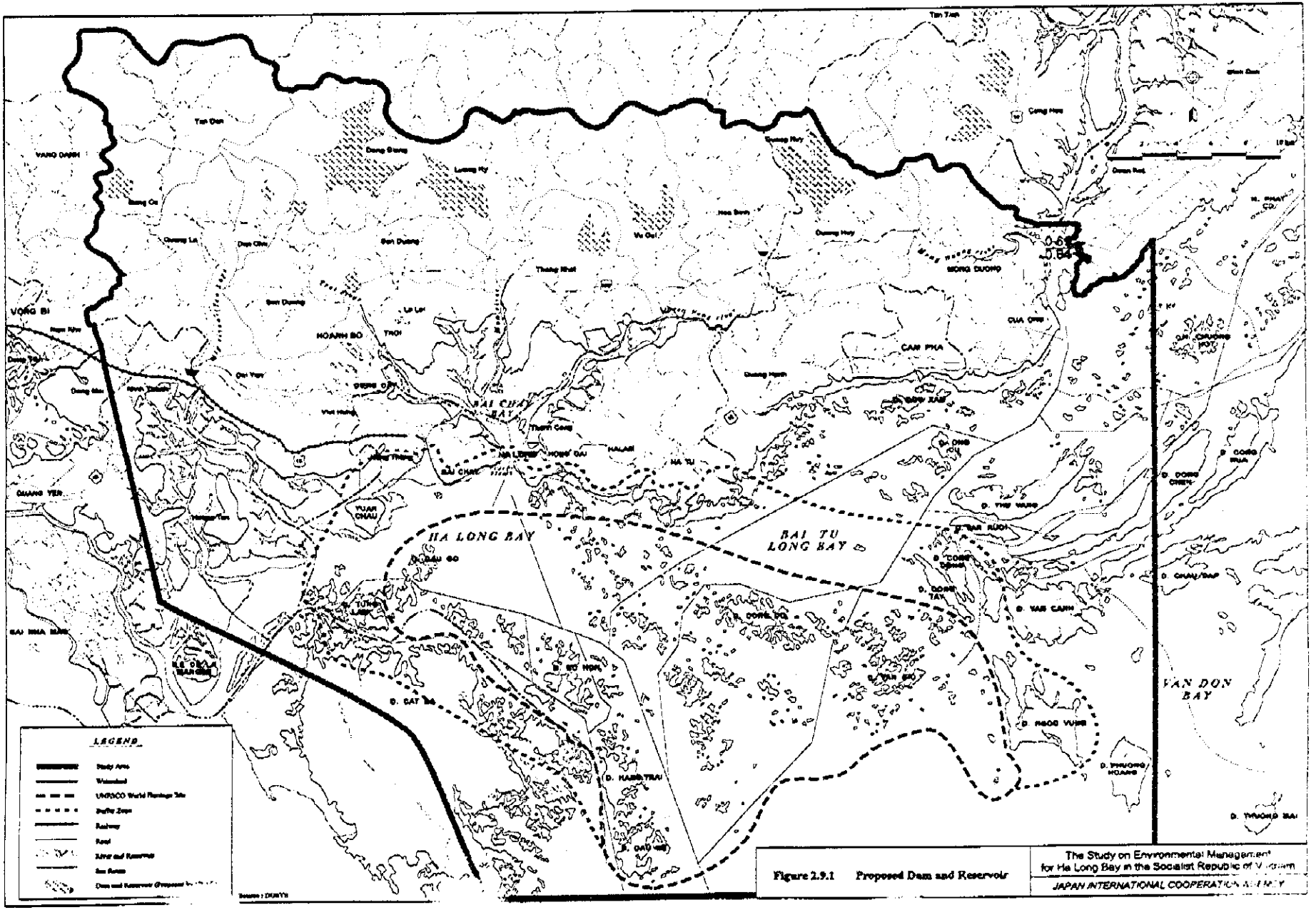


Figure 2.9.1 Proposed Dam and Reservoir

The Study on Environmental Management for Ha Long Bay in the Socialist Republic of Vietnam

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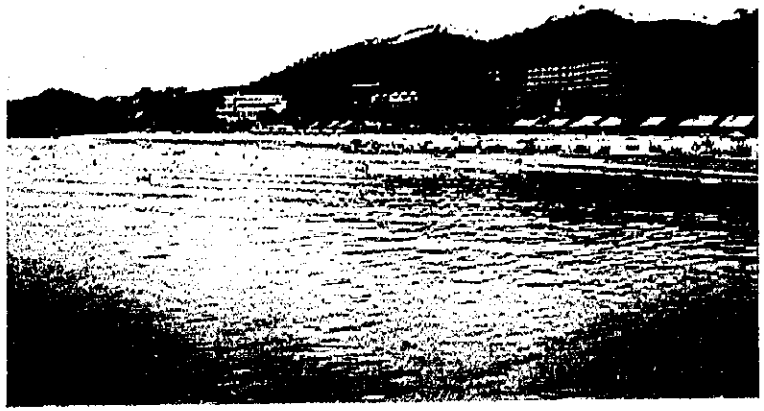
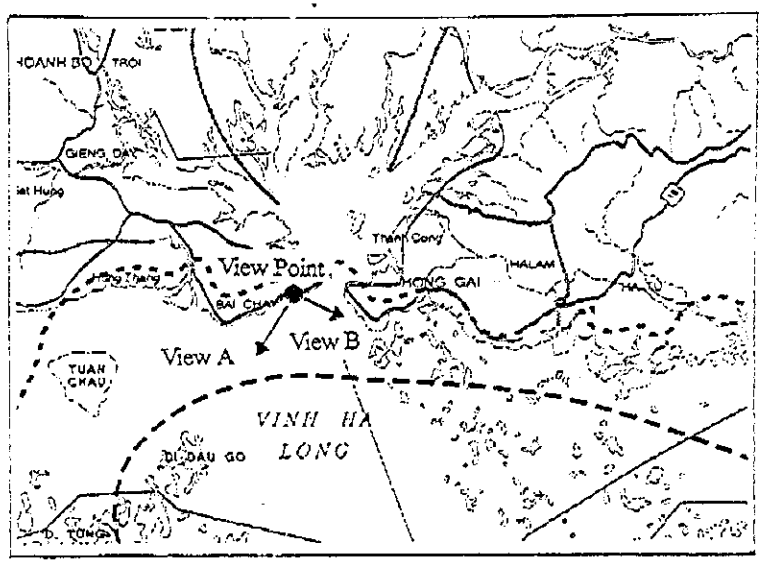
View Point : Beach in Bay Chay





View A

View B

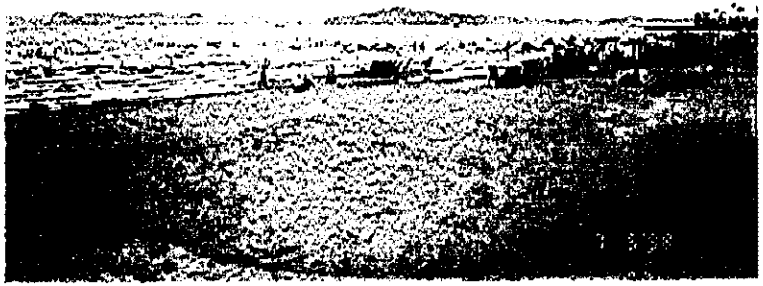
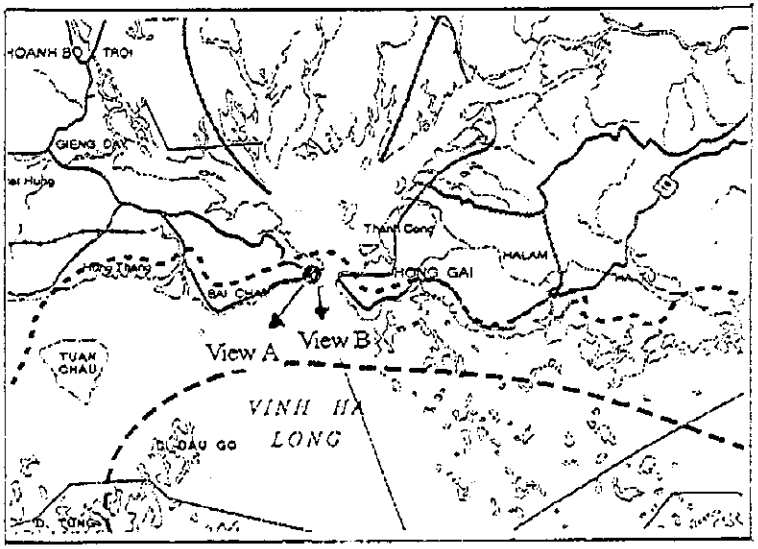


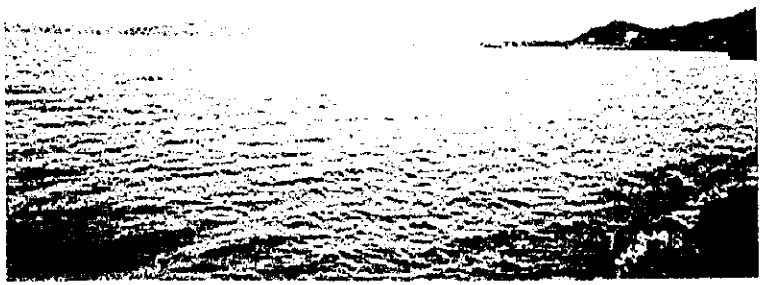
Figure 2.10.1 (1) Typical Landscape of Ha Long Bay World Heritage from Mainland

View Point : Seaside Road in Bay Chay



View A

View B



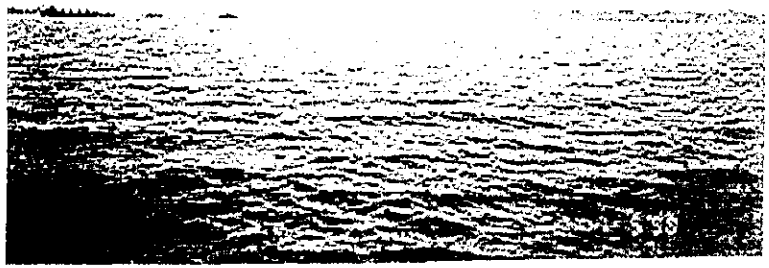
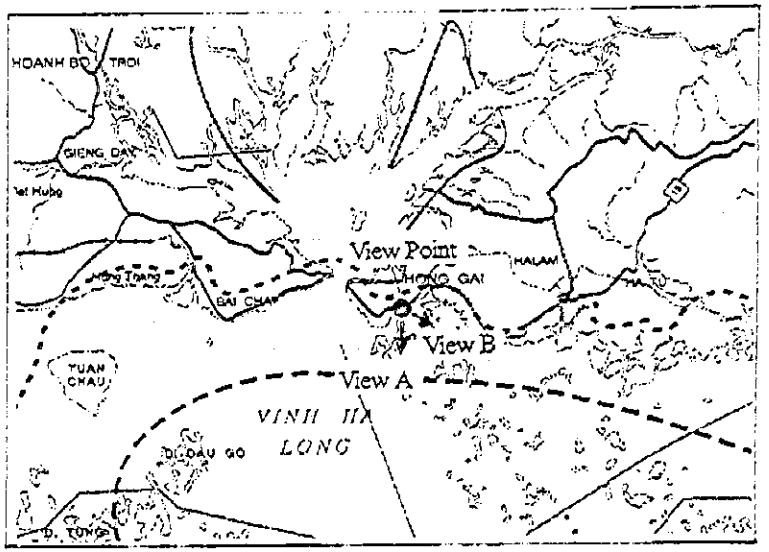


Figure 2.10.1 (2) Typical Landscape of Ha Long Bay World Heritage from Mainland

View Point : Lan Be Park in Hong Gai

View A



View B

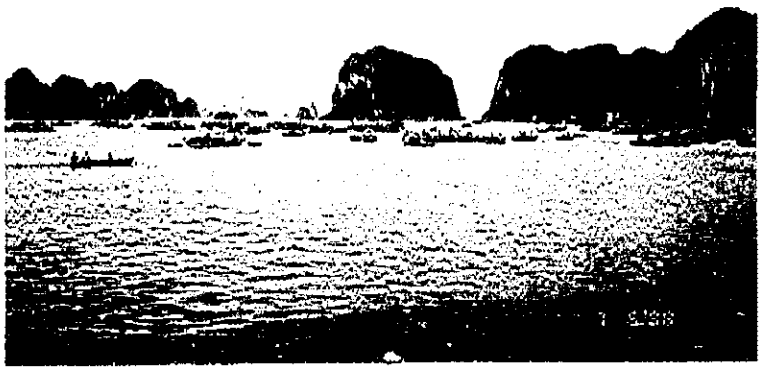


Figure 2.10.1 (3) Typical Landscape of Ha Long Bay World Heritage from Mainland

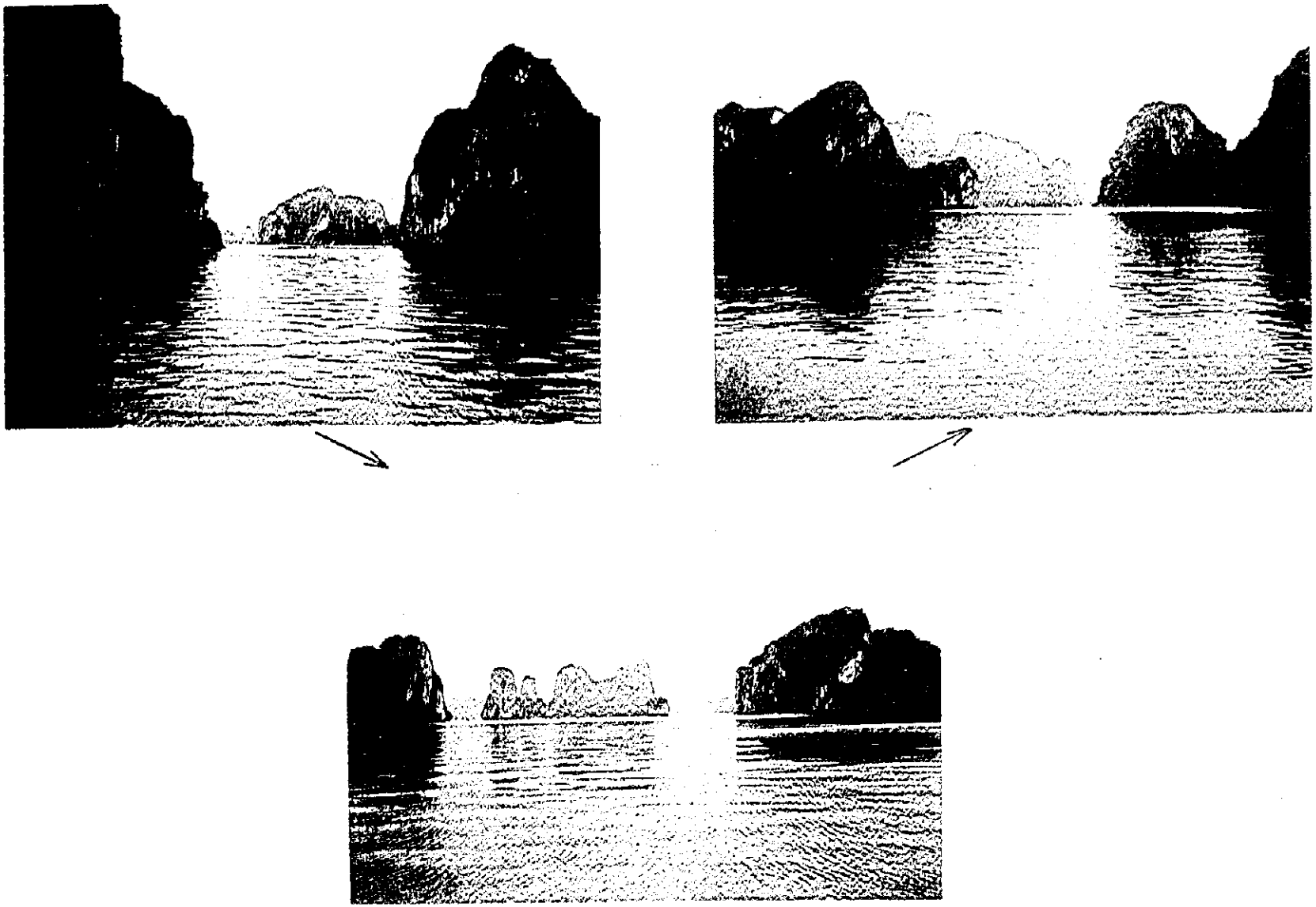
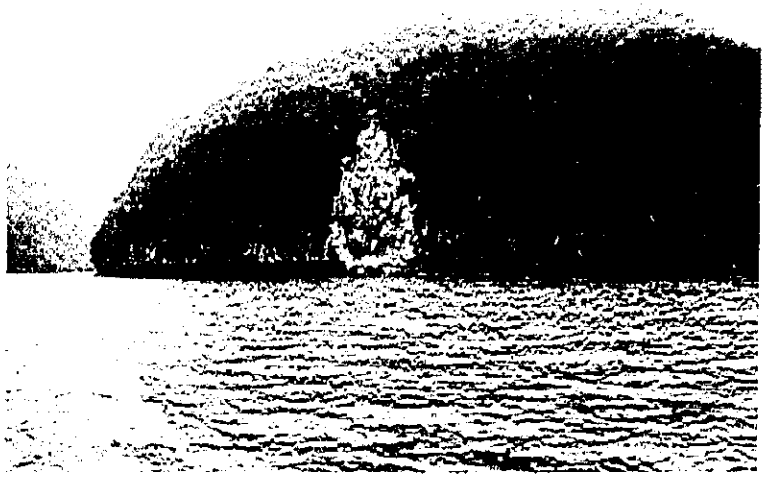


Figure 2.10.2 Typical Landscape of Ha Long Bay World Heritage from Boat



Landslide

Floating garbage

Anchored transport ship

Sailing transport ship

Figure 2.10. 3 Impacts Affecting the Value of Landscape of Ha Long Bay World Heritage

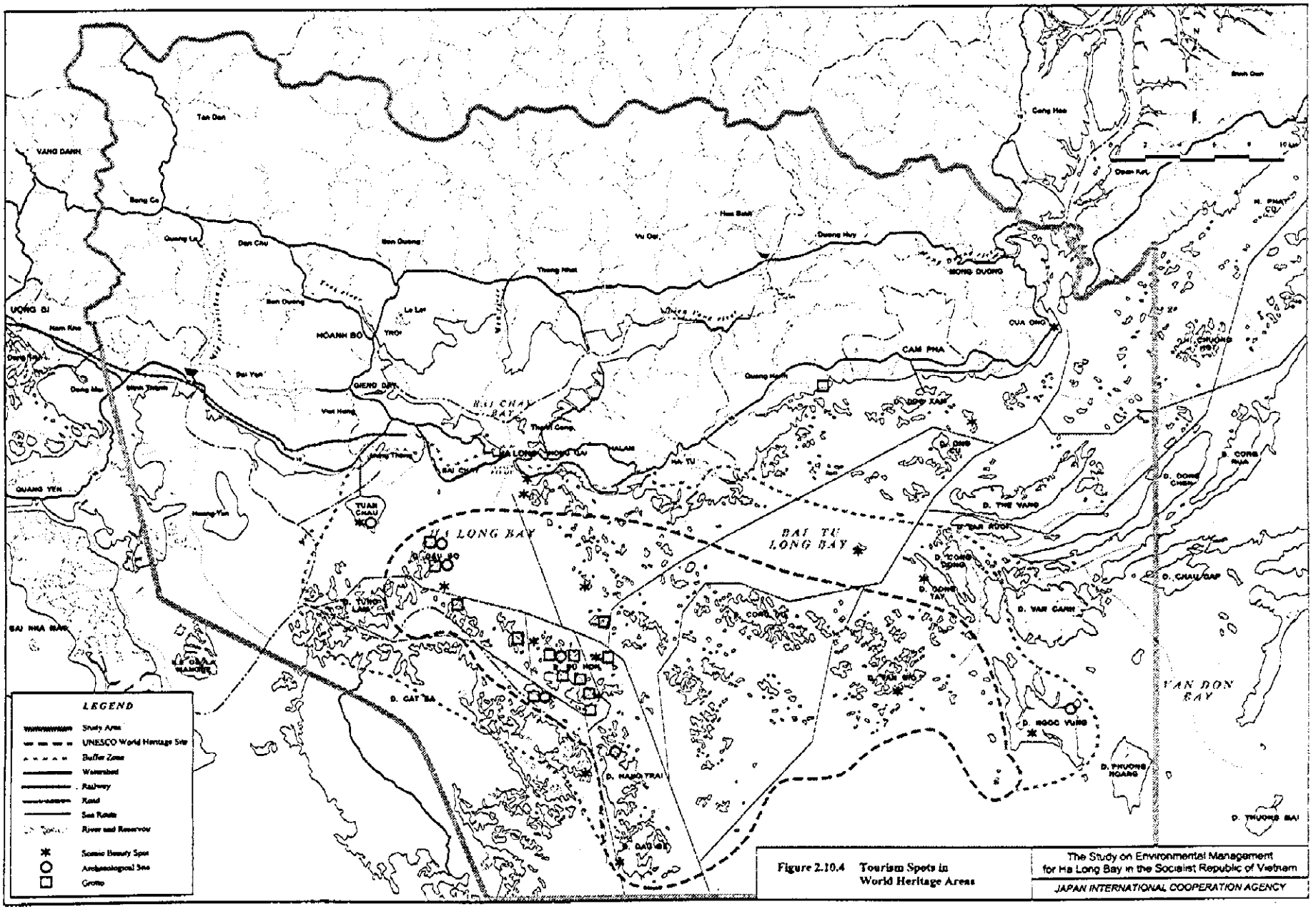


Figure 2.10.4 Tourism Spots in World Heritage Areas

The Study on Environmental Management for Ha Long Bay in the Socialist Republic of Vietnam

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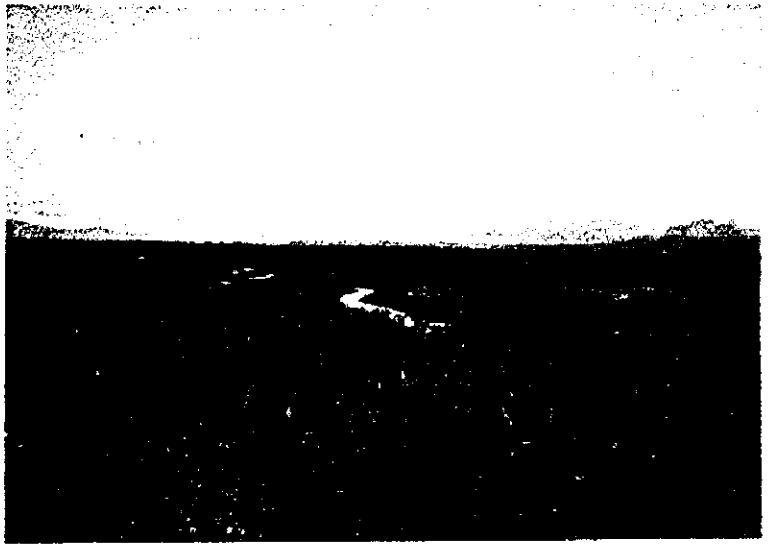
Mangrove Swamps of Quang Hanh

Tidal Flat along Cam Pha

Riverside of Mong Duon River

Figure 2.10.5 (1) Valuable Landscapes in the Study Area

Tidal Flat of Bai Chai Bay



Mangrove Swamps of Bai Chay Bay

Mangrove Swamps of Yen Hung

Figure 2.10.5 (2) Valuable Landscapes in the Study Area

CHAPTER 3

CHAPTER 3 SOCIOECONOMIC CONDITIONS

3.1 Administrative Unit

The study area covers Ha Long city, Hoanh Bo district, part of Cam Pha town, Yen Hung district, and Cat Hai district (Cat Ba island). The administrative units included there are presented in the table below.

District/City/Town	No. of Units	Names of Administrative Units
1) Ha Long city	16 quarters	Hong Gai, Bach Dang, Yet Kien, Tran Hung Dao, Cao Xanh, Cao Thang, Ha Lam, Ha Trung, Ha Tu, Ha Phong, Ha Khanh, Hong Ha, Hon Hai, Bai Chay, Giang Day, Ha Khau
	2 communes	Hung Thang, Tuan Chau
	1 small town	Troi
2) Hoanh Bo district	14 communes	Dai Yen, Son Duong, Viet Hung, Le Loi, Thong Nhat, Vu Oai, Dan Chu, Quang La, Bang Ca, Tan Dan, Duong Lam, Duong Son, Ky Thuong, Hoa Binh
3) Cam Pha town	11 quarters	Cam Thinh, Cam Dong, Cam Son, Cam Phu, Cua Ong, Cam Tay, Cam Thuy, Cam Thanh, Cam Thach, Cam Trung, Mong Duong
	3 communes	Quang Hanh, Cam Binh, Duong Huy
4) Yen Hung district	4 communes	Hong Tan, Minh Thanh, Ha An, Tin An
5) Cat Hai district	-	-

Source: DOSTE, 1998

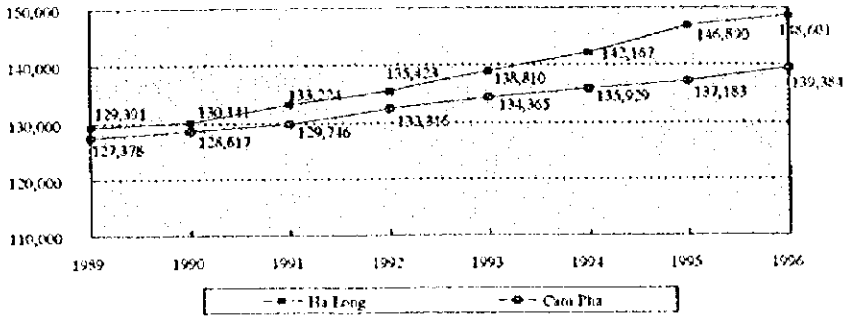
3.2 Population and Settlements

3.2.1 Population

The national census held every ten years provides the most reliable data on demographic characteristics. According to the latest data for the census held in 1989, the population of Ha Long city was 129,391 and that of Cam Pha town was 127,378 (see Tables 3.2.1 and 3.2.2).

There are two sources of current population data aside from the census, the local health center's population records and lists of households kept by heads of quarters or communes. It should be noted that the health center records generally include temporary residents and migrant workers whereas the census data don't. Particularly in Cam Pha town, there are large number of temporary migrant workers from other areas. Consequently, a certain difference between the two data may occur.

The figure below shows the population growth of the two major urban centers in the study area, Ha Long city and Cam Pha town.



Source: Provincial Population and Family Planning Committee, 1998

Figure 3.2.1 Population Growth of Ha Long City and Cam Pha Town

Ha Long city has at present 16 quarters in the inner city and 2 communes in the suburban area. Its population was 148,601 in 1996. The growth rate of the population was 2.0% per year (from 1989 to 1996) with a natural growth rate at 1.58%. Key characteristics of the population data of 1996 is described as follows:

i) Populations of the eastern and western Ha Long (Bai Chay) are, respectively, 115,000 and 34,000 persons.

ii) The proportion of non-agriculture population is 91%.

iii) The population density (1,208 persons/km^2) is higher than the average for the Quang Ninh province.

Cam Pha town is located east of Ha Long city and comprises 11 quarters and 5 communes. The total area is 48,633 ha. Most of the population live in the southeast area along the coast and the main road. Its population was 139,384 in 1996. The growth rate of the population was 1.30% per year (from 1989 to 1996).

The population of Hoanh Bo, Yen Hung, and Cat Hai districts are 52,464 (1997), 125,972 (1996), and 15,741 (1994), respectively. However, eastern part of Yen Hung district is mostly a wetland in river estuaries where only few inhabitants are living. The total population of the study area was around 370,000 in 1996.

3.2.2 Labor Force

The labor force of Ha Long city was 65,732 in 1993 and it was estimated to total more than 90,000 in 1995. Women account for 43.9% of the labor force. The city has a relatively high share of its labor force in services and industry.

Labor Force of Ha Long City by Economic Sector in 1993

No.	Industry	Employee	%
	Sector I	12,020	18.3
1	Agriculture & fishery	3,500	5.3
2	Forestry	220	0.3
3	Mining	8,300	12.6
	Sector II	27,550	41.9
4	Small scale industry	21,00	31.9
5	Construction	6,450	9.8
6	Other products	100	0.2
	Sector III	26,162	39.8
7	Transport, post and communication services	6,100	9.3
8	Commerce, tourism	11,400	17.3
9	Housing & public service	1,460	2.2
10	Scientific research (R&D)	100	0.2
11	Educational service	2,530	3.8
12	Culture, art, sports activity	480	0.7
13	Health & social services	1,400	2.1
14	Public administration	1,700	2.6
15	Financial service	650	1.0
16	Others	20	0.0
	Total	65,732	100.0

Source: Ha Long City Master Plan for 1994 - 2010

The educational level of the labor force is relatively high in Ha Long city. The population with technological knowledge was about 60% in 1995 according to the following table.

Labor Force by Educational Level in 1995

Postgraduate	0.0%
University	7.3%
Secondary School	15.0%
Technical Worker	37.4%
No formal training	40.3%

Source: Ha Long City Master Plan for 1994 - 2010

Labor forces by industrial sector in Cam Pha town, Hoanh Bo, the eastern parts of Yen Hung and Cat Ba are currently not available. For reference the labor force of Quang Ninh province by industrial sector is shown in Table 3.2.3.

3.2.3 Settlements

The coastal strip along Road No. 18 in the study area has been settled for a long period of time as well as the northern part of the Red river delta. Ancient limestone tools which have recently been found in Ha Long bay are believed to be 10,000 years old. (UNDP, Sustainable Development Planning for Road No. 18 Corridor, 1997)

Most population in the study area today are still concentrated in the coastal strip along Road No. 18, particularly in the two urban centers, Ha Long and Cam Pha. The distribution pattern is unequal because of its complicated topographical conditions. The settlements will expand along the coastal area the same as before.

3.3 GDP and Investment

Unlike most areas of Vietnam, the provincial economy is dominated by service and industry activities, not by agriculture. Around 80% of Provincial GDP comes from the industry & construction and service sectors. Particularly Ha Long city, the main urban center in the study area, is largely based on the industry and service activities. Agriculture is almost negligible in terms of GDP share. The other districts in the study area, however, are still largely dependent on agriculture.

GDP Share and its Change of Quang Ninh Province

GDP Share (%)	1991	1994	Vietnam 1994
Industry & Construction	32.7	34.6	29.7
Agriculture, Forestry	24.5	20.5	28.7
Service	42.8	44.9	41.7
Total	100.0	100.0	100.0

Note: Industry includes mining
Source: Statistical Yearbook 1997 and Urban Development Master Plan of Quang Ninh Province, 1995

It should be noted that there are big income gaps among the districts in the study area. Per capita GDP (1995) of Ha Long city is over twice the national average. On the other hand, those of Hoanh Bo and Yen Hung districts are just less than half of the national average.

GDP Share of Districts in the Study Area in 1994

GDP Share (%)	Ha Long	Cam Pha	Hoanh Bo	Yen Hung
Industry	47.0	9.3	3.6	2.8
Construction	1.4	12.6	11.5	3.7
Agriculture, Forestry	0.1	43.9	47.8	52.7
Service	5.4	4.1	2.4	5.3
Business	12.7	4.7	2.9	4.5
Tourism & Other Services	23.4	5.2	6.3	5.7
Government	10.0	20.2	25.5	25.3
Total	100.0	100.0	100.0	100.0

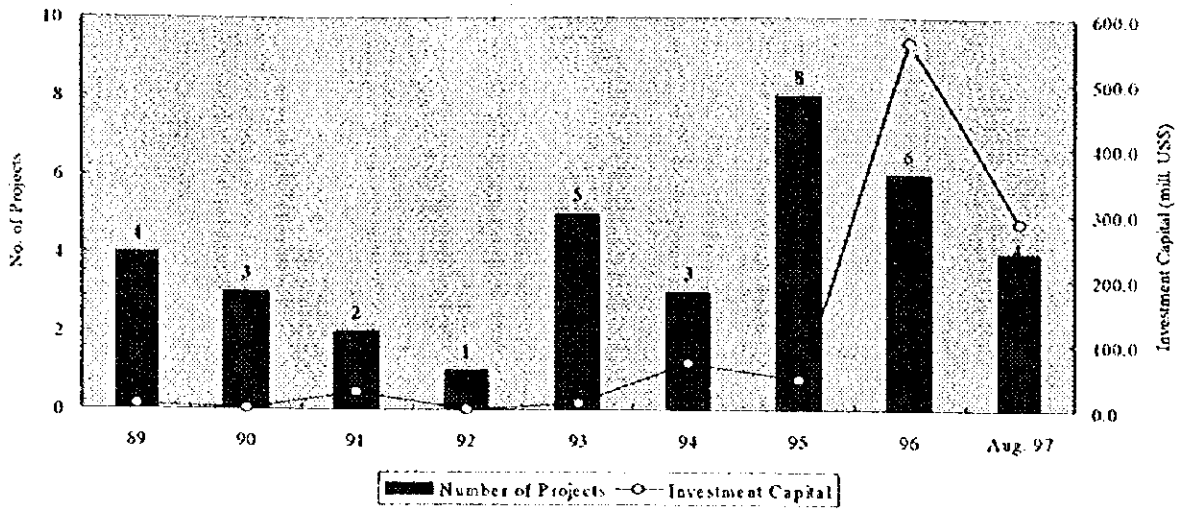
Note: Industry includes mining
Source: Coastal and Marine Environmental Management for Ha Long Bay, ADB, 1995

GDP of Study Area in 1995

Area	GDP (VND billion)	GDP per capita (VND million)	Average Annual Growth Rate (1990-1994) (%)
Ha Long	950	6.53	18.9
Cam Pha	409	2.96	2.8
Hoanh Bo	66	1.29	2.6
Yen Hung	144	1.17	3.9
Vietnam	222,840	3.01	10.4

Source: Statistical Year Book of Vietnam, 1996 and UNDP & DSI, Sustainable Development Planning For Road No. 18 Corridor, 1997

The recent rapid economic growth has been largely dependent on the Foreign Direct Investment (FDI). In Quang Ninh province 36 FDI projects had been approved by August 1997 since 1989. The list of projects is shown in Table 3.3.1. The investment capital has tended to become larger in recent years. Major sectors of FDI are hotel construction and tourism services as well as industry such as food processing and building materials. Recently, however, implementation of some approved projects have tended to be delayed partly because of future uncertainty of the local market caused by the recent economic turmoil in Southeast Asia.



Source: Ministry of Planning and Investment, 1998

Figure 3.3.1 Approved FDI Projects in Quang Ninh Province

3.4 Economic and Financial Conditions

There are two distinct and fundamental trends in the economy of the study area, i.e. increasing urbanization and a shift in dominance away from the traditional economic sectors of industry and agriculture to new economic sectors created by the general economic renovation of the country. On a per capita basis, the study area is a substantially larger generator of wealth than Hai Phong city, all of the Quang Ninh province, or Vietnam as a whole.

Another major difference from most of the country is that the study area resides within one of the national economic development zones. This means that the study area is one of Vietnam's priority areas for economic growth, and domestic and foreign investment.

3.4.1 Industrial Economy

Industrial production accounts for 78% of the total province's general industrial and agricultural production. Key contributions to the regional economy are coal production, bricks and tiles, and sea products.

In 1997, total marine and aquaculture production in the province was 18,556 tons, which translates to an export monetary value of almost US$11 million (i.e. US$3.5 million from sea products, and US$7.5 million from fish source).

Province-wide, it is estimated that about 10,000 people are involved in the marine and aquaculture industry.

In 1997, the revenue and the levy from tourism in the Quang Ninh province were VND 89 billion and VND 9 billion, respectively.

The Quang Ninh province is growing at a faster rate than the national average of 8 to 9%, but no statistical data has been obtained to back this up. At present, about 25% of labor population is employed in industry, as shown in the next tables. Agriculture sector makes up 54%. The major industries are coal mining and processing, construction materials, ship building and seafood processing. Since Ha Long bay was designated as World Heritage site by UNESCO, the tourism industry has been growing rapidly and has the potential to be the second largest income earner in the province, after the local industry.

Employment by Sector in Ha Long City and Province

Sector	Ha Long City	Quang Ninh Province (%)
Agriculture	1,408	172,696 (53.9)
Forestry	40	1,412 (0.4)
Fisheries	N/A	1,000 (0.3)
Industry	17,047	78,450 (24.5)
Tourism	2,700	2,700 (0.8)
Services	N/A	20,529 (6.4)
State	N/A	33,300 (10.4)
Education	1,630	10,576 (3.3)
Total		320,663 (100.0)

Note: N/A = Detailed data is not available.
Source: Environmental Impact Assessment for the Cai Lao Port Expansion Project 1998

3.4.2 Household Economy

A comprehensive socioeconomic survey partially covering the study area in 1995 showed that each family had an average of two members contributing to the household income. Monthly household expenditures averaged VND 854,000, but households in Ha Long city spent 24% more than families in Cam Pha town. The proportion spent on food is a common indicator of ability to pay for other items. The national average in Vietnam is 56%, while the Ha Long city citizens spent 62% and Cam Pha citizens 72%. This indicates a strained economy around the study area.

The poverty line calculated for a typical average household of 4.5 members was VND 400,000 in 1995 figures. Grouping of the households according to their monthly household expenditures showed that 11% were living below the poverty line, as shown in the table below. The proportion of households which could be considered having a low-middle income was 43% in Ha Long city and 57% in Cam Pha town. Households which could be considered rich were 16% in Ha Long city and 6% in Cam Pha town.

Household Groups by Expenditure in Ha Long City and Cam Pha Town

Group	Expenditure (VND/month)	Ha Long City (%)	Cam Pha Town (%)	Average (%)
Lower(under poverty line)	< 400,000	10.5	11.3	10.9
Low middle	400,000 ~ 800,000	42.6	57.1	49.4
High middle	800,000 ~ 1,200,000	30.7	25.8	28.4
Higher	> 1,200,000	16.2	5.8	11.3
Total		100.0	100.0	100.0

Source: Halong City Water Supply and Sanitation Project, Technical Working Paper 1 : Socio-Economic Assessment, DANIDA, 1995

Some representative commodity prices in 1997 and 1998 are shown in the following tables, at the national and local levels. Many market prices around the study area are higher than the provincial average, and even some are higher than those in Hanoi.

Economic Indicators of National Level

Items	General Commodity Price Index (100 for 1992)				
	1993	1994	1995	1996	1997
Annual Average	100.4	101.5	102.5	102.9	103.2
As of December	105.2	120.3	135.6	141.7	146.8
* Average Foreign Exchange Rate (VND/US$)	10,950	10,970	11,025	11,031	11,400

Note: * Source is the Quang Ninh Post Office No. 108. (1998)
Source: Vietnam 1996 Statistic Yearbook (1997), and Vietnam 1997 Statistic Yearbook (1998)

Retail Prices of Typical Commodities in Specific Locations

District	Retail Price of Typical Commodities by Place in 1997 (Unit :VND)		
	Rice (1 kg)	Pho (1 bowl)	2-star Hotel (single, 1 overnight)
Bai Chay	2,500 ~ 3,000	5,500	190,000 ~ 250,000
Hong Gai	2,300 ~ 2,800	4,500	150,000 ~ 220,000
Cam Pha	2,200 ~ 2,700	4,000 ~ 4,500	150,000 ~ 220,000
Central Hanoi	2,300 ~ 2,900	3,500	190,000 ~ 250,000

Source: Financial Department of the Quang Ninh Province, 1998

Typical Service Prices in Hanoi and Quang Ninh Province

Service Items	Price Unit (VND)	Present Service Price in 1998		
		in Hanoi	in Ha Long	Average in Quang Ninh
Average Wage Rate	per hour	2,423	1,769	1,730
	per month	500,000	420,000	400,000
Hospitalization	per day	105,000	120,000	120,000
Medical Treatment	per visit	20,000	25,000	25,000
Taxi Fee	per km	5,000	6,000	6,000
Bus Charge	per km	150	170	160
Petrol for Car	per liter		4,500	
Diesel Fuel for Car	per liter		3,900	

Source: Financial Department of the Quang Ninh Province, 1998

3.4.3 Economic Policies for the Study Area and the Quang Ninh Province

The Government of Vietnam (GOV) plans to develop Ha Long city as a center for national and international tourism and for regional economic, cultural and industrial development as an important part of the Hanoi-Hai Phong-Ha Long development triangle. Development of the Cai Lan deep seaport and large scale industries is being carried out in the inner part of Ha Long bay, namely Bai Chay bay, by the government and private investors.

GOV is placing importance on the tourism sector for the study area as a continuing source of economic growth and employment, and the future importance on the study area as a transportation hub of the northern economic development zone. In addition, it is hoped that industrialization will be self-financed from external sources.

The province's "Master Plan for Socioeconomic Development" has been approved for the period of 1996-2000-2010. The major target of the Master Plan is to increase the annual growth rate in every sector by 5 ~ 15%.

3.4.4 Financial Sources for Environmental Management

(1) Domestic Financial Source

In complement to the Law of Environmental Protection (LEP), Article 32 of the Governmental Decree (GD) 175/CP says that finances for environmental protection shall come from three sources :

a) the state budget allocated for it,

b) charges for the evaluation of EIAs according to the fees and rules established by MOF, and

c) other revenues (fines for breaches of the environmental laws, donations, etc.)

Public Expenditures for Environmental Projects/Programs

(Unit : VND million)

Items of Expenditures	Total Public Expenditures for Environmental Projects/Programs			
	1994	1995	1996	1997
1. Total Expenditures of Quang Ninh Province	260	330	625	5,208
1-1. Building of Waste Water Treatment Station	0	0	0	5,000
2-2. Environmental Management of DOSTE	260	330	625	208
a) Environmental program	130	165	325	104
b) Environmental survey	0	65	0	0
c) Environment for coal mining	0	100	300	0
d) Feasibility study of projects	0	0	25	0
e) Environmental training	0	0	0	31
f) Environmental monitoring	0	0	0	73
g) Others related to environmental activities	130	0	0	0
2. VINACOAL's Expenditures for Environment	N/A	N/A	N/A	20,000

Note : N/A = not available
Source : DOSTE, 1998

As for the past environmental budget for the Quang Ninh province including the study area, the above table shows the real expenditures of DOSTE and the province between 1994 and 1997. It shows that the state budget for local environmental sector has been quite limited. As example of "other revenues" above, 10% of the revenue is obliged on tourism ship service according to the Ha Long City People's Committee.

A water supply charge is another example which has been applied in the province as well, while there have been no pollution charges programs in place in Quang Ninh province. The table below shows that total amount of the levy nearly doubled from 1993 to 1997.

Collected Amount of Water-Supply Levy in the Quang Ninh Province

(Unit: VND million)

Year	1993	1994	1995	1996	1997
Water-supply Levy	97	104	123	154	189

Source: Tax Department, August 1998

Decision 276, General Regulations on Management of Fees and Other Charges, passed on July 28, 1992, specifies that all fees and charges collected by government agencies must be registered at the tax department and that the

generated revenue should contribute to the general budget. Fee rates should both cover collection and administration fees and contribute to the state budget.

However, arrangements for the use of these revenues have often given rise to disagreement between the agencies responsible for taxation and those responsible for environmental protection in Vietnam including the study area. Environmental agencies often argue that, in order to promote environmental protection, these funds should be allocated or 'earmarked' to support environmental protection activities. Tax authorities argue that decisions on revenue allocation are solely at the government's discretion and that earmarked funds further complicate already complex tax systems. A recent example of the earmarked (revolving) fund related to the study area is "VINACOAL Environmental Fund" proposed in 1998. Appendix 3 includes some explanation and rules of the Fund tentatively described in the "Provincial Environmental Protection Standards for the Open Cast Coal Mining Industry in Quang Ninh Province" (UNDP, 1998).

(2) Foreign Financial Source

The foreign financial arrangement of adequate funds required for large-scale projects is the essential step for implementation. The following three types of finance sources have been used in Vietnam as well. Among them, category 3) is not suitable for environmental projects because of its non-productive nature.

1) Official Development Assistance (ODA) finance to be provided by OECD countries,
2) Aid finance to be provided by international financing institutes (e.g. World Bank and Asian Development Bank), and
3) Commercial finance provided or arranged by contractors or suppliers, including some official financing

For instance, major foreign financing sources for on-going and planned port and waterway projects in the northern region of Vietnam including the Quang Ninh province are summarized in Table 3.4.1 indicating degree of funding possibility for future financial support in the same region.

Taking 7 foreign donors that financially assisted Vietnam also in the environmental sector between 1992 and 1994, their average annual financial

support (total of grant and loan) disbursed during the same period amounted to about US$ 112 million/year for all sectors. Ratio to the environmental sector was 11.4%, as shown in the next table.

Estimation of Financial Disbursements (Grant and Loan) of 7 Donors

(Unit: US$ million/year)

Donors	(a) Average during 1992 ~ 94	(b) Disbursement to Environmental Sector *	% = (b) / (a)
1. Bilateral Donors	51.9	2.3	4.4
Australia	34.2	1.4	4.0
Canada	4.6	0.2	4.9
Denmark	9.5	0.5	5.0
South Korea	1.3	0.2	11.8
Norway	2.3	0.0	1.9
2. Multilateral Agencies	60.4	10.6	17.5
European Community	41.9	7.0	16.8
UNDP	18.5	3.5	19.1
Total	112.4	12.8	11.4

Note: * "Environmental Sector" includes environmental conservation and natural resources planning & management, but excluding water supply and sanitation.
Source: Viet Nam's Development Partners - Profiles of Cooperation Programs, UNDP, 1995

Likewise, Table 3.4.2 presents total technical assistance disbursements and their share for a environmental sector in 1995 from 13 donors. The share of the environmental sector was only 5.3%. The data in these tables are relatively old, but they imply a past trend on donors interested in financial assistance for the environmental projects in Vietnam and on their extent of involvement into the environmental sector. UNDP and Scandinavian countries have contributed most to environmental conservation in Vietnam so far.

3.5 Industry

(1) General Characteristics

At present coal mining and its related industries have been playing a dominant role in the study area. Besides them, mechanical engineering, shipbuilding, construction materials, and food-processing industries are located in the area. The major industrial facilities are state owned and have been protected from either domestic or international competition until recently. Accordingly, the lack of competition have resulted in minimal or no additional investment in plant renovation, even for the recurrent costs of basic operation and maintenance. As a result of this lack of investment, some of the industrial facilities in the area are or

will be facing difficulty in being competitive on the international markets and having reserved necessary financial resources for pollution prevention.

Existing strength of industrial production in the area generally presents a good base for the expansion of industrial activities into other sectors. The natural resources of Ha Long bay provide an excellent base for the expansion of tourism led service sectors. However, the industrial production is heavily biased towards coal mining with little experiences in other industrial sectors. Restructuring production towards non-mining industrial subsectors will require a substantial shift in expertise and training of skilled labor.

The combination of manufacturing industry and tourism in the same area may lead to conflicts in land use planning. The financial cost for development of manufacturing industry in the study area can be lower than in other areas. On the other hand, the economic cost of such locations can be higher because of the negative impacts on not only the tourism, but also the local people's daily life in the long term. It should be carefully noted that the environmental cost will be also higher because of the precious value of the natural environment and the high potential for pollution that will go with the manufacturing industry development.

(2) Mechanical Engineering

In Cam Pha there are four mechanical engineering plants whose primary role is to serve the coal mining activities. However, their activities have diversified to produce accessories for other sectors, such as electric power, oil and gas, cement, transport, and construction. The quality of products, such as accessories for machines and equipment operated in open pit mines, electronic components and spare parts for imported machines is generally considered low. Today these plants are underutilized and operate at only 13-15% of available capacity due to weak demand for their products. (UNDP, Sustainable Development Planning for Road No. 18 Corridor, 1997)

(3) Shipbuilding

There are three shipyard plants in the study area. The largest one is Ha Long Shipyard located in Gieng Day, Ha Long city which belongs to a state owned

company, Vietnam Shipbuilding Industry. The shipyard was constructed by the assistance of Poland and has been fully operational since 1976. Its building capacity is from 1,000 to 3,500 dwt (deadweight tons) with permitted designed building capacity up to 5,000 dwt. However, the capacity has been recently utilized at only 30-50% because of the following problems: low demand, low quality, and high cost of their products, etc. In addition, the plant is facing severe difficulties with limited marketing opportunities, shortage of material supplies and capital.

The other two shipyards are operated under the provincial management: 1) Ha Long Shipbuilding Company and 2) Fishery Ship and Boat Building Company.

(4) Construction Material

Non-metallic minerals including limestone (for cement and as crushed rock for road and building construction), clay, silica, sand and gravel are prevalent in the study area. Nearly all materials are used locally. Gieng Day Brick Tile factory is operated under the provincial management. The designed capacity is 33 million pieces/year. As for the tile and brick industry the total capacity of the area is 73 million pieces/year at present.

There are three major proposals for cement plants in the Bai Chay estuary. Two of the proposed plants (Hai Long and Lang Bang) have been granted licenses by MPI. The environmental concerns should be addressed before construction of the plants, as the location of potential cement plants in the study area can have a very damaging effect on the environment.

(5) Mining

Coal resources in Quang Ninh Province has been exploited since before French colonial time, and the historical production is estimated to be over 200 million tons. VINACOAL's current production in Quang Ninh Province is about 10 million tons per year, and about 8.4 million tons are produced in the study area, as shown in Table 3.5.1. The major producers in the study area include Coc Sau mine of 1.5 million tons/year, Deo Nai mine of 1.1 million tons/year, Cao Son mine of 1.0 million tons/year, and Ha Tu mine of 0.8 million tons/year. The

estimated annual sales are in the order of 3 trillion VND, and the industry contributes to about 24% of the total provincial GDP. It provides jobs to about 80,000 people in the province.

To our knowledge, there is no approved official production plan for the future. According to Pham et al. (1997), the coal production in Quang Ninh will increase to 16.7 million tons in 2005 (Figure 3.5.1).

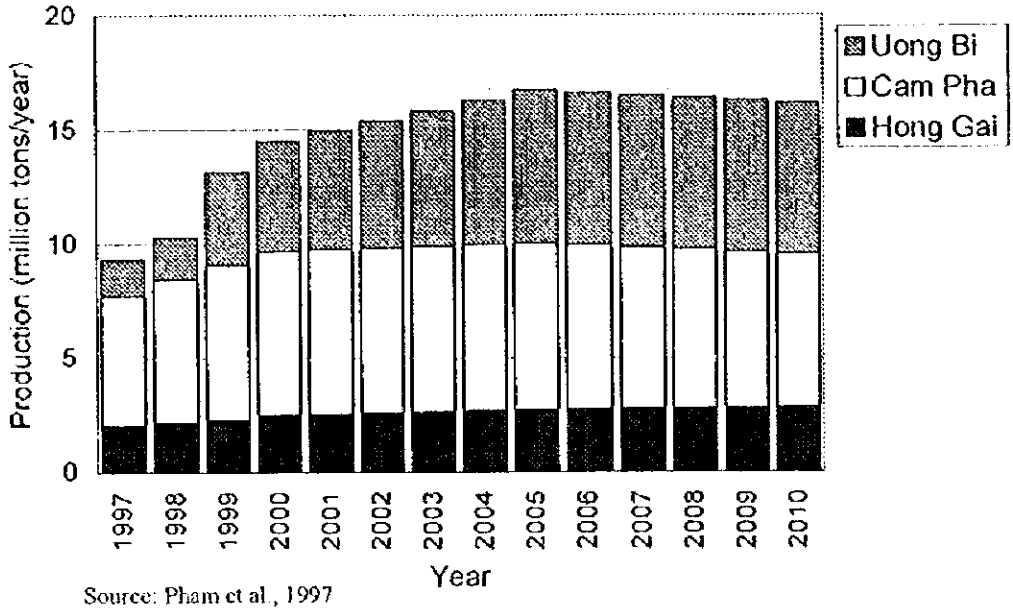


Figure 3.5.1 Estimated Coal Production in Quang Ninh by Region

Much of this boost in production relies on the significant increase in production in Uong Bi area, i.e. 1.8 million tons in 1998 to 6.7 million tons in 2005, while the increase in the study area (Cam Pha and Hong Gai) will be roughly 19% (8.4 million tons in 1998 to 10.0 million in 2005) presented in Figure 3.5.1. About 200 million tons of coal will be produced from 1998 to 2010 in Quang Ninh, of which 125 million tons will be produced in the study area. In this section, mines in Hoanh Bo district (in the catchment area of Yen Tu reservoir) are generally excluded from the analysis.

Most mines use out-dated mining technology, and their productivity is very low. The production per work-shift (8 hours) is about 200 kg, and is considerably lower than 31 tons of Australia, 25 tons of U.S., and 16 tons of South Africa.

3.6 Tourism

Tourism is an important growth sector in the study area. It has a potential to provide diversity and balance to the industrial structure of the area. The number of visitors has been steadily increasing in the 1990s, in particular the increase of foreign visitors is remarkable. Local visitors are drawn to traditional festivals and famous pagodas as well as Ha Long bay. Foreigners' destination is largely Bai Chay and Ha Long bay. Currently 40% of the foreign visitors is French, 30% is Taiwanese, and 10% is Chinese. In the last several years tourism activities have been undergoing considerable changes which were reflected in not only the number of visitors but also the development of infrastructure, the number of tourism enterprises, incomes and types of tourism activity.

Recent Trends of Tourism in Quang Ninh Province

Number of Visitors (1,000 pers.)	1993	1994	1995	1996	1997
Foreign	80	140	160	150	150
Domestic	220	190	190	230	250
Total	300	330	350	380	400
Length of Stay (day/capita)	N/A	N/A	1.42	1.60	1.50
Number of Hotels	16	27	71	110	123
Number of Rooms	400	1,000	1,400	1,900	2,300

Note: N/A = not available
Source: Department of Tourism, Quang Ninh province, 1998

Major hotels including a few international-class accommodations are currently concentrated in Bai Chay. Accommodations in Cam Pha are only guesthouses mainly serving professionals and government employees on business trips. The two existing hotels in Cat Ba island are state owned hotels. However, the quality of rooms and services is regarded as low and doesn't meet tourists' demand.

In addition, in Bai Chay there are a large number of mini-hotels which are privately operated. They often lead to chaotic development which can spoil locations through poor design and offering low quality accommodation. It is necessary to establish a proper policy for mini-hotel development to avoid spontaneous development and negative environmental impacts.

Transportation facilities for tourists are also concentrated in Bai Chay area. The number of boats and cruise ships has increased rapidly, from only 10 units in 1990,

to 35 in 1991, 70 in 1993, and 105 in 1995. There are at present 140 boats and cruse ships with average capacity of 30 passengers per unit. Approximately 5,000 tourists per day enjoy a cruise in Ha Long bay. In addition, there are 90 tourist buses in the province.

In order to maximize the tourism potential of the area it will be necessary to coordinate its development so that the leading sites can draw visitors to other tourist spots and thereby extend the duration of visitors' staying time. Ha Long city should be paid a particular attention to refine its plans for the premier international tourist sites. In particular, infrastructure developments such as transportation network with Ha Noi and Mong Cai, communication network and so forth are really important to meet the needs of the tourism sector but also the other economic sectors.

3.7 Agriculture, Fishery, and Forestry

(1) Agriculture

There is about 55,500 ha of agricultural land in Quang Ninh province (see the previous table of existing land use pattern). The three major agricultural areas in the province are Dong Trieu, Yen Hung, and Quang Ha. The three districts, Ha Long, Cam Pha, and Hoanh Bo composing the major part of the study area are not included in those areas.

The GDP share of agriculture, fishery, and forestry in Ha Long accounts for only 0.06% in 1994 and that implies that it doesn't have a dominant role of agricultural production in the province at all. However, the other two districts as well as Yen Hung still show the high GDP shares from 43 to 53%. The major agricultural products are rice, maize, sweet potato, cassava, peanut, soybean, vegetables, and livestock farming.

The agricultural land for rice planting is generally limited in the province and its productivity is still low for lack of proper irrigation system. The rice production is not self-sufficient in the province and the supply will continuously depend on other regions in the future.

Major Agricultural Products of the Study Area in 1996

(Unit: ton)

Products	Ha Long	Cam Pha	Hoanh Bo	Yen Hung	Total Province
Rice	516	1,321	7,396	31,636	139,912
Summer	338	1,070	5,349	18,181	89,047
Winter	179	250	2,037	13,454	50,866
Maze	0	119	757	54	7,375
Sweet Potato	380	632	2,387	4,388	45,086
Cassava	0	240	1,065	1,251	15,544
Peanut	0	35	195	165	2,481
Soybean	0	0	79	0	1,402
Vegetables	11,510	8,560	3,994	18,513	88,500

Source: Statistical Year Book of Quang Ninh Province 1996

Number of Livestock in the Study Area in 1996

(Unit: head)

Livestock	Ha Long	Cam Pha	Hoanh Bo	Yen Hung	Total Province
Buffalo	200	850	7,106	2,806	63,914
Cattle	173	350	676	2,580	11,630
Pig	29,813	22,065	15,097	35,450	250,751

Source: Statistical Year Book of Quang Ninh Province 1996

(2) Fishery

According to the interview survey to the Department of Fisheries (DOF) in Quang Ninh province, the fish production of the Ha Long bay area is about 4,000 to 5,000 tons per year in total, and it occupies 25% of the total production in Quang Ninh Province. The main fishing methods in Ha Long bay are long-line, gill-net, lifting-net and trawling. The main species are groupers, seabasses, seabeams, prawns and small shrimps in Ha Long bay and tunas and mackerels in offshore sea. The fisheries production has the tendency to decrease mainly because of overfishing, degradation of water quality, and the decrease of coral reef that has the breeding function for fish resources. Therefore, it is needed to conserve natural resources such as coral reefs and manage fishing activities in order to recover fish resources. DOF is responsible for management of fish resources and fishing activities in Ha Long bay. DOF has a plan to reduce fishing activities within Ha Long bay by shifting the fishing ground from inside area of Ha Long bay to offshore area.

(3) Forestry

The total forest land in the study area is over 67,000 ha in Ha Long city (20%), Cam Pha town (28%), Hoanh Bo district (54%), and Yen Hung district (7%). The

proportion of forest land in the study area is around 37% which is higher than that of the national average, 28%. Terrestrial forests in the study area generally include sub tropical lowland evergreen/semi-evergreen broadleaf forests, sub tropical hill evergreen/semi-evergreen broadleaf forests and limestone associated forests. Quang Ninh province has produced timber, turpentine, cinnamon, anis, and eucalyptus.

Deforestation is a key problem in the study area. In Quang Ninh province, for instance, about 507,000 ha of forested land in 1943 decreased to only 208,000 ha in 1985. Furthermore, the area has continuously been decreasing to 196,958 ha in 1996.

Besides, the study area has had relatively few coastal forests in comparison with other parts of Vietnam. This is largely due to the climatic condition which are marginal for tropical wetland species such as mangroves. Quang Ninh province as a whole had more than 35,000 ha of mangrove, although most of this consisted of bushes and shrubs on newly deposited alluvium.

At present, there are about 10,000 ha of wetland in the study area and most of which are in a very degraded state or simple mud flats in river estuaries. Few mangroves are greater than 1.5 m in height.

TABLES

Table 3.2.1 Population of Ha Long City

No.	Quarter/ Commune	Area (ha)	1989	1994	1995	1996	Density (pers./ha) 1996
1	Ha Long	102	7,211	7,490	7,579	7,611	75
2	Bach Dang	86	8,004	8,876	9,699	10,039	116
3	Yet Kien	120	5,665	6,042	6,122	6,235	52
4	Tran Hung Dao	72	7,158	7,303	7,467	7,536	105
5	Cao Xanh	180	8,768	11,692	13,037	13,262	74
6	Cao Thang	232	10,685	13,428	13,966	14,126	61
7	Ha Lam	286	8,566	7,908	7,657	7,677	27
8	Ha Trung	465	6,075	6,109	5,750	5,939	13
9	Ha Tu	2,019	8,451	8,638	9,424	9,524	5
10	Ha Phong	2,216	8,078	8,500	8,580	8,690	4
11	Ha Khanh	2,986	5,028	4,916	5,033	5,093	2
12	Hong Ha	274	8,082	9,134	9,033	9,674	35
13	Hon Hai	366	7,256	9,318	9,397	9,554	26
14	Bai Chay	1,074	8,898	11,835	12,402	12,676	12
15	Gieng Day	399	7,876	8,661	9,009	9,151	23
16	Ha Khau	823	7,298	8,340	8,195	8,311	10
17	Hung Thang	148	3,009	2,544	3,070	3,517	24
18	Tuan Chau	405	1,403	1,433	1,470	1,461	4
19	Thanh Cong	30	1,880	Merged to Cao Xanh			
Total		12,286	129,391	142,167	146,890	148601*	12

Note: Total figure marked * is a datum from Provincial Statistical Year Book and not equal to the sum of quarters/communes.

Source: Provincial Population and Family Planning Committee, 1998

Table 3.2.2 Population of Cam Pha Town

No.	Quarter/ Commune	Area (ha)	1989	1994	1995	1996	Density (pers./ha) 1996
1	Cam Thinh	1,624	7,656	8,210	7,625	7,854	4.8
2	Quang Hanh	6,413	10,375	10,769	14,035	15,281	2.4
3	Cam Dong	732	9,083	9,971	9,059	9,254	12.6
4	Cam Son	1,369	9,885	10,992	10,850	11,217	8.2
5	Cam Phu	852	13,168	14,030	14,261	14,687	17.2
6	Cua Ong	1,534	13,283	13,400	13,089	13,724	8.9
7	Cam Tay	473	8,666	9,105	7,805	7,949	16.8
8	Cam Thuy	239	8,052	8,688	7,945	8,142	34.1
9	Cam Thanh	125	7,556	9,039	7,908	8,077	64.9
10	Cam Thach	430	8,458	8,178	9,376	9,602	22.4
11	Cam Binh	167	5,518	6,040	6,092	6,234	37.4
12	Cam Trung	193	9,377	10,103	12,580	12,896	67.0
13	Mong Duong	11,583	10,122	11,110	10,216	10,478	0.9
14	Cong Hoa	8,061	2,242	2,520	2,368	2,428	0.3
15	Cam Hai	2,162	1,476	1,456	1,309	1,296	0.6
16	Duong Huy	4,662	2,461	2,318	2,665	2,694	0.6
Total		48,623	127,378	135,929	137,183	139,384*	2.9
Total in the Study Area		38,400	123,660	131,953	133,506	135,660	3.6

Note: Shaded areas are not included in the study area. Total figure marked * is a datum from Provincial Statistical Year Book and not equal to the sum of quarters/communes.

Source: Provincial Population and Family Planing Committee, 1998

Table 3.2.3 State Officials and Workers by Industrial Sector in Quang Ninh Province

(Unit: persons)

No.	Industry	1994	%	1995	%	1996	%
1	Agriculture & Forestry	2,304	2.1	2,262	1.9	2,229	1.7
2	Fishery	162	0.1	158	0.1	162	0.1
3	Mining	56,597	50.7	63,473	53.6	71,392	55.7
4	Manufacturing	11,138	10.0	10,911	9.2	12,258	9.6
5	Electricity, Gas and Water Supply	2,979	2.7	2,983	2.5	3,100	2.4
6	Construction	3,386	3.0	3,466	2.9	3,121	2.4
7	Trading, Motor repair	4,672	4.2	4,493	3.8	4,362	3.4
8	Hotels, Restaurants	1,557	1.4	1,727	1.5	1,619	1.3
9	Transport, Post and Communication	2,915	2.6	3,119	2.6	3,781	3.0
10	Financial services	1,592	1.4	1,689	1.4	1,752	1.4
11	Scientific Research (R&D)	210	0.2	232	0.2	250	0.2
12	Real estate and Renting services	929	0.8	944	0.8	949	0.7
13	Public administration & Defense	7,792	7.0	7,415	6.3	7,136	5.6
14	Education & Training	10,277	9.2	10,431	8.8	10,650	8.3
15	Health & Social work	3,442	3.1	3,461	2.9	3,427	2.7
16	Recreational, Cultural and Sports activities	230	0.2	250	0.2	300	0.2
17	Party and Membership organizations	1,020	0.9	1,016	0.9	1,073	0.8
18	Community, Social and Personal services	372	0.3	476	0.4	548	0.4
	Total	111,574	100.0	118,506	100.0	128,109	100.0

Source: Statistical Year Book of Quang Ninh Province, 1996

Table 3.3.1 Approved FDI Projects in Quang Ninh Province

No.	Project	License No.	Issue on	Status	Location	Capital (mill. US$) Investment	Legal	Country
1	Halder Vietnam Co. Ltd.	22 GP	10.9.89	Revoke Expired	Cua Ong	6.4	6.4	Hungary
2	Shrimp Raising Contract	26 GP	10.19.89	Revoke Expired	Quang Ninh Prov.	0.7	0.0	Hong Kong
3	Fish Raising Contract	27 GP	10.31.89	Revoke Expired	Quang Ninh Prov.	0.7	0.0	Hong Kong
4	Fish Raising Contract	28 GP	11.1.89	Revoke Expired	Quang Ninh Prov.	0.2	0.0	Hong Kong
5	Sea Park Co. Ltd. (aquaculture)	55 Gp	2.27.90	Revoke Expired	Cai Ron, Cam Pha	0.6	0.4	Hong Kong
6	Yen Hung Sea Product Production Co.	63 GP	3.23.90	Revoke Expired	Tien An, Yen Hung	1.0	1.0	Hong Kong
7	Quang Ninh - Taiwan Co. (pine tar processing)	95 GP	7.9.90	Active	Uong Bi	0.7	0.3	Japan
8	Quang Ninh - Fronteriac (real estate, hotel construction)	229 GP	8.20.91	Revoke Expired	Bai Chay	0.8	0.3	Hong Kong
9	Dong Vong Uong Thoung Mineral Exploitation Contract	260 GP	10.21.91	Active	Uong Bi	27.0	27.0	Indonesia
10	Viet Hoa Tea Co.	344 GP	4.13.92	Revoke Expired	Hong Gai	0.16	0.11	China
11	Hai Ninh Lita Co. Ltd. CTLD Hai Ninh Loi Lai (hotel construction)	501 GP	1.10.93	Active	Mong Cai	5.0	3.3	Hong Kong
12	Hong Hai Co. Ltd. (real estate)	553 Gp	3.18.93	Revoke Expired	Bach Dang, Ha Long City	0.8	0.6	China
13	Water Filter Contract	598 GP	5.14.93	Active	Quang Ninh Prov.	2.1	2.1	Japan
14	Viet An Co. Ltd. (real estate)	600 GP	5.16.93	Revoke Expired	Mong Cai	3.0	3.0	Macau
15	Ha Long Hydravia (tourist transportation by seaplane)	714 GP	11.3.93	Active	Bai Chay	0.1	0.1	France
16	Royal International JV Co. Ltd. (real estate, hotel Construction)	953 GP	8.12.94	Active	Ha Long Hotel, Bai Chay	39	15	Taiwan
17	Vina Flour Ltd.	976 GP	8.31.94	Active	Cai Lan, Ha Long City	26.0	10.7	Malaysia
18	The Heritage Ha Long JV (real estate, hotel management)	985 GP	9.5.94	Active	Bai Chay	7.5	4.0	Singapore
19	Ha Long Plaza Co. Ltd.	1123 GP	1.23.95	Active	Bai Chay	10.5	5.0	Thailand
20	Guest House Renovation Contract	1124 GP	1.24.95	Active	Bai Chay	1.3	1.3	Russia
21	Hoang Hung Phat Co. Ltd. (garment manufacturing)	1149 GP	2.28.95	Active	5 Cong, Ha Long City	0.3	0.30	Australia
22	Quang Giang JV Co. Ltd. (food industry, beverage)	1225 GP	5.3.95	Active	Quang Yen Town, Yen Hung	0.6	0.64	China
23	HA Long Dream Hotel JV	1288 GP	6.23.95	Active	Vuon Dao Market, Bai Chay	11.0	3.5	Thailand
24	Sea Product Farming Contract	1311 GP	7.10.95	Active	Soi Van, Ha Long Bay	0.4	0.4	Taiwan
25	Kec Campha Ltd. (electrical equipment)	1348 GP	8.9.95	Active	Km 2, Tran Phu Rd. Cam Pha	7.0	2.7	India
26	Ha Long Floating Hotel & Hai Phong Floating Hotel	1370 GP	9.10.95	Active	Bai Chay	16.0	16.00	Singapore
27	Quang Ninh Universal Cement Co. Ltd.	1619 GP	6.28.96	Active	Thong Nhat, Hoanh Bo	260.00	78.00	Taiwan
28	Cai Lan Oils & Fats Industries Co Ltd.	1645 GP	8.11.96	Active	Cai Lan, Ha Long City	220.4	12.5	Singapore
29	Zi Tsiang Oceans Undertaking Co. Ltd. (aquaculture & fishing)	1659 GP	8.25.96	Active	Quang Ninh Prov.	1.2	0.4	Taiwan
30	Schmidt Quang Ninh Construction Materials Manufacturing JV Co. Ltd.	1674 GP	9.17.96	Active	Giang Day, Ha Long City	3.3	1.3	British Virgin Islands
31	Ha Long Bay Investment Tourism Development JVC., Ltd. (real estate)	1707 GP	10.11.96	Active	Bai Chay	68.00	21.53	Malaysia
32	Asia Mining Service Co (AMS)	176 GP	12.3.96	Active	Coc Sau, Cua Ong	10.0	30.0	Australia
33	Bay View Resort Hotel	1881 GP	4.9.97	Active	Bai Chay	22.1	6.6	Singapore
34	Vina Takaoka Electrical Equipment Production JV Co.	1919 GP	5.30.97	Active	Cam Thanh, Cam Pha	13.6	6.4	Japan
35	Nisco Ogawa Pearl Co. Ltd.	1921 GP	6.2.97	Active	Van Don	1.5	1.0	Japan
36	Ha Long Cement JV Co.	1974 GP	8.20.97	Active	Thong Nhat, Hoanh Bo	250.0	75.0	Korea

Source: Ministry of Planning and Investment, 1998

Table 3.4.1 Financing Sources for On-Going and Planned Port and Waterway Projects in the Northern Region

Financial Category	Major Source Organization	Amount of Investment (US$ $\times 10^6$)	(%)
Multilateral funding	UNDP	0.4	
	ADB	60.0	
	Sub-total	60.4	2.3
Bilateral funding	Japanese Government	258.3	
	Belgium Government	1.2	
	Dutch Government	0.2	
	Finish Government	3.1	
	Sub-total	262.8	10.0
Private funding	USA companies	282.5	
	Thailand companies	442.5	
	Taiwan companies	624.3	
	Hong Kong companies	258.0	
	French companies	99.0	
	S. Korea companies	275.0	
	Japanese companies	210.0	
	Sub-total	2,191.3	84.0
Domestic funding	Vietnamese Government	6.2	
	Local investors	86.4	
	Sub-total	92.6	3.6
Grand Total		2,607.1	100.0

Table 3.4.2 Technical Assistance Disbursements (Grant and Loan) of 13 Donors

Donors	(a) All Sector in 1995	(b) Disbursement to Environmental Sector (US$ $\times 10^6$)*	(b/a) %
Bilateral Donors			
1) Australia	31,892	176	
2) Belgium	6,863	14	
3) Denmark	7,309	453	
4) Finland	1,380	1,024	
5) Germany	339	265	
6) Netherlands	9,422	1,216	
7) Sweden	15,437	745	
Sub-total	72,642	3,893	5.4
Multilateral Agencies and Others			
1) European Union (EU)	5,870	116	
2) International Atomic Energy Agency (IAEA)	520	68	
3) OXFAM-UK	423	79	
4) UNDP	8,457	320	
5) UNDP-Global Environment Facility (GEF)	338	338	
6) UNICEF	17,918	826	
Sub-total	33,526	1,747	5.2
Grand Total	106,168	5,640	5.3

Note: * "Environmental Sector" includes sector policy & planning, environmental preservation, wildlife & national parks, and sanitation.

Source: Technical Assistance Trends and Implications, UNDP, 1996

Table 3.5.1 Estimated Production, Overburden and Mine Wastewater to 2010

Production

unit: x 10^3 tons

area	method	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total (1998-2010)
Uong Bi	underground	1,398	1,628	2,148	2,498	2,668	2,839	3,009	3,180	3,350	3,350	3,350	3,350	3,350	3,350	38,070
	open-pit	210	220	1,928	2,308	2,516	2,725	2,933	3,142	3,350	3,330	3,310	3,290	3,270	3,250	35,572
	total	1,608	1,848	4,076	4,806	5,185	5,564	5,942	6,321	6,700	6,680	6,660	6,640	6,620	6,600	73,642
Hong Gai	underground	660	725	835	960	1,020	1,080	1,140	1,200	1,260	1,290	1,320	1,350	1,380	1,410	14,970
	open-pit	1,360	1,405	1,435	1,525	1,510	1,495	1,480	1,465	1,450	1,440	1,430	1,420	1,410	1,400	18,865
	total	2,020	2,130	2,270	2,485	2,530	2,575	2,620	2,665	2,710	2,730	2,750	2,770	2,790	2,810	33,835
Cam Pha	underground	1,300	1,510	1,725	1,970	2,084	2,198	2,312	2,426	2,540	2,682	2,824	2,966	3,108	3,250	31,595
	open-pit	4,400	4,793	5,085	5,210	5,124	5,038	4,951	4,865	4,779	4,523	4,267	4,012	3,756	3,500	59,903
	total	5,700	6,303	6,810	7,180	7,208	7,236	7,263	7,291	7,319	7,205	7,091	6,978	6,864	6,750	91,498
Total		9,328	10,281	13,156	14,471	14,923	15,374	15,826	16,277	16,729	16,615	16,501	16,388	16,274	16,160	198,975

Overburden

unit: x 10^3 m^3

area	method	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total (1998-2010)
Uong Bi	underground	2,796	3,256	4,296	4,996	5,337	5,678	6,018	6,359	6,700	6,700	6,700	6,700	6,700	6,700	76,140
	open-pit	1,155	1,210	10,604	12,694	13,840	14,986	16,133	17,279	18,425	18,315	18,205	18,095	17,985	17,875	195,646
	total	3,951	4,466	14,900	17,690	19,177	20,664	22,151	23,638	25,125	25,015	24,905	24,795	24,685	24,575	271,786
Hong Gai	underground	1,320	1,450	1,670	1,920	2,040	2,160	2,280	2,400	2,520	2,580	2,640	2,700	2,760	2,820	29,940
	open-pit	7,480	7,728	7,893	8,388	8,305	8,223	8,140	8,058	7,975	7,920	7,865	7,810	7,755	7,700	103,758
	total	8,800	9,178	9,563	10,308	10,345	10,383	10,420	10,458	10,495	10,500	10,505	10,510	10,515	10,520	133,698
Cam Pha	underground	2,600	3,020	3,450	3,940	4,168	4,396	4,624	4,852	5,080	5,364	5,648	5,932	6,216	6,500	63,190
	open-pit	24,200	26,362	27,968	28,655	28,181	27,707	27,233	26,759	26,285	24,878	23,471	22,064	20,657	19,250	329,467
	total	26,800	29,382	31,418	32,595	32,349	32,103	31,857	31,611	31,365	30,242	29,119	27,996	26,873	25,750	392,657
Total		39,551	43,025	55,880	60,593	61,871	63,149	64,428	65,706	66,985	65,757	64,529	63,301	62,073	60,845	798,140

Wastewater

unit: x 10^3 m^3

area	method	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total (1998-2010)
Uong Bi	underground	5,871	6,837	9,021	10,491	11,207	11,923	12,638	13,354	14,070	14,035	14,000	13,964	13,929	13,894	159,364
	open-pit	420	440	3,856	4,616	5,033	5,450	5,866	6,283	6,700	6,660	6,620	6,580	6,540	6,500	71,144
	total	6,291	7,277	12,877	15,107	16,240	17,372	18,505	19,637	20,770	20,695	20,620	20,544	20,469	20,394	230,508
Hong Gai	underground	2,772	3,045	3,507	4,032	4,284	4,536	4,788	5,040	5,292	5,403	5,514	5,626	5,737	5,848	57,730
	open-pit	2,720	2,810	2,870	3,050	3,020	2,990	2,960	2,930	2,900	2,880	2,860	2,840	2,820	2,800	100,381
	total	5,492	5,855	6,377	7,082	7,304	7,526	7,748	7,970	8,192	8,283	8,374	8,466	8,557	8,648	132,185
Cam Pha	underground	5,460	6,342	7,245	8,274	8,752	9,231	9,710	10,189	10,668	11,230	11,793	12,355	12,917	13,479	119,806
	open-pit	8,800	9,586	10,170	10,420	10,248	10,075	9,903	9,730	9,558	9,046	8,535	8,023	7,512	7,000	251,991
	total	14,260	15,928	17,415	18,694	19,000	19,307	19,613	19,920	20,226	20,277	20,327	20,378	20,429	20,479	582,880
Total		26,043	29,060	36,669	40,883	42,544	44,205	45,866	47,527	49,188	49,255	49,321	49,388	49,455	49,521	

Source: Production data by Pham et al., 1997

Notes 1) for 2001-2004 and 2006-2009, linear interpolations were applied.

2) overburden and wastewater for each area were estimated based on the load/product used in (Pham et al., 1997)

CHAPTER 4

CHAPTER 4 PHYSICAL INFRASTRUCTURE CONDITIONS, DEVELOPMENT AND OPERATION

4.1 Transportation

4.1.1 Port and Harbor

(1) Hong Gai Floating Port

The Hong Gai port is situated in the Hong Gai basin and known as a "floating port". The port is a part of the Quang Ninh port system though it has no quay facilities. The water basin area of the Hong Gai port is 787.5 ha with a depth of 8.1 m. The current navigation channel is 11.0 km long and 6.8 m wide. Four tugboats are used for the Hong Gai port being shared with the Cai Lan port. Capacity of boats is from 150 to 1,000 CV (cylinder volume). Cement is the largest cargo handled in this port (about 40,000 tons/month). Ship calls and cargo volume of the Hong Gai floating port in 1998 are given in the tables below.

Ship Calls of Hong Gai Floating Port (1998)

Month	Total Calls	GRT	DWT	Domestic Ship			Foreign Ship		
				Call	GRT	DWT	Call	GRT	DWT
January	9	65,396	91,306	4	15,580	25,508	5	49,816	65,798
February	19	104,082	165,427	13	50,495	97,544	6	53,587	67,883
March	12	73,671	102,027	7	30,795	49,943	5	42,876	52,084
April	14	64,999	96,407	7	23,239	34,800	7	41,760	61,607
May	10	44,598	67,266	8	29,755	46,083	2	14,843	21,183
June	9	80,388	103,194	5	19,411	29,133	4	60,977	74,061
Total	73	433,134	625,627	44	169,275	283,011	29	263,859	342,616

Note: GRT (Gross Ton), DWT (Dead Weight Ton)
Source: Port of Quang Ninh, 1998

Cargo Volume of Hong Gai Floating Port (1998)

(Unit: ton)

Month	Coal	Rock	Cement	Palm Oil	Steel	Chemical	Fertilize	Wheat	Vegetable Oil	Other Cargo	Total
January	20,769	934	19,101	264	0	436	0	17,365	9,565	2,449	70,883
February	24,200	1,211	64,637	0	532	651	18,768	0	5,088	8,055	118,122
March	19,499	2,100	45,603	0	0	33	0	18,000	4,357	737	90,329
April	25,825	0	23,720	0	0	296	10,843	0	7,952	10,669	79,305
May	0	410	42,274	47	786	0	0	0	496	2,388	46,401
June	55,520	0	31,300	0	226	0	15,000	0	8,455	0	113,501
Total	145,813	4,655	229,635	311	1,544	1,416	44,611	35,365	35,913	24,298	518,541

Source: Port of Quang Ninh, 1998

Although the Hong Gai floating port is not a specific coal port, it has also handled a large amount of coal cargo, about 500,000 to 600,000 tons annually, as shown below.

Volume Handled at Hong Gai Floating Port

Year	1992	1993	1994	1995	1996
Coal (ton)	635,169	666,562	490,207	477,136	448,172

Source: Port of Quang Ninh, 1998

The Hong Gai floating port is financially and technically operated with 662 staff and 561 port workers in various fields such as planning, administration, inspection, control, and construction management as of August 1997. It is scheduled to be used for a partial substitution of the planned Cai Lan port in addition to its own present services, until the Stage I construction of the Cai Lan port completes. The general freight handled at the Hong Gai floating port will be transferred to the Cai Lan port after 2002, while its coal cargo will transfer to the Hon Net floating port. The area of the Hong Gai floating port will be used as water basin of the Cai Lan port.

(2) Hong Gai Coal Port

The Hong Gai coal port is located at the tip of the Hong Gai Peninsula. Just opposite to the B12 oil port across the Cua Luc strait. It has berth length of 200 m, water depth of 7.5 m (depth at toe : 13 m), being used only for loading coal. This coal port is under the Ministry of Energy, with 52 staffs and 72 port workers of the Hong Gai Coal Processing Plant. It has a port operation system for 24 hours a day.

The water basin area is 60,000 m^2, with depth of 15 m and two mooring buoys as offshore mooring facilities. There are two 90-ton/hour cranes and one 120-ton/hour conveyer as cargo handling equipment in the port. The handled coal has been carried from Nam Cau Trang or Ha Lam to the Hong Gai coal port by interior railway. The amount of coal cargo handled by the port is as follows :

Cargo Volume of Coal Handled at Hong Gai Coal Port

Year	1992	1993	1994	1995	1996
Coal (ton)	653,268	890,662	908,937	966,953	941,309

Source: Hong Gai Coal Port, 1998

In 1999, the Hong Gai coal port will be closed because of planned decrease of coal handling amount. In 2000, the coal cargo in association with movement of the loading facilities will be relocated to the Cot 5 port for a short term. After being removed, the port facilities such as the warehouse area and revetment will be expanded for handling general cargo and for tourism use. The forecast of cargo volume is about 30,000 tons/year, and general cargo will be handled. The amount of the investment will be about VND 1.5 billion.

(3) Cot 5 Coal Port

The Cot 5 coal port is located 5 km (Coc 5) from Hang Ha commune in Ha Long city. It has a 47 m long berth and water depth is 4 m. The applicable ship size ranges from 100 to 200 tons, many of which are transferring ferry boats and barges. Average mooring time is 4 hours, and occupancy rate of the berth is almost 100%. The yard area is small at 750 m^2. Its cargo-handling equipment has recently increased to 4 sets of conveyers with capacity of 90 tons/hour, in order to substitute the function of the Hong Gai coal port. The transit shed of the floor area covers 15,000 m^2. The coal handled is mainly being carried from the coal processing plant in Nam Cau Trang by railway and conveyer. The coal handled in the port is as follows:

Handled Coal Volume of Cot 5 Coal Port

Year	1992	1993	1994	1995	1996
Coal (ton)	95,026	52,157	91,928	70,350	63,451

Source: Cot 5 Coal Port, 1998

The Cot 5 coal port is operated by 33 staffs and 47 port workers who are working in the Hong Gai Coal Processing Plant. However, its operation time varies with tidal conditions.

One conveyer will be removed from the Hong Gai coal port to the Cot 5 coal port in order to increase capacity from 200,000 to 500,000 tons/year. The cargo handling capacity is planned to further increase to 600,000 ton in 1999. Other port facilities to be expanded are as follows:

a) Supplementary railway to the Cot 5 Port,
b) Expanded storage area (40 m × 100 m = 4,000 m^2), and
c) New conveyer system

(4) Nam Cau Trang Port

The Nam Cau Trang port is located 8 km (Coc 8) from Hong Ha commune of Ha Long city. There is one berth of 200 m in the inter tidal area. The navigation channel extension is about 4 km from Nam Cau Trang to Hong Gai bay. Ferries transporting coal are of ship sizes ranging from 200 to 250 tons. This port is now managed by a team from the Hong Gai Coal Processing Plant.

The following upgrading is planned to increase exporting volume from 200,000 to 500,000 tons/year. The ferry sizes are expected to have capacity of 400 tons after dredging.

a) Construction of a new port in the base of No.72 Port,
b) Dredging of channel (800 m × 40 m inside the port area),
c) Building of the revetment to raise the capacity to 500,000 tons/year,
d) Setting of a conveyer system from the plant to the transporting facilities, and
e) Establishment of temporary store of 3,000 tons.

(5) B12 Oil Port

The B12 oil port located in the entrance of Bai Chay bay is under the control of the Petroleum Company B12. The oil cargo tankers' sizes range from 400 DWT to 36,000 DWT. Major ship nationalities are Chinese, Malaysian, and Panamanian. Five buoys exist offshore to allow tankers to moor and unload cargo up to 30,000 DWT. Oil is piped to the shore from these buoys and stocked in a storage tank. Facilities and ship-turn of the port are presented in the following tables.

Facilities of B12 Oil Port

Name of Berth	Length (m)	Depth (m)	Average Mooring	Berth Occupancy Rate (%)
Floating port (30,000DWT)	225.0	-15.0	4day/unit	10
Hard port (300DWT)	82.0	-6.5	2day/unit	30
Hard port (1,500DWT)	20.0	-1.5	4day/unit	15

Source: Petroleum Company B12, 1998

At present, the B12 oil port has been rebuilt and repaired to receive ships with 30,000 DWT, in accordance with the Decision 1363/QD-PCHH (June 4, 1997) of the Vietnam Marine Department. The calculated capacity will be 1.8 to 2.0 million tons/year. The distance between the wharf and the shore is about 200 m with 5 facilities for anchoring. Each facility consists of buoys of 22 m^3 linked by chains

of 62 and 82 cm in diameter. These are connected with concrete platform of 45 and 30 tons and with stone weigh extension of 1.5 ~ 2.0 m. The facilities are periodically checked to ensure safety. To receive oil from the ships, 6 pipes including underground steel pipes are installed. The soft pipe system is checked every 3 months and each time before a ship sails into the port to pump oil and petrol, and pressure is checked during pumping process every 6 months.

Ship Calls of B12 Oil Port (1997)

Month	Ship Size (ton)	Barge	Ship Call		
			Foreign	Domestic	Total
January	650-12,888	144	16	3	19
February	650-15,786	96	12	4	16
March	520-14,688	141	15	5	20
April	470-12,888	119	11	6	17
May	370-17,500	128	18	2	20
June	470-14,688	115	16	8	24
July	320-15,786	94	13	7	20
August	650-17,800	78	23	6	29
September	590-17,857	99	11	8	19
October	470-17,857	109	16	9	25
November	370-14,555	119	14	12	26
December	550-17,287	142	22	10	32

Source: Petroleum Company B12, 1998

Commodities through the B12 oil port consist of various kinds of petrol, diesel and other oils. These are imported with domestic and foreign rental ships. Oil handling ships will sail into the port under the pilot's control in the leading ship. Commodities will be unloaded by pumping machine through under-ground pipe system to the oil-petrol storage tanks. From there, oil or petrol is transferred through pipes to the other oil storages in Hai Phong, Hai Duong, Hanoi, Ha Tay, and Phu Ly and to barges with size of about 300 DWT.

Although QNPC intended to relocate the port to the Con Ong island (east of Cam Pha), the Petroleum Company B12 submitted a port plan proposing to remove it nearby the storage area by 2005. Main activities of the Company's port plan are as below:

a) Port facility plan:
   - to increase the storage tank volume up to 16,000 m^3,
   - to complete the construction of a dock with capacity of 3,500 ton, and
   - to improve the facility capacity enough for 40,000-DWT-size ship

b) Cargo handling plan: to replace old pipes with new ones, and

c) Port operation plan: to automate the international-level operation system of port and storage.

(6) Cai Lan Port

The Cai Lan port is located in Bai Chay bay, which is about 100 km apart from the Hai Phong port. In 1995, the Berth No.1 was opened on an experimental basis. There was a small cargo flow in 1995 and 1996. The port is connected to the open sea by an access or navigation channel, which passes from Bai Chay bay through Ha Long bay and into the Gulf of Tonkin. The F/S Report of the Cai Lan port expansion project was reviewed including an environmental study as a part of detailed design of the project components. Then, the review works report was proposed in 1998. Its construction schedule is as follows:

1) Development for 2002 : Stage 1 of Phase I

New berths of No.5, 6, and 7 are added, and No.5 and 6 will be designated for general/bulk commodities while No.7 is for containers. The existing berth No.1 retains its current function handling grain and general/domestic goods.

2) Development for 2005 : Stage 2 of Phase I

New berths of No.2, 3, and 4 are added to handle for bulk/general goods. The berth No.5 is modified from handling bulk/general goods to handling grain. The berth No.6 is re-allocated to container traffic.

3) Development for 2010 : Phase II

Extra berths of No.8 for containers as well as No.9 and 10 for domestic purposes, are added. The berths No.9 and 10 are allocated to domestic traffic in order to separate its function from the port's foreign trading functions.

Figure 4.1.1 and Tables 4.1.1 to 4.1.3 show the proposed forecast of traffic, number of vessels, stepwise configuration and construction items of the Cai Lan port project, and these are summarized below.

Forecast of Traffic for Cai Lan Port

(Unit: 1,000 ton)

Commodity/Years	1997	2000	2002	2005	2010
Export	6	387	504	1,208	3,072
Import	66	1,029	1,467	2,892	6,333
Domestic	17	576	825	1,419	2,022
Total Traffic	89	1,992	2,796	5,519	11,427
North Vietnam	4,588	6,858	-	-	18,168

Source: Review Works Report of Cai Lan Port Expansion Project, 1998

(7) Vung Due Coal Port

The Vung Due coal port is located south of Cam Pha town, and 10 km from Cua Ong coal port. The Duyen Hai Company under QNPC manages this port, and some coal mine companies use stockyards and handling systems of the port. There are two cranes for cargo handled in the port area. About 200,000 to 300,000 tons per year of coal is handled.

(8) Cua Ong Coal Port

The Cua Ong coal port is located in 10 km away from Cam Pha town. This port is called "Cam Pha port". It has two berths for loading coal. Length of the main berth is 300 m, and water depth is 9 m (depth at toe is 9.5 m). Type of the structure is revetment of concrete. Water basin area of this berth is 400 m × 400 m with depth of 9.5 m. Other interior berth has length of 45 m, water depth of 2 m, and basin area of 100 m × 200 m. The size of ship is from 10,000 to 50,000 DWT.

The annual amounts of coal cargo volume and the number of ship turns is estimated at about 3 million tons and 500 ships, respectively, based on the obtained data from the Quang Ninh Port Authority.

Ships with 30,000 ~ 50,000 DWT are used to transport exported coal for a long distance. However, cargo handling is constrained by facilities available and water depth of the Cua Ong coal port. So some ships transship at the floating ports due to the cargo regulations shown as below :

Ship Size	Limitation of Cargo
30,000 DWT	27,500 tons
50,000 DWT	35,000 tons

Source: Quang Ninh Port Authority, 1998

The cargo from coal processing plants are carried by railway and on Road No. 18. There are two mobile cranes with capacity of 250 tons/hour to transfer coal to ships and two automatic conveyers with capacity of 800 tons/hour as loading facilities in Cua Ong port. The amount of coal cargo handling in recent years is as follows :

Cargo Volume of Cua Ong Coal Port

Year	1992	1993	1994	1995	1996
Coal (ton)	943,552	982,716	1,256,106	1,637,253	2,228,514

Source: Cua Ong Coal Port, 1998

There are drainage facilities along the port road and a sediment pond of about 20 m (L) × 30 m (W) × 1 m (H). It seems that the wastewater is discharged through this sediment pond. The service boats consist of 2 tug boats with capacity of 980 CV and 3,200 CV, a pilot boat with 350 CV, a police boat with 72 CV and an immigration boat with 72 CV.

Organization of the Cua Ong coal port is the Port & Coal Business Company and to VN General Coal Company. Actually, the VN General Coal Company has managed this port with 68 staffs and 331 port workers. Staff allocation for operation activities such as pilotage, police, immigration, stevedoring, and shipping has not been clarified. Operation time of this port is 24 hours. According to the expansion plan of the port up to 65,000 DWT, the following activities are to be implemented:

a) To repair the navigation system for up-grading,
b) To dredge the channels,
c) To repair the revetment and mooring facilities,
d) To upgrade the Cua Ong port,
e) To repair the main revetment, and
f) To complete transferring dock "CONONG-HONET".

Stagewise schedule of the development plan is to complete of facility study on port development, and to invest on the port building in 1999 to 2000.

(9) Hon Net Floating Port

The Hon Net Facility Project was approved by the Ministry of Communication & Transport in 1997, and the Quang Ninh Port Authority manages the Hon Net floating port. At present about 150,000 tons are handled per year based on the data from the Quang Ninh Port Authority. In statistics, almost 95% of the ship size are 400 DWT or less. The major cargoes are oil exported to China and rubber for domestic purpose. Other freights including cement and steel are loaded in the Hon Net floating port.

At present, several sites in Ha Long bay and Bai Tu Long bay have been declared as locations for anchoring transport ships. Especially due to the limitation of depth and wharf condition from Cua Ong to Hong Gai, the most ships for carrying coal with the capacity from 30,000 to 50,000 DWT have to anchor in Hon Net (HN) and Hon Con Ong (HCO) water basin areas for loading and unloading. Although the Cai Lan port will be built to serve ships with capacity of 50,000 DWT, it is expected that the ships with higher capacity have to load and unload in HN and HCO. According to the Hon Net Facility Project, the total project cost is about 13 billion VND and its construction schedule of the facilities is as follows:

a) ~ 1999
   - Construction of 2 floating ports for 30,000 tons, office, ground route, motor-boat wharf, motor boat, and office facilities, and
   - Construction of 2 floating ports for 50,000 tons (1 in HCO where the General Coal Department loads and unloads, and 1 in HN)

b) after 1999
   - Construction of 1 floating port for 50,000 tons, and
   - Construction of 4 floating ports for 30,000 tons (each 2 in HN and HCO)

(10) Passenger-car Ferry Port

The passenger-car ferry port, managed by the Hong Gai Ferry Company is located in the Cua Lue strait. There are two berths operated in Bai Chay and Hong Gai. The ferry boats out of operation are reserved at the mooring buoy in Bai Chay or in the quay of about 5 m-depth and 20 m-length in Hong Gai.

The port has 4 self-propelled car ferries and two non-propelled car ferries with a small tug-boat aside. A regular service is operated throughout a day using the 4 ferries and the pontoon during 6 : 00 am to 22 : 00 pm, while from 22 : 00 pm to 6 : 00 am only two ferries are in operation. A one-way passage of the Cua Luc strait by a self-propelled car ferry takes approximately 12 minutes. The number of ferries crossing the Cua Luc strait and number of the carried vehicles are as follows:

Number of Ferries Crossings the Cua Luc Strait

Type of Ferry /years	1992	1993	1994	1995	1996
Tug Boat	55,366	54,626	52,904	51,792	N/A
Self Propelled Ferry	8,770	16,758	28,456	42,367	N/A
Passenger Ferry	13,514	14,774	28,018	10,802	N/A
Other(small Boat)	6,264	N/A	N/A	N/A	N/A
Total	83,914	86,158	111,378	104,970	119,104

Note: N/A= not available
Source: Hong Gai Ferry Company, 1998

Number of Vehicles Carried through Cua Luc Strait

Type of Vehicles	1992	1993	1994	1995	1996
Car and Bus	163,229	196,864	223,172	271,663	306,403
Over load	8,441	7,140	8,261	7,639	5,272
Truck	82,279	111,259	119,862	138,696	151,806
Motor-cycle	404,500	517,400	N/A	N/A	N/A
Bicycle	320,800	350,900	N/A	N/A	N/A
Other	15,832	18,844	15,800	21,701	18,256

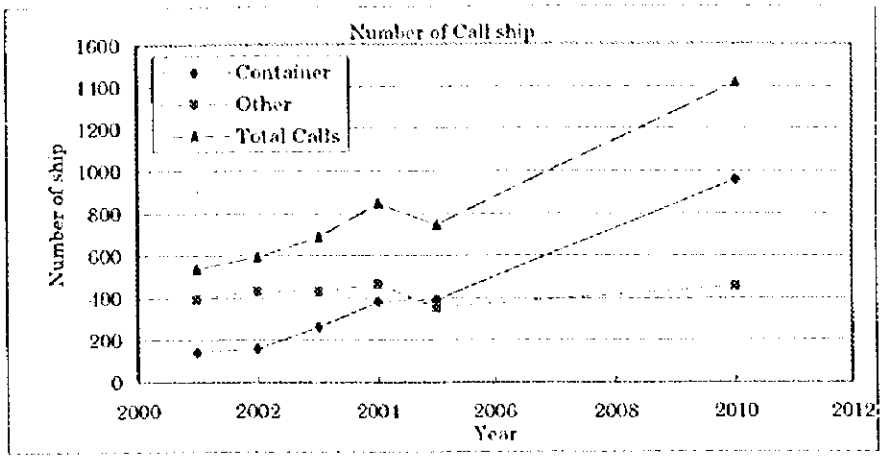
Note: N/A= not available
Source: Hong Gai Ferry Company, 1998

The charges of the ferry are as follows:

Charge of Ferry by Commodity

Commodity	Charge (VND/Time)
People	500
Bicycle	600
Motor-cycle	1,000
Car	7,000
Car (mini bus)	10,000
Bus	20,000
Truck (< 3.5 ton)	15,000
Truck (> 3.5 ton)	18,000
Truck (> 10 ton)	55,000

Source: Hong Gai Ferry Company, 1998



Source: Review works report of Cai Lan Port Expansion Project, 1998

Figure 4.1.1 Number of Vessel Calls of Cai Lan Port

4.1.2 Other Transportation

(1) Road

The total length of urban roads in Ha Long city is 480 km of which 153 km are asphalt roads and the remaining 327 km are macadam roads. National highway No. 18 going through the study area is one of the most important infrastructures for the region. It connects the Ha Long bay area westwards with Hanoi and eastwards with a Vietnamese-Chinese border town, Mong Cai. The section of No. 18 belonging to the study area is about 60 km, the road width is 7-12 m and the vehicle density is 1,600-2,000 vehicles/day. In addition, Road No. 18B goes through for 50 km in the study area from Hoanh Bo district and Mong Duong in Cam Pha town. The width is 5-7 m. The vehicle density is at present low, as most of the section hasn't been asphalted and is not in good condition.

Although the existing highway No. 18 is almost the only arterial coastal road in northern Vietnam, its conditions are still poor. Its width is narrow, its roadbed is rough, and potholed from place to place. The maximum safe speed by car or bus is around 40 to 50 km/h for most sections of the road. Consequently the trip from Ha Long to Hanoi generally needs several hours. Even at this low speed, the risk of traffic accidents is still high, as various types of vehicles such as high-speed passenger cars, buses, low speed trucks, motorcycles, bicycles, and even pedestrians are at present disorderly sharing the same lanes in the road.

The rehabilitation and improvement of highway No. 18 is rather urgent and crucial to the socioeconomic development of not only the Ha Long bay area, but also the north growth triangle area as a whole. The following plan is going on or is expected to be implemented in the near future.

Improvement Plan of Highway No. 18

Section	Number of Lanes and Date
Noi Bai - Bac Ninh (new road)	4 lanes by 2001
Bac Ninh - Chi Linh (rehabilitation)	2 lanes by 2000
Chi Linh - Ha Long (upgrading)	2 lanes by 2000
Ha Long - Mong Cai (rehabilitation)	1 or 2 lanes by 2000
Ha long - Mong Cai (up grading)	2 lanes by 2010

Source: Sustainable Development Planning for Road No. 18 Corridor, UNDP, 1997

In addition, a ferry at Cua Luc makes trips slower than necessary and may become a stumbling block for future economic development. A pre-feasibility study was carried out for the bridge on the National Highway No.18 over the Cua Luc strait by the Ministry of Transport, and it proposed to construct the bridge with the following general specification. A construction plan of a new bridge over the Cua Luc strait was approved by the Prime Minister recently in 1998.

a) Route length: 6 km from Hong Gai to Bai Chay
b) Length of bridge: 820 m
c) Number of lanes: 4 lanes
d) Clearance for ship from the sea: 55 m
e) Estimated construction cost: US$80 million

(2) Railway

The railway from Hanoi at present ends in Bai Chay, 4 km west of the Cai Lan port. The used capacity of the railway lines is at present very limited, however, because of different track sizes and low speed of trains. The section from Hanoi to Kep is double tracked with gauges of 1 m and 1.435 m. The section from Kep to Bai Chay (100 km) is 1.435 m gauge. Besides, the section between Hanoi and Hai Phong is 1 m gauge. As the 1 m gauge is dominant in Vietnam, the track with 1.435 m gauge from Kep to Bai Chay will be changed to the 1 m gauge track and be integrated to the interregional railway network. The extension of the line from Bai Chay to Cai Lan port (5 km) is also planned.

In addition, there are several coal transport railway lines from the Hong Gai coal port to Ha Lam (6 km) and Tan Lap (15 km), and from the Cua Ong coal port to Mong Duong (7 km), Tay Khe Sim (16 km), Coc 6 (5 km), and Deo Nai (10 km).

4.2 Water Supply

4.2.1 Water Resources

The water resources in the Study Area comprise both ground water and surface water. Ground water can be found in three aquifers in the coastal area: the Permian limestone; the Lower Triassic coal bearing layers; and the Middle Triassic coal bearing layers. From an exploitation view the ground water can be subdivided into shallow ground water, ground water supplied lakes and deep ground water. There are also many small streams in the coastal strip but these are generally ephemeral and are frequently polluted by domestic and industrial activities. Thus, the only surface water sources that can be utilized for public water supply are main rivers such as the Dien Vong and the Dong Ho which have sizable catchment areas largely outside of the coal mining areas.

The shallow groundwater resources can be exploited by shallow dug wells and these are found all over the study area. However these wells are very susceptible to surface pollution and season variations in water level. Many wells have a nitrate concentration above acceptable levels and high levels of biological contamination are also common. The wells are also liable to dry out in the dry season. For these reasons, shallow wells are not generally suitable for supplying water to the public distribution system.

Shallow groundwater can also be found in former coal mines that have been filled with inflowing ground water. One such source is Ha Tu lake, which supplies about 4000 m^3/day directly to distribution for Hong Gai.

A total of 21 deep wells for public water supply have been drilled in the coastal zone of the study area but only 7 are currently in use, the others having been affected by saline intrusion and mining activities. Water quality in the wells still in operation is reportedly good but the yield is limited.

The main sources for public water supplies are thus the Dien Vong river for Hon Gai and Cam Pha and the Dong Ho river for Bai Chay.

4.2.2 Present Treatment and Distribution Facilities

The main water supply facilities, which are operated by the Quang Ninh Water Supply Company, comprise the Dien Vong intake and treatment plant from which water is distributed to both Hong Gai and Cam Pha, and the Dong Ho intake and treatment plant from which water is distributed to the Bai Chay area.

The theoretical supply capacity of the original Dien Vong Dam and treatment plant is 60,000 m^3/day but this capacity has never been realized in practice. The maximum production capacity of the present system is estimated to be about 15,000 m^3/day (Halong Water Supply and Sanitation Project, Technical Aspects - Water, CBI, June 1995). The amounts of water actually reaching consumers are further reduced due to the condition of the supply pipes and the poor reliability and condition of pumps, treatment and electrical equipment. As a result of the unreliable supply situation the percentage of the population using the public water supply is low and the total sales at present to Hong Gai and Cam Pha are only 6,285 and 2,836 m^3/day respectively. It is apparent that the constraints to growth of water supplies are poor reliability and quality problems rather than shortage of water resources.

Virtually all the public water supply to Bai Chay is from the Dong Ho intake and treatment plant. This has a theoretical supply capacity of 20,000 m^3/day which can be almost realized if necessary. The treatment plant originally comprised only filtration and chlorination but settlement tanks have also recently been provided by PPC for the raw water to overcome sediment problems caused by coal mining activities. The quality of water is now reported to be good. The reliability of supplies is much better than in Hong Gai and Cam Pha but total sales are still only 2,835 m^3/day at present.

The extent of coverage of the water supply system is relatively high with all 13 districts in Hon Gai having water supply pipes (although very few houses are connected in the two districts). In Cam Pha the water distribution system covers

12 out of 16 districts, and 3 of the 5 districts in Bai Chay are presently covered. There are also plans to serve the future tourism areas on Tuan Chau Island and in Hung Thang. However, the numbers of house connections and hence the numbers of consumers are relatively low as shown below.

Town	Number of house connections	Number of consumers	Approximate total population	Percentage with piped water
Hon Gai	11,495	41,553	122,000	34%
Bai Chay	3,750	11,495	36,000	32%
Cam Pha	2,846	10,095	125,000	8%
Total/overall average	18,091	63,143	283,000	22%

Source: Interview with Quang Ninh Water Supply Company, June 1998.

The balance of water used by households comes from shallow wells, rainwater and, to a limited extent, water vendors. A household survey by Carl Bro International in 1995 indicated that the proportion of the sources of supply was as shown below.

Source	Ha Long city %	Cam Pha town %	Overall average %
Shallow well	40	65	52
Rain water	18	21	19
Piped water	36	9	23
Water vendor	4	3	4
Other	3	2	2
Total	101	100	100

Source: HWSSP, Technical Working Paper 4, Water Supply, CBI, 1995

4.2.3 Development of the Water Supply System

A World Bank funded rehabilitation contract for water supply and distribution to Bai Chay, Hong Gai, and Cam Pha was awarded in Spring 1999. The construction period is expected to be three years. The rehabilitation works will not, at this stage, increase the theoretical supply capacities but will make the supplies more reliable and, in the case Hong Gai and Cam Pha, also improve water quality by changing the supply point to the newly constructed Cao Van dam on the Dien Vong river. This will provide a reliable yield of 60,000 m^3/day for the first phase and there are plans to double the supply from this source in the future to 120,000 m^3/day.

The target for the water rehabilitation project is to increase the percentage of population served to 40% by the year 2002 and, in the long term, to 80%. Achievement of the 2002 target will require some 20,000 additional connections and the long term goal would require some 40,000 further connections. The use of shallow wells is common, particularly in Cam Pha, and, even if confidence in the

reliability and quality of the public water supply improves, there may well be considerable reluctance in lower income areas to pay the connection and volumetric charges for piped water. There is therefore some doubt whether the long-term target, in particular, will be met.

4.2.4 Water Consumption

According to the Quang Ninh Water Supply Company, the average per capita consumptions for piped supplies are: 87 ℓ/day in Hon Gai; 100 ℓ/day in Cam Pha; and 110 ℓ/day in Bai Chay. The average consumption of water from other sources is much lower and is probably in the region of 20 ℓ/c/day. The higher consumption in Bai Chay is not unexpected as the majority of existing connections are in the relatively affluent tourist area. The low percentage connection rate in Cam Pha probably distorts the consumption figure, as only the wealthier high water consumers are liable to have connections. Another factor in Cam Pha is the low pressure and intermittent supply which causes some people to leave their taps open during the day to ensure that storage tanks fill when water is available. As the connection percentage rises and reliability of supply improves, the overall per capita consumption in Bai Chay and particularly Cam Pha will probably converge with that in Hon Gai.

In the long term, water consumption will increase as living standards rise and the use of flush toilets becomes more prevalent. The Ha Long City Water Supply Project has based demand forecasts on overall per capita consumptions of 110 ℓ/day in 2003 and 150 ℓ/day in 2015. The parallel Feasibility Study for the Sanitation Project assumes that the wastewater flows generated will be 80% of water consumption.

4.3 Sanitation Conditions

4.3.1 Sewage

(1) On-site Sanitation

Some 85% of households have their own latrine or toilet, the most common being pit latrines, double vault composting latrines, and pour flush toilets. The

distribution of these types of latrine varies over the study area and is also changing fairly rapidly as a result of a general move to the use of pour flush toilets with septic tanks. A number of surveys and informal inquiries have been carried out in the last few years by various organizations using different questionnaires in different areas at different times. The following surveys are of particular relevance:

i) Survey by Carl Bro International (CBI) covering Ha Long city and Cam Pha, June 1995, Technical Working Paper 1, Socioeconomic Assessment, Appendix 14

ii) Survey by Kampsax International, August 1997, covering selected areas in Bai Chay and Hong Gai plus one area in Cam Pha

iii) Survey by Quang Ninh DOSTE, late 1997, Hong Gai quarter Environmental Handling and Study Project

The CBI survey indicated that, in 1995, pit and double vault latrines predominated in both Ha Long city and Cam Pha but in Ha Long just over 26% of households used flush latrines (85% of which were connected to septic tanks) whereas in Cam Pha only 11% used flush toilets.

The Kampsax survey involved relatively small sample surveys of the Hong Gai central area, large hotels and mini hotels in Bai Chay, restaurants in Bai Chay and central but relatively low income areas in Hong Gai, Bai Chay, and Cam Pha. In Hong Gai central area, 82% of properties had flush toilets, 91% of which were connected to septic tanks, but only 22% of the septic tanks discharged to drainage channels. In the tourist areas of Bai Chay the use of flush toilets was almost universal and nearly all discharged to septic tanks of which 87% were connected to drainage channels. The situation in the lower income areas was somewhat different with only 47% of properties having flush toilets.

The DOSTE survey had a large sample and clearly indicated the significant differences between the various sections within the quarter. There was a high rate of septic tank installations along the main thoroughfares whereas, in the high density housing areas and steeper slopes behind the coastal road there was a much wider variety of latrine types with dry latrines still predominating. The DOSTE

survey also indicates 57% of households discharge washwater to the drainage system but only 47% had septic tanks.

The conclusions that may be drawn from these surveys are as follows:

i) There is a rapid conversion of properties in commercial centers and particularly along main roads to flush toilets with septic tanks, dry latrines are still prevalent in areas remote from main roads,

ii) Almost all new developments near main routes are constructed with septic tanks and the tanks are connected to the sanitary drainage channels in adjacent streets, older septic tanks and those remote from main roads generally have soakaways, and

iii) There are about 3,000 people living on the sea, and their wastewater is released into the sea directly.

Overall, it is estimated that at present approximately 30% of houses in the study area discharge human wastes to the drainage channels, generally via septic tanks. Whilst the percentage discharging washwater to the drainage channels is higher, the channels are generally unlined away from central areas and most of the washwater discharged to such channels will percolate into the ground. It is therefore, considered that the houses discharging human wastes to the drainage system generate most of the wastewater pollution load that is carried to the bay. The remaining households are thought to contribute relatively little to the wastewater pollution load.

Percolation into the ground of septic tank effluent as well as wastewater from unlined channels occurs to a significant extent and there is also some seepage from the various types of 'dry' latrines in the study area. The capacities of soils in terms of biological and bacteriological treatment can be high and, except where the ground is highly permeable or fractured or where the ground water table is very close to the ground surface, it is unlikely that significant biological or bacterial loads will reach the bay through groundwater flow. The situation with nutrients and other soluble pollutants will not be so favorable and groundwater flow could well be a source of such pollution loads into the bay. Whilst percolation into the ground reduces pollution loads to the bay there is, on the other hand, clearly a serious risk of contamination of shallow aquifers and, in particular,

pollution of nearby shallow wells where geological and hydrogeological conditions are unfavorable.

There is also a small but significant proportion of the community who discharge their untreated sewage directly to the sea. This includes residents of housing built on rock outcrops at the sea shore, residents on some islands, and residents on boats. The exact numbers concerned are difficult to determine but they are considered to account for less than 5% of the population throughout the study area. Thus this does not constitute a large pollution load to the bay in overall terms but it is aesthetically objectionable and can also create a health hazard.

(2) Present Sewerage System

Hong Gai, Bai Chay, and Cam Pha are served by drainage channels, which for the most part are relatively short and carry runoff from a series of small catchments along the narrow coastal strip and discharge to the sea. Originally the channels were intended only for rain water but there has been a trend for households to connect wastewater outlets to the drainage channels with the result that, in densely inhabited areas, they now act as a combined system. Washwater from house kitchens, baths and sinks is most frequently disposed direct to the drainage channels in urban areas. However, in main road and new development areas, washwater is normally discharged to a septic tank prior to discharge to the drainage channel. In more remote or rural areas, washwater may be discharged to gardens, ponds, or directly to adjacent ground.

The channels are not usually lined except in the town centers where they are generally covered as well. They are frequently partially blocked by household refuse which is dumped in the drainage channels as this is often perceived as the most convenient means of disposal. When it rains the wastes is carried to the sea and is normally deposited on the beaches and fringes of islands. Flooding occurs at a number of locations due to insufficient channel capacity and also due to blockages caused by indiscriminate dumping of solid wastes or, especially in Cam Pha, wastes from the coal mines.

The coverage of the sanitary drainage system in the study area is low by any standards; the length of sewer per capita being 0.03 m in Hong Gai compared to 0.12-0.14 m for Hanoi, Ho Chi Minh, Hai Phong, and Da Nang. In contrast, well sewered international cities have sewer lengths of 1.0-2.5m per capita. The extent of the existing sanitary drainage channels in the Bai Chay, Hong Gai, Cam Pha and Cua Ong regions are shown in Figures 4.3.1 to 4.3.4, respectively.

(3) Present Situation Regarding Tourism Development and Wastewater Discharges

As described in previous chapters, Ha Long bay is a resort area that attracts significant numbers of foreign and Vietnamese visitors. The seasonal distribution of foreign and Vietnamese visitors differs with the highest numbers of foreign visitors in late autumn and spring but the majority of Vietnamese visiting during the summer months, particularly at weekends. Information provided by the Department of Tourism indicates that for the summer months (June, July, and August) the average number of tourists staying in hotels is approximately 28,000 per month. The average length of stay is about 1.5 days, with a large proportion of Vietnamese visitors during the summer staying for weekends. It is therefore estimated that there are approximately 2000 hotel visitors in Ha Long city on a typical weekend during the summer months.

The number of day visitors is rather more difficult to determine as there are no records of such. However, since day visitors are predominantly Vietnamese, the highest numbers will occur in the summer months and it is estimated that during the peak times there are approximately 2000 day visitors in the resort area. Thus it is estimated that, at the peak, there are approximately 4000 tourists of all types in Ha Long city.

The tourist resort is centered on a narrow strip of development along the south coast of Bai Chay and nearly all visitors stay in this area. The main areas of tourist accommodation are the large state and private hotels that are mostly located near the coast to the west of Vuon Dao. There are also a substantial number of mini hotels, mainly in Vuon Dao and also on higher land above the large hotels. Almost all hotels are served by septic tanks that discharge to drainage channels (via a

recently constructed sewer in the case of the Vuon Dao mini hotels). Behind the main tourist area there are five main catchments each drained by a natural channel. These are generally unlined except near the coast road and until recently these channels discharged combined sewage and storm water directly onto the bathing beaches. Construction of four new drainage outfalls, which carry the combined sewage and storm water to just beyond the edge of the swimming beach, was completed in May 1997. These four outfalls are connected to four of the main drainage channels behind the beach area. The fifth and largest channel which also serves the Vuon Dao mini hotel area discharges onto the shore in front of the post office though not in a swimming area.

The Royal Joint (Taiwan/Vietnam) Venture Company is presently completing a new tourist development on reclaimed land on the Bai Chay beach stretching 1.5 km west from the Youth Party hotel area. The development includes restaurants, amusement parks, changing rooms and toilet facilities. Eight septic tanks, with a total capacity of 800 population equivalent, have been built to serve the development. The septic tanks are designed to discharge to the sea either through outfall pipes laid across the beach or to lateral combined drainage channels which then discharge to one or more of the new main outfalls.

These discharges, although less visually objectionable than in the past, were still detrimental to tourism development and more importantly, constituted a health risk to swimmers. Therefore, in 1997 the QNPC commissioned the design and construction of a wastewater collection and treatment scheme for the central Vuon Dao tourist district to alleviate the problems associated with wastewater discharges near bathing beaches. A design was prepared by the Center for Urban and Industrial Area Environment Technique (CEETIA) and construction of the scheme was completed at the end of 1998. The scheme is designed to improve the environment of the beach area and to ensure safe bathing water quality by intercepting three major wastewater discharges in the area and providing full treatment including sterilization of the effluent. Three pumping stations, one beside each drainage channel, have been constructed in the promenade to pump the base wastewater flows to a treatment plant which has been constructed approximately 100 m from the beach. The plant uses a compact activated sludge

system and includes effluent chlorination facilities. The main wastewater discharges to the swimming area are projected by CEETIA to reach 2,500 m^3/day in the summer or 1,500 m^3/day out of season. However, the present discharges are much smaller than these figures.

An additional source of pollution associated with tourism is discharges from tourist boats in Ha Long bay. Nearly all tourists who visit Ha Long will go on a trip to the islands and the toilets on the 140 boats carrying these tourists discharge directly to the sea. However, in this case, it would appear that solid wastes is a greater problem than the wastewater discharges.

(4) Present Situation Regarding Industrial Wastewater

A company survey carried out by Kampsax International for the water supply project showed that, of 130 companies interviewed with a total of 41,150 employees, 51.9% of all employees worked in coal mining, coal processing, or industries related to coal mining, 20.3% were employed in production companies and only 1.3% were employed in food processing companies. The largest proportion of production companies are mechanical factories and the remainder are mainly brick works or ceramics factories. The companies representing the balance of 26.5% of employees are mainly offices, service companies, schools, military establishments, traders, health care facilities, transportation companies, hotels and restaurants.

A questionnaire survey of the main potentially polluting industries was carried out for the Study during 1998 by DOSTE. The responses indicate that the mining and coal processing industries are by far the largest sources of wastewater. The 40 mines who returned questionnaires estimated that they discharged approximately 20 million m^3/year, most of which is pumped from mines. With one exception, this wastewater is untreated apart from some sedimentation.

The mining industries also consume large quantities of water (4.5 million m^3/year) but nearly all this water is obtained from boreholes or spring sources rather than the public water supply. According to information received from QNWSC, the quantities of water they supply to various sectors is as shown below.

Water Supply to Various Sectors

(Unit: m^3)

Sector	Bai Chay		Hong Gai		Cam Pha	
	Quantity	% of total	Quantity	% of total	Quantity	% of total
Domestic	506,431	48.9	1,102,421	48.1	432,270	41.8
Industry	148,504	14.4	566,520	24.7	442,032	42.7
Hotels	190,284	18.4	13,788	0.6	14,750	1.4
Port Area	32,172	3.1	1,560	0.1	0	0.0
Commercial	41,688	4.0	186,705	8.1	35,964	3.5
Offices, hospitals, etc	115,696	11.2	423,031	18.4	110,124	10.6
Total Sales	1,034,775	100.0	2,294,025	100.0	1,035,140	100.0

Source: Interview with QNWSC, 1998

Although the proportion of water supplied to industry is reasonably high, particularly in Cam Pha, few of the existing industries are 'wet' and much of the water supplied is for domestic rather than process use. The main exceptions are breweries and food processing but, as indicated by the Kampsax survey, these industries are of relatively small scale. The questionnaire survey indicates that, despite national legislation that requires treatment onsite, industrial wastewater is, at present, frequently discharged without treatment. Where there is treatment, it normally comprises septic tanks for domestic rather than process wastes. However, analyses of industrial wastewater discharges carried out in 1998 for the Study by the Hai Phong Institute of Oceanology show that most discharges are weak (see Table 4.3.2) and that the present pollution load from industry, excluding coal mining areas and coal processing, is small (see Table 4.3.4).

In Bai Chay all major industry is, or is planned to be, concentrated in industrial complexes on the north side of Bai Chay. The area immediately to the north of Gieng Day is the center of the local brick industry, while a new industrial area is planned to develop around a new deep water port at Cai Lan. The only industries operating in this industrial complex are a flour mill, a vegetable oil refinery, a leather products factory, and a concrete products factory. These industries produce little wastewater but the vegetable oil refinery does have biological treatment for its wash down water. Further industries are expected to move to this area in the near future including a dairy produce plant and a garment factory. It is understood that Quang Ninh province propose that a developer for the industrial complex will provide the infrastructure including wastewater collection and treatment but the status of these plans is unknown. It is also assumed that each industry will be required to provide preliminary treatment for its own wastewater to comply with

legislation and to ensure that the effluent is suitable for further treatment with other effluents at a central treatment plant.

The two main industrial polluters in Hong Gai at present are the Quang Ninh Brewery on the north coast, which discharges effluent into Bai Chay bay and the Quang Ninh Fishery Export Factory in central Hong Gai, which discharges into Ha Long Bay. Neither factory has treatment facilities for process wastewater and both discharge effluents that are typically equivalent in strength to strong domestic wastewater. In addition, there are a multitude of smaller factories and commercial enterprises which discharge a variety of wastes including oils, the contents of metal plating baths, degreasing fluids and various other chemicals into drainage channels. Some of these wastes are toxic and hazardous and, while the scale of discharges may not be large enough to constitute a serious problem at present, it is important that these small industries be encouraged through an awareness campaign to dispose of difficult substances in a safe manner.

The present situation in Cam Pha is dominated by the coal industry although there are plans for other major industries including a steel mill, a cement factory and a thermal power station to be established in the future. The major immediate problem arises from the past tipping of overburden from mining operations on the hillsides above the town from where it is carried by storm runoff into streams and into the drainage system of the town. The discharges from coal mining activities also have a significant influence on groundwater quality as well as river quality. Apart from coal mining, the largest existing industries in Cam Pha are the mechanical engineering factories which, considering the size of the factories, discharge relatively small quantities of industrial wastewater. There are, in addition, a brewery and abattoirs which discharge small quantities of fairly strong wastes.

(5) Operation of Existing Sewerage Facilities

Sanitation services in the study area are provided by two state owned enterprises: the Ha Long City Environmental Sanitation Company (HLESC) and the Cam Pha Urban Environment Company (CPUEC). Currently both companies are under the control of the Municipal People's Committee with their directors reporting

directly to the Chairman of the respective People's Committee. However, the status of the companies is to change under the Law on State Enterprises, 1995, and proposals have been prepared for both companies to be 'Public State Owned Enterprises' which will have powers to collect revenue and will be part self funded. At the time of writing this report, these proposals were awaiting approval by QNPC and the status of the companies had not changed. This report therefore describes their operation as "administrative enterprises" under the previous legislation whereby their role is to provide a range of public services and not to operate as business orientated companies. All revenue that they generate is paid to the Municipal People's Committees and each company receives an annual budget from them for all operating costs. Householders are charged fees which have been set or approved by the Municipal People's Committee and are normally based on national guidelines and on what the Committee considers the community will be prepared to pay. This means that the fees charged are often much lower than the actual cost of the services provided. In addition, the companies provide a number of services for which the community is not required to pay directly.

The present overall responsibilities of the companies may be summarized as follows:

- collection and disposal of solid wastes,
- maintenance of the sanitary drainage system,
- washing roads,
- maintenance of public street lighting (including payment of electricity charges),
- maintenance of public toilets,
- road sweeping
- maintenance of parks and verges,
- provision of funeral services, and
- maintenance of cemeteries.

The companies are not responsible for design and construction of new facilities but may undertake relatively small works if budgets are made available.

With regard to sewerage facilities, HLESC is responsible for cleaning and maintenance of a total of 47 km of sanitary drainage channels in Hong Gai and

Bai Chay and CPUEC is responsible for cleaning and maintaining 32 km of sanitary drainage channels within the Cam Pha area. The major activity is manually digging sediment and dust (often resulting from coal activities) out of the channels and disposing of the debris to landfill. The companies also maintain a total of 25 public toilets in the towns and HLESC also empties septage from collective housing as well as offering septic tank operating services to householders.

The companies at present have limited experience in implementation, operation and maintenance of wastewater facilities. They have a range of operational and financial weaknesses and problems that have in part stemmed from the present subsidized system. The main problems may be summarized as follows:

- Lack of operational budget,
- Lack of tools and equipment,,
- No control over levels of collection or tariff policy,
- Insufficient capacity to provide services in all urban areas,
- Poor condition of equipment and infrastructure, e.g. drainage channels,
- Lack of ongoing investment,
- General lack of public hygiene education and low awareness of health hazards,
- Overlapping responsibility between the companies and the Quarter and Municipal People's Committees,
- Inadequate powers and resources to enforce environmental laws and regulations, and
- Customers are not satisfied with quality of services.

The present weaknesses of the companies and their lack of knowledge and resources to apply environmental regulations must be seen as a potential hindrance to the implementation of an Environmental Management Plan. However, many of these problems can, in theory, be overcome during the transition of the present subsidized companies (which are effectively service departments of the municipal authorities) to Public State Owned Enterprises which will take on a new business orientated role and will develop in future as autonomous companies. This, however, will require considerable restructuring and strengthening of the companies before they can fulfill their new roles and it is not anticipated that the

change to State Owned Enterprises will be a quick or easy one. Nevertheless it is essential that the problems are overcome and the companies strengthened if major improvements in sanitation are to be achieved.

(6) Consequences of the Present Sewerage System and Practices

The current wastewater sanitation practices are clearly unsatisfactory overall but they do have the advantage of limiting both the quantity and the strength of wastewater discharged to the drainage channels and thence to the sea. The total volume and pollution load resulting from domestic wastewater discharged at present is difficult to ascertain, as there are over 100 distinct outlets in the study area plus other diffuse discharges. Analyses of samples and flow measurements at selected points for both domestic and industrial discharges have been undertaken to establish criteria for the various types of catchment. The results of the analyses are summarized in Tables 4.3.1 and 4.3.2 for domestic and industrial wastewaters respectively. The pollution loads based on the analyses and measured wastewater flows are given in Tables 4.3.3 and 4.3.4 for domestic and industrial discharges respectively.

The results of the domestic wastewater Field Survey confirm that flows are small at present and typically as few as 30% of households discharge wastewater to the drainage system; the remainder either using septic tanks draining to soakaways or dry sanitation methods. The low strength of the domestic wastewater samples confirms that, of households discharging wastewater to the drainage system, the vast majority have septic tanks. A properly functioning septic tank should reduce the suspended solids content of the wastewater by up to 85% and the biochemical oxygen demand (BOD) by 35-40%.

The results of the industrial wastewater Field Survey confirm that the major pollution loads arise from the coal mining activities. The largest load measured from other industries is that from the Quang Ninh Brewery, although it is small compared with the loads from coal mines.

It is emphasized that the loads measured are representative of the wastewater discharges in the drainage channels and do not necessary represent the total load from a source that could contribute to the overall pollution load to Ha Long bay.

Domestic wastewater in particular may pond on the surface and either percolate into the ground, evaporate, or be carried overland by surface water run-off. Thus part of the total domestic wastewater pollution load is derived from non-specific sources.

Despite the survey results, it is worth noting that domestic wastewater flows to the drainage system are increasing now and will inevitably continue to increase due to the combined influence of increased numbers of water supply connections and the trend towards the use of flush toilets. This effect will be most marked in central urban areas and in the relatively affluent outlying districts and will necessitate extension of the sanitary drainage systems in these areas. On the other hand, there will be limited benefit in extending the sanitary drainage systems into the more remote areas in the foreseeable future unless there are particular reasons to do so (e.g. pollution of ground water sources).

There are a number of obvious disadvantages of the current sanitation practices. Firstly, the lack of treatment for the wastewater that does reach the drainage channels results in a pollution load to Ha Long bay. The most serious affects are the unsatisfactory bacterial quality of near shore waters and the visible pollution, particularly in tourist areas. The shortage of public toilets and lack of public hygiene education exacerbate the situation. There are also sizable biological and nutrient pollution loads discharged but the affects of these appear to be limited to near coast waters.

Another disadvantage of the present sanitation practices is that the poor design and construction of many latrines leads to unhygienic conditions and health risks. Due to small household plot sizes, double vault and pit latrines are frequently constructed with compartments or pits that are too small and consequently fill in a very short time. Therefore they have to be emptied before the contents have properly decomposed and, since the contents may be used as compost, this can result in serious health risks. Similarly, the disposal of night soil from bucket latrines to drainage channels and open land or together with solid wastes also constitutes a health risk. Further disadvantages of these systems include foul odors, fly and mosquito nuisance and the possibility of uncontrolled seepage of leachate into the surrounding soil with the risk of contamination of shallow wells. The use

of shallow wells is common, particularly in Cam Pha, and over 50% are situated within 10 m of latrines and nearly 20% are as close as 5 m (Source: Carl Bro International, Technical Working Paper 1, Socio-Economic Assessment, 1995).

4.3.2 Solid Wastes

(1) Present Conditions of Domestic Solid Wastes Collection and Disposal

According to pilot studies carried out by Kampsax International, the total wastes generation from households is approximately 650 gram per capita per day in Ha Long city and 570 gram per capita per day in Cam Pha. Thus Kampsax estimated that the 280,000 inhabitants within the built up areas of Ha Long city and Cam Pha generate about 65,000 tons of solid wastes annually which is equivalent to some 165,000 m^3/year. Not all of this wastes is disposed of, some materials such as bottles, metal cans and the like are separated and sold by householders or collected by scavengers. On the other hand, wastes is also generated from other sources including street sweeping, markets, hotels, industrial and commercial concerns, government offices, schools and hospitals. Consequently, the potential total amount of municipal wastes for collection and disposal is larger than the gross amount generated by households alone. The estimated total amounts of wastes that potentially could be collected and disposed of at present in the main regions of the study area are shown below.

Solid Wastes Collection Potential

	Source of Wastes	Hong Gai	Bai Chay	Cam Pha
1)	Total household wastes generated, m^3/year	70,275	20,665	66,014
2)	Household wastes recycled, m^3/year	10,541	3,100	9,902
3)	Household collection potential, m^3/year = 1) -2)	59,734	17,565	56,112
4)	Street sweepings, m^3/year	12,045	3,650	7,300
5)	Commercial, markets, institutional, etc., m^3/year	10,950	4,380	6,716
6)	Hospital wastes, m^3/year	1,168	37	38
7)	Total potential wastes collection, m^3/year = 3) + 4) + 5) + 6)	83,897	25,632	70,166

Source: Sanitation Feasibility Study, Final Report, Annexes, Kampsax International, 1998

The Ha Long City Environmental Sanitation Company (HLESC) and the Cam Pha Urban Environment Company (CPUEC) are responsible for collection and disposal of domestic solid wastes. As described in Section 4.3.1 (5), the

companies are short of resources and they do not have the capability to collect all wastes generated.

Within the Ha Long city area, HLESC provides solid wastes collection services in 11 out of a total of 18 quarters. The coverage is nearly 100% in 6 central quarters and it is planned to extend this level of service to 11 quarters. Wastes is collected door to door in certain areas; but, more generally the households transport the solid wastes to bins or carts at the 148 prescribed collection points throughout Ha Long city. In the quarters outside the inner urban area the local People's Committees have responsibility to collect and remove solid wastes to collection points from where the company removes and transports the wastes to a landfill site either in Hong Gai or Bai Chay for disposal.

In Cam Pha, CPUEC collect wastes in 6 quarters in the central and western parts of the town and one quarter in the eastern part whilst 9 quarters or communes are not covered by any wastes collection services. Of the households served, about half have door to door collection either by a small compactor truck in main roads or by hand cart in alleys. The remainder either carry their wastes to a collection point or put it in the street where sweepers subsequently collect it. Due to the limited coverage, households without wastes collection service either dispose of solid wastes to adjacent roads, drainage channels and natural streams, or burn it in yards or gardens.

The coverage of various types of collection in the main regions of the study area is summarized below.

Solid Wastes Collection Coverage

Collection System	Hong Gai (%)	Bai Chay (%)	Cam Pha (%)
Door to door collection	10	0	15
Collection point	42	42	15
Overall coverage	52	42	30

Source: HWSSP, Sanitation Feasibility Study, Main Report Annexes, 4 Solid Wastes Collection and Disposal, 1998

The locations of current and planned wastes disposal and landfill sites are shown in Figure 4.3.5. The wastes collected in Hong Gai is taken to a landfill at Deo Sen north of Hong Gai. This is an uncontrolled landfill that is located beside a cemetery and has been in operation since November 1994. Wastes is tipped at the

front of the landfill mass and bulldozed over the edge. The wastes is compacted to some extent but there is no cover to the landfill. The landfill does not have an impermeable liner and there is no treatment for the leachate that is emitted. Since permeability of the soils is relatively high, there is potential for contamination of the ground and groundwater in the area. However, the area has enough volume for a number of years of wastes disposal from Hong Gai and it would be feasible to upgrade the landfill to a satisfactory environmental condition.

Wastes from Bai Chay was until recently disposed to a small unauthorized dump near Cai Lan. Environmental and safety conditions at this site were unacceptable and dumping at this location has been banned. Wastes is now disposed at Ha Khau which is the site for a new landfill site proposed by Kampsax. The site, which is in Yen Tiem commune and about 13 km from the ferry, is at the head of a valley and has an area of some 6 ha. A liner system and leachate treatment will be required at this site but have not been implemented yet.

Wastes from Cam Pha is taken to a dump site located at Vung Duc, an island south of the city connected to the mainland by a causeway. Wastes is tipped in an area between the island and the causeway and bulldozed from the tipping front to the bay on the north side. The total area of the bay is about 2.5 ha, of which some 0.6 ha has been used for disposal. The area is subject to flooding at high tide and wastes can be flushed into the sea causing littering of the shoreline. In addition, leachate from the landfill discharges directly to the sea. These conditions are environmentally unacceptable but tipping is continuing at this site in the absence of a suitable alternative at present.

Wastes from the Cua Ong area is dumped at the C9 site, which is located by the National Highway 18A in the hills about 16 km northeast of Cam Pha. The site has been used as a temporary landfill for about two years and tipping has been carried out in many different places to a valley 10 to 20 m deep. The access road is hilly and twisting and the site is considered unsuitable as a long-term sanitary landfill.

(2) Present Conditions of Industrial and Other Wastes Collection and Disposal

It should be noted that this section does not consider the present situation with regard to the disposal of mining overburden and coal industry wastes. This is a major problem that is reviewed elsewhere in this Study.

The environmental companies collect wastes from markets, commercial institutions, industries, government institutions and hospitals as well as domestic wastes from households. In general the same workers who collect domestic wastes collect these wastes from collection points. The amount collected from industry is not quantified separately by the companies but is thought to be small and generally limited to ordinary canteen and office wastes rather than industrial wastes. Industrial companies are generally responsible for making their own arrangements to transport their process wastes to landfills. No surveys have been undertaken by the companies of the amount of industrial wastes transported to solid wastes landfills but it is generally considered that little industrial wastes apart from building rubble is found in landfills. It is reported that waste materials frequently accumulate in factories and industrial premises. On the other hand, it is common for food industry wastes to be recycled for animal feed.

The Questionnaire Survey carried by the JICA study team in April 1998 included questions on solid wastes quantities, characteristics and disposal methods. The 23 factories that responded to these questions estimated that they produced a total of approximately 42 tons of wastes per day. The present methods of disposal include collection by the Environmental Companies, tipping at the municipal landfill sites, tipping on vacant land or river banks, burial, burning, and sale or reuse for various purposes. It was not possible from the questionnaire answers to determine the quantities disposed of by each method.

Industrial surveys carried out by previous studies and the Questionnaire Survey indicate that relatively little hazardous or toxic wastes is produced by industry at present. A mechanical factory reported that it produced 1.5 tons per year of inorganic chemical wastes out of a total wastes production of 240 tons per year. It is probable that there are other factories and small workshops that also produce hazardous wastes such as contaminated oil and degreasing agents. At present most

of these wastes are probably discharged to the ground or to drainage channels. Whilst the scale is not large enough to create a serious problem at present, it is important that controls for hazardous wastes are put in place and that a satisfactory disposal method for hazardous wastes is established.

The Questionnaire Survey was also sent to hospitals and of the 10 that responded, 7 gave estimated quantities of medical wastes produced. These estimates total just over 76 ton per year. The methods of treatment and disposal quoted include incineration, sterilization, chemical treatment, burial, and collection and disposal to dump sites. It is not possible from the questionnaire answers to determine the quantities disposed and treated by each method. However, the environment companies have estimated that just over 40 tons of hospital wastes is collected annually in Ha Long City and Cam Pha. The HLESC reports that wastes from hospitals in Quang Ninh Province are taken to a central facility in the mountains for burning but is not clear whether burning refers to incineration or ordinary wastes burning. It appears from the questionnaire answers that, while some hospitals take care to segregate and in some cases treat hazardous medical wastes, other hospitals may be less organized and careful. It is important that this potentially hazardous wastes is collected separately and disposed of in a manner that is safe for workers and the public in general.

(3) Consequences of Present Solid Wastes Practices

The inadequate coverage of solid wastes collection services is generally perceived to be a major environmental problem and it is easy to forget that there are some positive aspects of the present practices. Wastes is collected seven days a week and the coverage for the three most central areas of Hong Gai is almost 100% even though the overall rate for the whole area is approximately 50%. Whilst the coverage in Bai Chay and particularly Cam Pha is lower, the main roads in the central areas of these towns are still relatively free from rubbish and litter. The existing disposal sites are not controlled and some of the sites have environmental and safety problems which make them unacceptable as sanitary landfills. Nevertheless, the basis of a system exists which, with adequate funding, strengthened management, improved operation and maintenance skills, and

enforcement of environmental laws and regulations, could be developed into a satisfactory solid wastes management operation.

Other positive aspects of present practices are the relatively low per capita generation of solid wastes and the sorting of garbage for use as animal feed or recycling of materials. Although wastes generation rates will almost inevitably increase as standards of living rise and collection services improve, it is important that the mentality of minimizing wastes production is retained. An important part of this process is the sorting of garbage to separate food stuffs, metal cans, glass bottles, etc., for sale or recycling. These practices should be encouraged, particularly as there is likely to be a higher proportion of recyclable items in domestic wastes as generation rates grow.

The disadvantages of present practices are, of course, more obvious and are widely recognized. The limited collection coverage means that many residents have to make their own arrangements for disposal of solid wastes. Unfortunately there is a lack of awareness of the environmental and public health risks associated with unsatisfactory solid wastes disposal. Many residents will therefore take the easiest option to dispose of their garbage and this leads to indiscriminate dumping in streams, channels, on the shoreline, at the roadside or, in the case of residents and passengers on boats, in the waters of Ha Long bay. Dumping in this manner creates many problems including:

- creation of breeding habitats for flies and rodents which leads to high public health risks,
- general environmental degradation and loss of amenity in the whole area,
- deterioration of water quality in Ha Long bay and potential contamination of seafood,
- restriction and blockage of streams and channels leading to ponding of putrid water and wastewater in dry weather and flooding during storms,
- increased maintenance requirements for the drainage system, and
- objectionable conditions and health risks on bathing beaches.

These problems are objectionable to local residents and visitors a like and have a detrimental effect on the economy of the area since tourists, particularly those from overseas, will be deterred from visiting Ha Long bay. As an indication, the

Ha Long Bay Management Board currently remove 0.5 m^3/day of garbage from the bay but estimate that, with sufficient resources, they could collect 3 m^3/day.

The problems associated with the existing wastes dump sites include:

- odor and wind blown litter problems in neighboring areas due to lack cover,
- spontaneous combustion in the dump sites,
- contamination of groundwater, streams and the sea by leachate due to lack of liners, leachate collection systems and treatment, and
- slope stability problems due to lack of control and compaction.

4.4 Electric Energy Supply

Electricity for Quang Ninh province is supplied from the national power grid through the Uong Bi thermal power plant (105 MW) and the six 110 KV substations of Gieng Day, Giap Khau, Cam Pha, Mong Duong, Tien Yen, and Mong Cai. There are other sources from small scale hydroelectric plants in the districts of Quang Ha, Tien Yen, Binh Lieu, Hoanh Bo, and Dong Trieu.

Electricity for Ha Long city is supplied by two 110 KV substations of Giap Khau with capacity of 2 × 25,000 KVA, 110/35/6 KV and Gieng Day with capacity of 1 × 16,000 KVA, 110/35/6 KV. The total capacity is 66,000 KVA. These two substations also supply the neighboring areas, namely Cam Pha town and Dong Dang in Hoanh Bo district.

The local distribution network in Ha Long city which is about 280 km long is currently operated under 3 voltage levels: 35, 6, 3 KV. The 35 KV grid line is used for transmission as well as distribution through 35/0.4 KV transmission substations. Electricity for households and public users is mainly supplied by the 6 KV grid lines through 6/0.4 KV substations. The 3 KV grid line mainly supply the coal mines. The losses in the local distribution including transformer and line losses are pointed out to be very high, about 22% on average.

In Cam Pha town power is supplied by the two 110 KV Cam Pha and Mong Duong substations through 35 KV distributing lines. In Hoanh Bo district power is supplied by the 35 KV lines : Bieu Nghi-Dong Dang-Hoanh Bo, Bieu Nghi-Yen

Cu, Dong Dang-Hong Gai, Dong Dang-Yen My lines and other supplementary lines.

4.5 International Assistance

The international assistance projects for infrastructure development in the study area which have been approved by the government and/or have been implemented are as follows:

a) Cai Lan port construction project,
b) National Highway No.18 improvement feasibility study,
c) Ha Long city water supply and sanitation project, and
d) Bai Chay bridge construction project.

The Cai Lan port construction project was approved by the Prime Minister in July 1996. The investment capital comes from a soft loan of OECF, US$86 million (10.3 billion yen) for the first phase. Three new berths will be constructed by 2002 and an additional three berths by 2005. The detailed information on the plan is described in Section 4.1.

The objective of the National Highway No. 18 project is to contribute to socioeconomic development through the support for road improvements on highway No. 18 from Chi Linh to Bai Chay (81 km). The total investment plan is about US$69 million from the Government of South Korea.

The Ha Long city water supply and sanitation project is assisted by the Danish government. The objective is to investigate and describe the possibilities for improving people's access to safe drinking water and sanitation and to work out preliminary design accordingly. The Feasibility Study for the sanitation component has just been completed. The detailed information on the project is described in Section 4.3.

The construction of Bai Chay bridge has been the government's great concern and its approval was recently announced by the Vietnamese government. The project will be implemented by the financial assistance of OECF. The bridge is expected to change not only the traffic flow between Bai Chay and Hong Gai more

smoothly and efficiently, but to contribute considerably to improvement of the regional transportation network.