Table 3-4-1 Transit Shed in Main Port

Transit shed	Storage capacity (m^2)	Location	Major cargo stowed	Utilization status
No. 1	3,920	Berth No. 2	Chemical & Dangerous cargo (fertilizer)	Not yet fully utilized
No. 2	3,920	Berth No. 3	Fertilizer only	Not yet fully utilized
No. 3	3,320	Berth No. 3/No.	General cargo Fertilizer	Not yet fully utilized
No. 4	3,894	Berth No. 4	General cargo Bagged cargo	Not yet fully utilized
No. 5	1,145	Berth No. 5	Ro/Ro cargo Personnel Effect	Not yet fully utilized
No. 6	5,120	Berth No. 6	General cargo Equipment	Not yet fully utilized
No. 7	1,840	Berth No. 8	Fertilizer, cement	Not yet fully utilized
No. 8	2,139	Berth No. 7	General cargo Equipment	Not yet fully utilized
No. 9	1,110	Berth No. 7	General cargo Equipment	Not yet fully utilized
No. 10	6,120	Berth No. 9	Cereals, car	* to be renovated for bonded shed
No. 11	3,024	Berth No. 10	Cereals	Not yet fully utilized
No. 12-A	3,692	Berth No. 2	General cargo	under renovation to CFS
No. 12-B	3,312	Berth No. 8	General cargo	Not yet fully utilized
No. 13	6,048	Berth No. 9	General cargo Fertilizer, Cement	* to be renovated for bonded shed

shore side railway line is predominantly used, leaving some space seaward for passage of trucks.

Another main line runs inside the yard area. In this case, the train, after sorting in the marshalling yard, kicks back to the west, traveling in two directions at the branching point at the Berth No.6. One line comes to the apron, connecting the above mentioned quayside line at Berth No.7. Another line runs up to Berth No.7 through the space sandwiched by the transit sheds No.7/No.12 and No.10/No.13. This latter line running along the transit sheds is not being fully utilized.

In addition to the above railway lines, non-used lines lie behind the Shed No.1, No.2, and No.3. The railway line running in front of shed No.1 to No.4 has been demolished. At present, about 40 - 60 wagons travel daily in and out on average, with a maximum of 100 wagons per day. In the planning of port rehabilitation, railway realignment should be carefully executed, giving due consideration to the continuing value of the railway in Vietnam.

There is no clearly termed port road, except for the asphalt paved port road running in front of the transit sheds. Trucks enter through the main gate (Gate No.4), run in front of the transit shed and cut into their destination berth.

In terms of efficient port operation, noteworthy point in Hai Phong Port is the two railway lines running over the apron of Berth No.1 to No.11. These railway lines are likely to hinder the container terminal operation expected for Berth No.1 to No.3 in future. For achieving more efficient traffic handling in the port, some making system would be necessary in and around the container marshalling and open storage yard.

3-5-2 Chua Ve Port

On the quaywall of Chua Ve Port, two(2) railway lines are installed, connecting to the Main Port area. One more railway line running in the marshalling yard connects to this main line to the Main Port. At present, these railways are not in use.

There are two port access roads to Chua Ve Port from the Main Port, one passes through along the shore side of the small port complex consisting of old Chua Ve Port, City Port, local fishing ports, the other runs through the main city road. Behind the Chua Ve Port lies a city road which will connect to the nation road "Route No.5". This port access is still under construction.

Most trucks enter the port through the edge of Berth No.1, passing through the apron and going out of the port at the backside of the marshalling yard. The entrance position at Berth No.1 forces a sharp hair-pin turn for all incoming traffic. In future, a safer and more efficient traffic handling system should be established.

Chapter 4 Preliminary Demand Forecast

Chapter 4 Preliminary Demand Forecast

4-1 General

4-1-1 Objective of Demand Forecast

The objective of the preliminary demand forecast is to roughly estimate cargo volumes of Hai Phong Port up to the year 2000. The estimated volume of the target year 1998 serves as the basis for the Rehabilitation Plans.

4-1-2 Target Year of the Rehabilitation Plan

The target year of the Rehabilitation Plan was determined as "the year 1998" after the following consideration;

1) The Urgent Implementation Plan will start in 1994,

2) The Rehabilitation Plan shall be a 5 year plan, by reason of total investment cost, construction schedule and necessary period for improvement of management and operation.

4-1-3 Preliminary Demand Forecast

(1) Forecast of Total Cargo Volume done by Vietnamese Side

The total cargo volume estimated by Vietnamese Side (refer to the Table below) has been taken into account in the Study after review of their forecast method, and consideration of the share relation to Cai Lan Port in the year 2000.

Year	1994	1996	2000
Total	4000	5000	7000
Export	1100	1550	2000
Import	1400	1600	2500
Domestic	1500	1850	2300

Unit:Thousand Tons

(2) Method of Forecast

The forecast has been carried out by using both a Macro Forecast and Commodity Basis Forecast. In terms of the container cargo volume, the forecast volume has been obtained from a containerized ratio upon comparison of the Saigon Port.

The expected cargo volume of 2 to 5 million tons from/to Ynnan province of China is separately considered as an additional volume. This is because the capacity of railway through the Vietname-China border is unlikely to improve before the target year, and there also exist such unknown factors as potential political conflicts between Vietnam and China.

Table 4-1-1 Inter-Provincial Cargo Flow of Hai Phong City (1990)

Unit:1000t

		Total		Food Grain		Cement		G. Cargo	
		in	out	in	out	in	out	in	out
	Total Cargo Flows	1,649	2,341	59	412	211	376	67	220
	Provinces								
	I North Mountains & Midlands	1,236	802	51	68	3	192	52	9
H	1 Ha Tuyen	2	24				23		1
I	2 Cao Bang								
N	3 Lang Son	12	3		1				2
T	4 Lai Chau								
E	5 Hoang Lien Son	21	56		4		19	2	1
R	6 Bac Thai	40	81		45			2	2
	7 Son La	2							
L	8 Quang Ninh	974	332	51	1		142	4	
A	9 Vinh Phu	179	271		12	3	4	41	
N	10 Ha Bac	6	35		5		4	3	3
D	II Red River Delta	177	1,147	5	321	20	73	8	189
	11 Ha Noi Capital	138	998		308	11	58	8	179
	12 Hai Phong City								
	13 Ha Son Binh	9	13	2	5		1		
	14 Hai Hung	12	59		8	4	4		2
	15 Thai Binh	3	22	3			10		3
	16 Ha Nam Ninh	15	55			5			5
	III Central Coast of Northland	202	259	2	23	188	0	3	9
	17 Thanh Hoa	195	231		23	187		2	7
	18 Nghe Tinh	4	25	1				1	1
	19 Quang Binh		1						
	20 Quang Tri	1	1			1			
	21 Thua Thien-Hue	2	1	1					1
	IV Central Coast of Southland	21	99	0	0	0	89	0	8
	22 Quang Nam-Da Nang	19	19				11		5
	23 Quang Ngai	1							
	24 Binh Dinh		41				40		
	25 Phu Yen	1							
	26 Khanh Hoa		39				38		3
	27 Thuan Hai								
	V Centarl Highland	0	0	0	0	0	0	0	0
	28 Gia Lai-Kon Tum								
	29 Dac Lac								
	30 Lam Dong								
	VI North-East of Southland	13	34	1	0	0	22	4	5
	31 Ho Chi Minh City	13	34	1			22	4	5
	32 Song Be								
	33 Tay Ninh								
	34 Dong Nai								
	35 Vung Tau-Con Dao								
	VII Mekong River Delta	0	0	0	0	0	0	0	0
	36 Long An								
	37 Dong Thap								
	38 An Giang								
	39 Tien Giang								
	40 Ben Tre								
	41 Cuu Long								
	42 Hau Giang								
	43 Kien Giang								
	44 Minh Hai								

Source: 'National Transportation Sector Review' Vol II UNDP

Table 4-1-2 Major Origin and Destination of Commodities Handling in Hai Phong Port

Commodities	Cargo Volume Thousand T		Origin and Destination of Major Commodities: Major Origin	Major Destination
EXPORT CARGO	382	16.0%		
CONTAINER	116	30.4%	FEEDER VESSELS VIA S'PORE, HONG KONG, TAIWAN	
LOGS, TIMBER	98	25.6%	THANH HOA, TUYEN QUANG	THAILAND, TAIWAN
METAL(SCRAP)	75	19.6%	NORTHERN PROVINCES	THAILAND, TAIWAN, JAPAN, INDONESIA
ORE(ZINC)	41	10.7%	LAO CAI	THAILAND
RICE	25	6.6%	THAI BING, HAI HUNG	CUBA, CIS, AFRICA
GENERAL CARGO	13	3.3%	RED RIVER DELTA	EASTERN EUROPE
FOODSTUFF	8	2.2%	RED RIVER DELTA	JAPAN, S'PORE
RATTAN WARES, JUTE TAPIS	3	0.9%	RED RIVER DELTA	EASTERN EUROPE
VEGITABLE	2	0.6%	RED RIVER DELTA	RUSSIA(CIS)
MACHINERY, EQUIPMENT	0	0.1%	HANOI	CUBA
APATITE			THAI NGUYEN	KOREA
IMPORT CARGO	849	35.7%		
FERTILIZER	374	44.1%	MALAYSIA, INDONESIA, RUSSIA,	RED RIVER DELTA
CONTAINER	117	13.8%	FEEDER VESSELS VIA S'PORE, HONG KONG, TAIWAN	
METAL	99	11.7%	RUSSIA(CIS), JAPAN, KOREA	NORTHERN PROVINCES, CHINA
ORE(COPPER)	59	6.9%	RUSSIA(CIS), ALBANIA	THAI NGUYEN
WHEAT FLOUR	33	3.9%	UN/FAO PROJECT	NORTHERN PROVINCES
ASPHALT	32	3.7%	S'PORE, KOREA, JAPAN	CITY AREA
MACHINERY, EQUIPMENT	23	2.8%	RUSSIA(CIS), TAIWAN, KOREA	NORTHERN PROVINCES
CHEMICALS	18	2.2%	JAPAN, CIS, KOREA	HANOI
FOODSTUFF	7	0.8%	RUSSIA(CIS)	HANOI
CEMENT	3	0.3%	JAPAN, CIS	NORTHERN PROVINCES
COTTON, YARN & TEXTILE	1	0.1%	RUSSIA(CIS), KOREA, JAPAN	NAM DINH, HANOI
COAL			AUSTRALIA, JAPAN	THAI NGUYEN
RICE				
OTHERS	82	9.7%		
DOMESTIC CARGO	1,148	48.3%		
CEMENT	493	43.0%	HOANG THACH, HAI PHONG	HCM
FOOD(Mainly Sugar)	285	24.9%	SOUTHERN PRONVINCES	NORTHERN PROVINCES
CONSTRUCTION MATERIALS	99	8.6%	NORTHERN PROVINCES	SOUTHERN PRONVINCES
FERTILIZER	64	5.6%	NORTHERN PROVINCES	SOUTHERN PRONVINCES
CLINKER	32	2.8%	HOANG THACH, HAI PHONG	HCM
ORE	31	2.7%	LAO CAI	HCM
METAL	26	2.3%		
GYPSUM	22	1.9%		CEMENT FACTORIES IN SOUTH
COAL	20	1.7%		
FOODSTUFF	5	0.4%	HAI PHONG, HANOI <--> HCM	
MACHINERY, EQUIPMENT	4	0.3%	HAI PHONG, HANOI <--> HCM	
APATITE	3	0.2%	LAO CAI	SOUTHERN PRONVINCES
OTHERS	64	5.6%		
TOTAL CARGO VOLUME (1992)	2,378	100.0%		

Source: Hai Phong Port

4-1-4 Port Hinterland

From a historical viewpoints, Hai Phong Port has been playing an important role in the development of northern Vietnam because of its function as the sole international port in the north. This resulted in a close relationship between the port and the northern provinces. Table 4-1-1 provides the evidence of this tight connection to the northern area in terms of Cargo Flow from/to Hai Phong City. The major origin and destination of the handling cargo at the port are listed in Table 4-1-2 which is also shows the current situation of the cargo flow.

On the basis of the above fact findings, the hinterland of Hai Phong Port used for the demand forecast is determined as follows;

(1) North Mountains and Midlands (13 Provinces),
(2) Red River Delta (7 Provinces), and
(3) Thanh Hoa Province , total 21 provinces. (cf. Fig.2-2-1)

4-1-5 Socio-economic Indicators

According to "Strategy for Socioeconomic Stabilization and development Up To The Year 2000", annual target growth rates and figures are as shown in Table 4-1-3.

Table 4-1-3 Target Growth Rates of Major Socio-economic Indicators

Target Growth Rate(%)	1991-1995	1996-2000	1991-2000
Average GDP Growth Rate			
Option-1	5-5.5	8.0	6.9
Option-2	6-6.5	8.5	7.5
Average Growth Rate of Agricultural Output			
Option-1	3.7-4.0	4.0-4.5	4.0
Option-2	4.0-4.5	4.0-4.5	4.2
Average Growth Rate of Industrial Output			
Option-1	8.0-9.0	10.0-11.0	9.5
Option-2	10 -11	14 -15	12.5

	1990	1996	2000
Target Population (in million persons)	67.6 *66.2 (実績)	73.2	80-81

SOURCE: STRATEGY FOR SOCIOECONOMIC STABILIZATION AND DEVELOPMENT UP TO THE YEAR 2000

* GENERAL STATISTICAL OFFICE

The socio-economic indicators up to the year 2000 can be calculated by using the growth rates on the table choosing high growth rate of Option-2, or taking a correlation of each elements. The results are given in Table 4-1-4.

Some assumptions have been made in the calculation:

(1) The growth of the industrial sector will be accelerated after the annual target growth rate of 11% is achieved; namely 15% from 1996 to 2000.

(2) The population has been estimated on the assumption that the growth rate will decline 0.15% annually.

(3) The Gross Production of Industry in the hinterland has been estimated by using a correlation to the Gross Production of Industry in all provinces.

Table 4-1-4 Socio-economic Indicators

(in constant prices of 1982)

Year	NATIONAL INDICATOR														HINTERLAND N. mountains and midlands Red river delta/ Thanh Hoa					
	Population (1000pers)		National Income (Bil Dong)		Gross Product of Industry (Bil Dong)		Gross Product of Agricult. (Bil Dong)		Sown Area (1000ha)	Production of Food (1000t)		Gross Produ Construct. (Bil Dong)		Popul. 1000pers	Gross Production of Industry (Bil Dong)		Sown Area (1000ha)	Production of Food (1000t)	
1980	53,722				66.9				7,049	14,406								4,978	
1981	54,927	2.2%			67.6	1.0%				15,000	4.1%								
1982	56,170	2.3%			73.5	8.7%				17,000	13.3%								
1983	57,373	2.1%	143.4		83.0	13.0%				17,000	0.0%								
1984	58,653	2.2%	155.3	8.3%	94.0	13.2%				17,900	5.3%								
1985	59,872	2.1%	164.1	5.7%	103.3	9.9%	91.7		6,834	18,200	1.7%						2,572	8,138	
1986	61,110	2.1%	169.6	3.4%	109.6	6.2%	96.0	4.7%	6,812	18,379	1.0%	24.8			39.0	4.7%	2,561	6,420	
1987	62,452	2.2%	173.9	2.5%	120.6	10.0%	96.4	0.4%	6,710	17,563	-4.4%	26.1	5.2%	24,581	43.0	10.1%			
1988	63,730	2.0%	183.9	5.8%	137.8	14.3%	100.5	4.3%	6,968	19,583	11.5%	25.9	-0.8%		47.0	9.5%			
1989	64,412	1.1%	188.3	2.4%	133.3	-3.3%	108.0	7.5%	7,090	21,516	9.9%	26.8	3.5%	26,634	42.4	-9.8%	2,718	7,791	
1990	66,033	2.5%	192.8	2.4%	137.5	3.1%	109.7	1.6%	7,111	21,489	-0.1%	28.1	5.0%	27,284	44.6	5.2%	2,649	7,271	
1991	67,606	2.4%	202.0	4.8%	151.8	10.4%	112.9	2.9%	7,448	21,990	2.3%	29.5	5.0%		48.2	7.9%	2,727	6,613	
1992	69,306	2.5%	217.3	7.6%	175.0	15.3%	122.3	8.3%				30.9	4.7%	28,583	53.0	10.0%		6,911	4.5%
1993	71,039	2.5%			194.2	11.0%	127.8	4.5%		25,410		32.4	5.0%	29,298	56.9	7.5%		7,222	4.5%
1994	72,708	2.4%			215.6	11.0%	133.6	4.5%		26,665	4.9%	34.1	5.0%	29,986	61.4	7.8%		7,547	4.5%
1995	74,308	2.2%			239.3	11.0%	139.6	4.5%		27,976	4.9%	35.8	5.0%	30,646	66.3	8.0%		7,887	4.5%
1996	75,831	2.1%			275.2	15.0%	145.8	4.5%		29,347	4.9%	37.6	5.0%	31,274	73.7	11.2%		8,241	4.5%
1997	77,272	1.9%			316.4	15.0%	152.4	4.5%		30,779	4.9%	39.4	5.0%	31,868	82.2	11.6%		8,612	4.5%
1998	78,624	1.8%			363.9	15.0%	159.3	4.5%		32,275	4.9%	41.4	5.0%	32,426	92.1	11.9%		9,000	4.5%
1999	79,882	1.6%			418.5	15.0%	166.4	4.5%		33,839	4.8%	43.5	5.0%	32,945	103.3	12.3%		9,405	4.5%
2000	81,040	1.5%			481.3	15.0%	173.9	4.5%		35,473	4.8%	45.7	5.0%	33,422	116.3	12.6%		9,828	4.5%
	①				②		③			④		⑤		①	⑥			③	

Source: General Statistical Office
Strategy for Socio-economic Stabilization and Development up to the year 2000

Notes: ① Estimates by using Annual Growth Rate 2.5% with 0.15% reduction per year
② Estimates by using Annual Growth Rate 11% & 15%
③ Estimates by using Annual Growth Rate 4.5%
④ Estimates by using correlation of Total Gross Production of Agriculture
⑤ Estimates by using Annual Growth Rate 5.0%
⑥ Estimates by using correlation of Total Gross Production of Industry

4-2 Preliminary Demand Forecast

4-2-1 Characteristics of Throughput at Hai Phong Port

In terms of the throughput of Hai Phong Port listed in Table 4-2-1(by commodities:1988 to 1992, total throughput:1982 to 1992), there are some notable characteristics as follows:

(1) In the past five years, the total throughput has constantly declined (average annual growth rate:-5.5%) following a peak volume in 1989. This phenomenon was caused by the decreasing amount of international import and export cargo volume.

(2) The share of domestic cargo volume in total throughput is relatively high (average 44%). Thus, it can be said that Hai Phong Port has the function of domestic core port as well.

(3) While the total throughput was going down, the container cargo volume sharply rose, after commencement of the container handling in 1990, in both sectors of export and import. As a result, the amount of containerizable commodities such as general cargo, foodstuffs, vegetables, chemicals, and machinery, etc. was reducing its share because of the possible shift to container transportation.

(4) Though several commodities showed a slumping tendency, cement and fertilizer steadily expanded their shares of the throughput. Cement is the major commodity of the domestic cargo, and fertilizer is also the major import commodity. It is likely that there will be a strong demand for fertilizer from the agricultural sector and a great need to transport the cement from the north to the south.

(5) Primary products and raw materials (rice, apatite, ore, or gypsum) show fluctuation in the throughput, but their shares are still not very high.

(6) The export of metal, which mainly consisted of scrap iron, dropped after exhaustion of the stock. Log and timber export also dropped because of a governmental ban.

4-2-2 Forecast of Total Cargo Handling Volume

As a macro forecast, the total throughput has been estimated on the basis of previously obtained socio-economic indicators.

Of the total cargo volume of 1992, industrial cargo had the largest share of 76%, while agricultural cargo, even though it includes fertilizer imports, had only a 24% share. In this context, it has been found that there exists a good correlation (coefficient of 0.95) between the Gross Production of Industry (hereinafter GPI) and the total throughput during the years from 1982 to 1989. There also is another indicator; an elastic value , which is a ratio of annual growth of GPI and the total throughput, of about 0.95 is constantly observed during the same period.

Based on the above, total cargo volume has been calculated

Table 4-2-1 Total Cargo Handling Volume in Hai Phong Port 1988-1991

Year	1988		1989		1990		1991		1992	
TOTAL CARGO VOUME	2,982,042	100%	2,724,608	100%	2,515,976	100%	2,433,373	100%	2,378,165	100%
EXPORT CARGO	233,771	7.8%	751,010	27.6%	524,373	20.8%	408,875	16.8%	381,531	16.0%
CONTAINER		0.0%		0.0%	12,640	2.4%	51,455	12.6%	115,910	30.4%
LOGS, TIMBER	2,355	1.0%	7,092	0.9%	58,765	11.2%	158,453	38.8%	97,668	25.6%
METAL (Mainly Scrap)	35,236	15.1%	497,182	66.2%	227,375	43.4%	119,116	29.1%	74,818	19.6%
ORE (Zinc)	2,924	1.3%	2,252	0.3%	2,919	0.6%	18,491	4.5%	40,765	10.7%
RICE		0.0%	32,837	4.4%	14,540	2.8%	1,997	0.5%	25,055	6.6%
GENERAL CARGO	95,114	40.7%	137,786	18.3%	153,457	29.3%	34,527	8.4%	12,622	3.3%
FOODSTUFF	30,722	13.1%	25,293	3.4%	17,270	3.3%	11,602	2.8%	8,410	2.2%
RATTAN WARES, JUTE TAPIS	19,806	8.5%	4,915	0.7%	2,285	0.4%	7,002	1.7%	3,462	0.9%
VEGITABLE	46,010	19.7%	42,790	5.7%	26,161	5.0%	5,522	1.4%	2,367	0.6%
MACHINERY, EQUIPMENT	1,604	0.7%	863	0.1%	1,615	0.3%	710	0.2%	454	0.1%
APATITE					7346	1.4%				
IMPORT CARGO	1,498,823	50.3%	1,068,271	39.2%	976,443	38.8%	621,218	25.5%	848,920	35.7%
FERTILIZER	308,944	20.6%	270,718	25.3%	281,497	28.8%	313,244	50.4%	374,264	44.1%
CONTAINER		0.0%		0.0%	40,377	4.1%	100,024	16.1%	117,390	13.8%
METAL	406,787	27.1%	283,064	26.5%	202,104	20.7%	28,238	4.5%	99,171	11.7%
ORE (Copper)	138,244	9.2%	75,201	7.0%	81,605	8.4%	39,441	6.3%	58,591	6.9%
WHEAT FLOUR	70,885	4.7%	21,247	2.0%	40,578	4.2%	23,888	3.8%	33,291	3.9%
ASPHALT	13,268	0.9%	28,427	2.7%	27,722	2.8%	11,544	1.9%	31,510	3.7%
MACHINERY, EQUIPMENT	145,363	9.7%	117,511	11.0%	81,123	8.3%	33,699	5.4%	23,457	2.8%
CHEMICALS	28,716	1.9%	15,828	1.5%	13,622	1.4%	11,018	1.8%	18,352	2.2%
FOODSTUFF	10,681	0.7%	13,924	1.3%	4,660	0.5%	6,562	1.1%	6,946	0.8%
CEMENT	11,256	0.8%	951	0.1%	1,120	0.1%		0.0%	2,737	0.3%
COTTON, YARN & TEXTILE	36,921	2.5%	16,292	1.5%	29,609	3.0%	12,642	2.0%	845	0.1%
COAL	20,347	1.4%	204	0.0%		0.0%		0.0%		
RICE	166,791	11.1%	56,541	5.3%		0.0%		0.0%		
OTHERS	140,620	9.4%	168,363	15.8%	172,426	17.7%	40,918	6.6%	82,366	9.7%
DOMESTIC CARGO	1,249,448	41.9%	905,327	33.2%	1,015,160	40.3%	1,403,280	57.7%	1,147,714	48.3%
CEMENT	164,282	13.1%	92,693	10.2%	185,130	18.2%	328,265	23.4%	493,245	43.0%
FOOD (Mainly Sugar)	374,038	29.9%	202,985	22.4%	147,517	14.5%	457,480	32.6%	285,378	24.9%
CONSTRUCTION MATERIALS	95,053	7.6%	134,522	14.9%	217,628	21.4%	224,788	16.0%	99,185	8.6%
FERTILIZER	139,853	11.2%	31,335	3.5%	65,161	6.4%	60,994	4.3%	64,021	5.6%
CLINKER	203,959	16.3%	268,609	29.7%	257,879	25.4%	169,490	12.1%	31,849	2.8%
ORE		0.0%	598	0.1%	486	0.0%	3,950	0.3%	30,640	2.7%
METAL	70,638	5.7%	58,044	6.4%	32,482	3.2%	15,774	1.1%	26,046	2.3%
GYPSUM	26,365	2.1%	11,319	1.3%	24,355	2.4%	12,521	0.9%	22,342	1.9%
COAL	68,055	5.4%	31,675	3.5%	19,634	1.9%	12,771	0.9%	19,856	1.7%
FOODSTUFF	24,227	1.9%	5,871	0.6%	7,940	0.8%	34,994	2.5%	4,905	0.4%
MACHINERY, EQUIPMENT	20,489	1.6%	7,468	0.8%	3,950	0.4%	3,497	0.2%	3,681	0.3%
APATITE	15,972	1.3%	12,872	1.4%		0.0%	4,034	0.3%	2,624	0.2%
OTHERS	46,517	3.7%	47,336	5.2%	52,998	5.2%	74,722	5.3%	63,942	5.6%

Total Cargo Volume 1982-1992 Unit:1000t

1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992
2,183	2,255	2,449	2,511	2,605	2,575	2,982	2,725	2,516	2,433	2,378
	3.3%	8.6%	2.5%	3.8%	-1.1%	15.8%	-8.6%	-7.7%	-3.3%	-2.3%

Source: Hai Phong Port

by using the above elastic value and planned growth of GPI to the year 2000 in Table 4-1-4. The results are summarized in Table 4-2-2 yielding a good agreement between the actual volume and estimate-2(1983-1989). Another forecast (estimate-1) by chronological method also is carried out for comparison, but this method can neither properly give the past records nor future figures.

With reference to the forecast during 1990 to 1992 in Table 4-2-2, it should be noted that in spite of the increase of GPI and the estimated figures of the cargo volume, the actual cargo volume had constantly been decreasing after 1989. If the forecast indicates a potential volume of Hai Phong Port, the difference of the actual and the estimate should be the lost volume caused by some disadvantage existing in the port.

Table 4-2-2

Demand Forecast of Total Throughput

(in constant prices of 1982)

Year	Total Throughput (t)						Gross Production of Industry (Mil Dong)	
	Estimate				Actual			
	①		②					
1979								
1980	2,018						66,925	
1981	2,112	4.7%					67,594	1.0%
1982	2,206	4.5%			2,183		73,463	8.7%
1983	2,300	4.3%	2,344		2,255	3.3%	83,034	13.0%
1984	2,394	4.1%	2,520	7.5%	2,449	8.6%	93,953	13.2%
1985	2,488	3.9%	2,631	4.4%	2,511	2.5%	103,258	9.9%
1986	2,582	3.8%	2,653	0.9%	2,605	3.8%	109,632	6.2%
1987	2,677	3.6%	2,772	4.5%	2,575	-1.1%	120,551	10.0%
1988	2,771	3.5%	3,010	8.6%	2,982	15.8%	137,819	14.3%
1989	2,865	3.4%	2,766	-8.1%	2,725	-8.6%	133,311	-3.3%
1990	2,959	3.3%	2,711	-2.0%	2,516	-7.7%	137,506	3.1%
1991	3,053	3.2%	2,842	4.9%	2,433	-3.3%	151,776	10.4%
1992	3,147	3.1%	3,113	9.5%	2,378	-2.3%	174,960	15.3%
1993	3,241	3.0%	3,282	5.5%			194,206	11.0%
1994	3,335	2.9%	3,461	5.5%			215,568	11.0%
1995	3,429	2.8%	3,650	5.5%			239,281	11.0%
1996	3,523	2.7%	3,988	9.2%			275,173	15.0%
1997	3,617	2.7%	4,356	9.2%			316,449	15.0%
1998	3,711	2.6%	4,759	9.2%			363,916	15.0%
1999	3,805	2.5%	5,200	9.2%			418,503	15.0%
2000	3,899	2.5%	5,681	9.2%			481,279	15.0%

Source: General Statistical Office
Strategy for Socio-economic Stabilization and Development up to the year 2000

Notes: ① Chronological Estimate
② Estimate by using the ratio of growth rates of total cargo and Gross Industrial Production

4-2-3 Forecast of Cargo Handling Volume by Major Commodities

(1) Assumption and Method of Forecast

On the basis of the formerly mentioned character of Hai Phong Port, the preliminary demand forecast on commodity basis has been made by means of the following methods and assumptions:

a) General

Because it is only a preliminary forecast, instead of adoption an elaborate method using a balance of demand and production in all commodities, a more convenient method using a correlation or growth rates has been applied to this forecast, (except for cement which is major commodity and it has big influence on the total throughput).

Such minor and containerizable commodities as foodstuffs, vegetable, and machinery have been incorporated into the general cargoes.

In addition, it should be noted that some assumptions are not based on statistics, since the statistics in Viet Nam especially during 1980's are not appropriately established. Therefore, for convenience sake, simple growth rates is applied to the forecast of some commodities upon consideration of the national development plans or review on the tendency of the past growth rates.

b)Cement and Clinker (Domestic cargoes)

The throughput of cement has been obtained from a balance of production and consumption. It is assumed, for the produced amount, that new domestic cement factories, even though they are in the planning stage, will be realized and will produce planned output on schedule (approximately 4 million tons added to the existing production). For the consumption amount, it can be estimated by using per capita consumption rate. In balancing the production and the consumption, surplus amounts in the hinterland are assumed to be transported to the south through Hai Phong Port; this amount should be the throughput of cement.

The throughput of clinker has some relation to the cement throughput. Thus, until a new factory begins operation and produces a higher grade of clinker, a certain amount of clinker shall be required.

c)Fertilizer (Import Cargo)

The throughput of fertilizer has been obtained from a correlation to the GPI in the hinterland.
As a general assumption of a developing country, a new fertilizer factory may be built to substitute import amount. In this case, we may assume a 5% decrease in imports after 1998.

d)Construction Materials (Import and Domestic Cargoes)

The throughput of construction materials have been estimated by using a correlation to the construction investment which is expected to steadily increase this century by 10 % annually.

The demand for asphalt is assumed to increase at the same growth rate as that of construction materials.

e)General Cargo (International and Domestic Cargoes)

General cargo consists of Food, Vegetable, Chemicals, Cotton & Textiles, and Machinery & Equipment. The throughput of the general cargo has been estimated by using elastic values of GPI and throughput. For the import/export cargo, an acceleration in the growth rate (5% annually) has been taken into account because of the expected effect of EPZ(Export Processing Zone).

f)Logs and Timber (Export Cargo)

To compensate for the ban on raw timber, a wooden product industry is expected. A certain time lag (3 years) and a growth rate of 5% have been assumed.

g)Metals (International and Domestic Cargoes)

The throughput of imported metals has been calculated using an assumed annual growth rate of 15%, and the throughput of domestic metal has a correlation to the amount of imported metal.

Regarding the throughput of exported metal, an increasing amount of cast iron or steel products are considered on the basis of the fact that construction of a new steel factory of VINAPIPE (planned production 30,000t) has started in Hai Phong.

h)Apatite and Ore (International and Domestic Cargoes)

The future amount of induced cargo by a contract between Hai Phong Port and a mine factory in Lao Cai has been included in the figures of Apatite and Ore.

(2) The results of the forecast by major commodities

Table 4-2-3 and Fig.4-2-1 show the results of the forecast. Forecast-1 and forecast-2 on Fig.4-2-1 give the forecast of the total throughput mentioned in 4-2-2 and the forecast by major commodities respectively. Forecast-1 and -2 yield almost the same figures in the target year of 1998, although there are some differences prior to the target year.

It can be understood that forecast-1 represents socio-economic demand ,in other words, potentiality, and forecast-2 represents a projection under the present situation. If so, the difference may shrink after constant expand of the total throughput after an implementation of necessary rehabilitation.

Table 4-2-3 Demand Forecast of Total Throughput by Commodities

UNIT:1000TON

Year		1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
ACTUAL TOTAL CARGO VOLUME		2,982	2,725	2,517	2,433	2,378								
FORECAST-1 MACRO				2,711	2,842	3,113	3,282	3,461	3,650	3,988	4,356	4,759	5,200	5,681
FORECAST-2 BY COMMODITY							2,812	3,088	3,312	3,611	4,305	4,687	5,154	5,772
EXPORT CARGO		234	751	524	409	382	585	630	680	751	872	1,050	1,296	1,653
GENERAL CARGO	1	193	212	213	111	143	308	342	380	437	502	578	664	764
LOGS, TIMBER	1	2	7	59	158	98	101	104	107	110	113	117	120	124
METAL	2	35	497	227	119	75	50	57	66	76	87	101	116	133
ORE	2	3	2	3	18	41	50	50	50	50	50	75	105	150
RICE	1	0	33	15	2	25	26	27	27	28	29	30	31	32
APATITE	2			7			50	50	50	50	90	150	260	450
IMPORT CARGO		1,499	1,068	976	621	849	1,057	1,144	1,237	1,361	1,410	1,485	1,585	1,712
GENERAL CARGO	1	433	353	382	229	283	475	516	562	633	713	804	906	1,021
FERTILIZER	1	309	271	281	313	374	367	390	412	434	369	314	267	227
METAL	2	407	283	202	28	99	114	131	151	173	199	229	264	303
ORE	2	138	75	82	39	59	60	60	60	60	60	60	60	60
ASPHALT	2	13	28	28	12	32	36	42	48	55	63	73	84	96
CEMENT	1	11	1	1	0	3	5	5	5	5	5	5	5	5
COAL	2	20					0	0	0	0	0	0	0	0
RICE	1	167	57				0	0	0	0	0	0	0	0
DOMESTIC CARGO		1,249	905	1,015	1,403	1,148	1,170	1,314	1,394	1,499	2,023	2,152	2,273	2,407
GENERAL CARGO	1	465	264	212	571	358	313	330	348	380	415	454	496	541
CEMENT	1	164	93	185	328	493	488	554	549	549	976	996	996	996
CONSTRUCTION MATERIALS	2	95	135	218	225	99	165	208	255	306	361	420	484	554
FERTILIZER	1	140	31	65	61	64	68	72	76	81	69	58	50	42
CLINKER	2	204	269	258	169	32	42	53	65	79	93	110	127	147
ORE	2		1		4	31	30	30	30	30	30	30	30	30
METAL	2	71	58	32	16	26	27	30	33	36	40	44	50	56
GYPSUM	2	26	11	24	13	22	25	25	25	25	25	25	25	25
COAL	2	68	32	20	13	20	10	10	10	10	10	10	10	10
APATITE	2	16	13		4	3	3	3	3	4	4	5	5	6
Break Bulk Cargo	1	1,885	1,321	1,414	1,773	1,841	2,150	2,339	2,465	2,657	3,192	3,355	3,535	3,752
Export	1	196	252	287	271	266	435	472	514	575	645	724	815	920
Import	1	920	681	665	542	660	847	911	978	1,072	1,087	1,123	1,178	1,253
Domestic	1	769	388	463	960	915	868	955	973	1,010	1,460	1,508	1,542	1,580
Bulk Cargo	2	1,097	1,404	1,101	660	537	662	749	846	954	1,114	1,332	1,620	2,019
Export	2	38	499	238	138	116	150	158	166	176	227	326	481	733
Import	2	579	387	311	79	189	210	233	259	289	323	362	408	460
Domestic	2	480	518	552	443	233	301	359	422	490	563	644	731	827

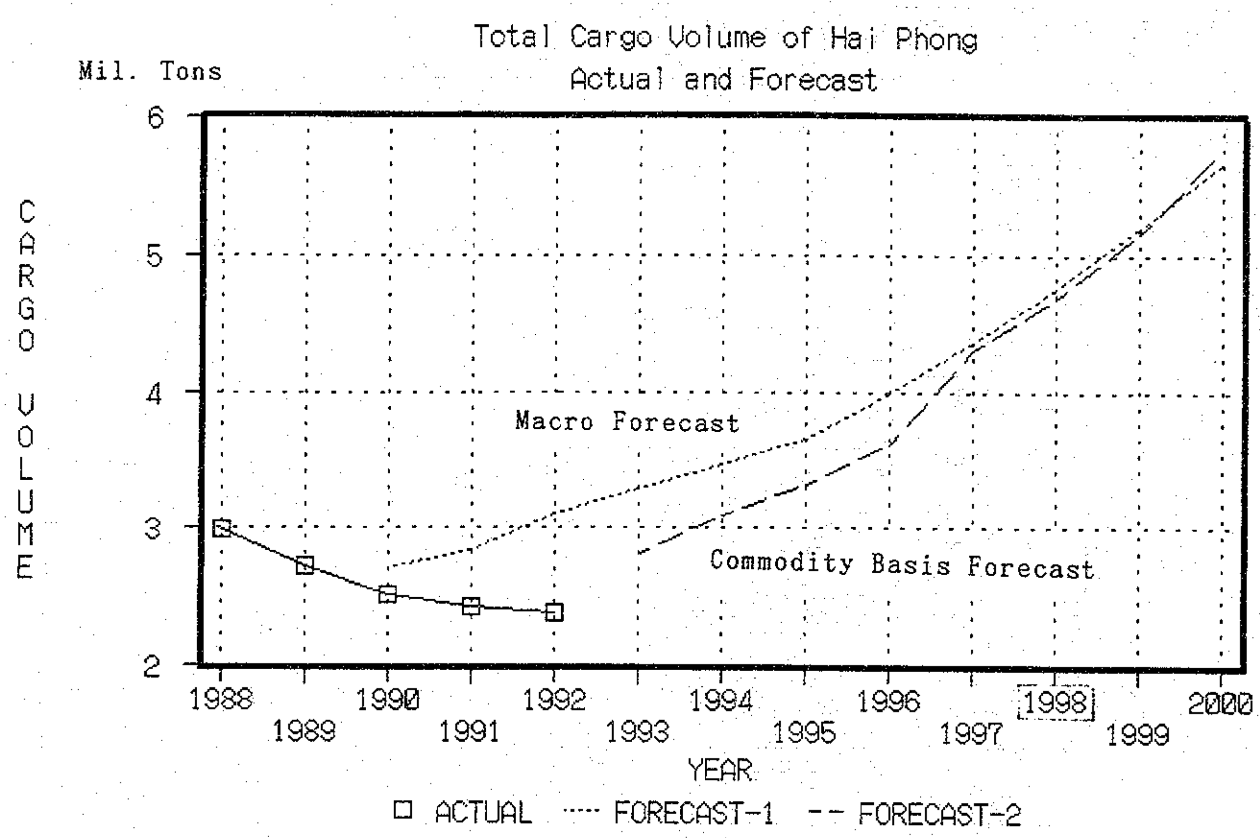


Fig.4-2-1 Forecast of Total Cargo (Macro and Commodity Basis)

4-2-4 Containerization

As formerly mentioned, container cargo has emerged as the major item in total throughput. The future aspect of containerization will be a key factor in development of Hai Phong Port. Therefore, a careful estimation on future container cargo volume is required. (For the past records and the present conditions of the container cargo, see 8-1.)

(1) Method of Forecast

The forecast of container cargo has been obtained from the multiplication of containerizable cargo volume and container ratio in each years. The containerizable cargo (break bulk cargo) has been estimated in the forecast by major commodities as shown in Table 4-2-3. The domestic break bulk cargo has been excluded, since the container may not be transshipped to other ports from Hai Phong until the year 2000. The container ratio has been determined by using theoretical logistic curve on the basis of the past throughput. The upper limit of the container ratio has also been determined as 80% with reference to the past records or planned values in other Asian Ports. The forecast of import and export container cargo have separately been carried out, and the total volume has been obtained from the each figures. The actual average weight per box in 1992 is used for the estimation of TEU. The empty ratio is assumed to be 50% under 1992/1993 figures.

(2) Forecast of Container Cargo Volume

The summary of the forecast is shown in Table 4-2-4, and Fig.4-2-2 gives the comparison of the estimated and the actual container ratio of Hai Phong Port. The container ratio of Saigon Port obtained from the original calculation is also indicated in the same figure. It can be said that both ports have the same background in terms of the international containerization, thus the increase of container ratio may be the similar in both ports as shown in Fig. 4-2-2. This comparison can emphasis the propriety of the estimated container volume in Table 4-2-4.

4-2-5 Cargo Distribution to Cai Lan Port

As mentioned in 5-1, the necessary infrastructures at Cai Lan Port are not expected to be completed by the year 2000. Thus, it is supposed that Cai Lan Port will not be able to handle a great volume of cargoes even if the port begins operation. Instead, only a small amount of export cargoes such as apatite and ore (approx. 0.6 mil. tons) out of the forecasted throughput of Hai Phong in 2000 (5.7 mil. tons) will be shifted to Cai Lan around the year 2000.

4-2-6 Cargo from/to China

Kunming, the capital city of Yunnan province in China, intends to use Hai Phong for a gate port to the city, since Hai Phong Port is more geographically advantageous than the other ports in China, i.e., Kunming to Peihai:1673km, to Guangzhou:2325km while to Hai Phong:915km. In addition to the

Table 4-2-4 Forecast of Container Cargo Volume and TEU

	Units	Actual			1993	Forecast							
		1990	1991	1992	Jan-Jun	1993	1994	1995	1996	1997	1998	1999	2000
Total	Stuffed TEU	17191	14389	25467	18213	40500	52840	66160	83420	95780	110120	124460	140780
	Empty TEU	1365	4738	8644	6705	16500	21160	25840	31580	37220	43880	50540	58220
	Empty Ratio	7.4%	24.8%	25.3%	26.9%	28.9%	28.6%	28.1%	27.5%	28.0%	28.5%	28.9%	29.3%
	Total TEU	18,556	19,127	34,111	24,918	57,000	74,000	92,000	115,000	133,000	154,000	175,000	199,000
	Tons/TEU	9	8	8	8	8	8	8	8	8	8	8	8
	Tons	167,808	159,007	273,603	204,186	460,000	598,000	750,000	934,000	1,082,000	1,239,000	1,408,000	1,593,000
Export	Stuffed TEU	8283	5437	8959	5261	16000	20500	25000	30500	36000	42500	49000	56500
	Empty TEU	1181	4483	8318	5848	16000	20500	25000	30500	36000	42500	49000	56500
	Empty Ratio	12.5%	45.2%	48.1%	52.6%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%	50.0%
	Total TEU	9,464	9,920	17,277	11,109	32,000	41,000	50,000	61,000	72,000	85,000	98,000	113,000
	Tons/TEU	8	6	6	7	6	6	6	6	6	6	6	6
	Tons	71,116	63,634	109,230	76,702	201,000	256,000	313,000	382,000	455,000	533,000	617,000	709,000
Import	Stuffed TEU	8908	8952	16508	12952	24500	32340	41160	52920	59780	67620	75460	84280
	Empty TEU	184	255	326	857	500	660	840	1080	1220	1380	1540	1720
	Empty Ratio	2.0%	2.8%	1.9%	6.2%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%	2.0%
	Total TEU	9,092	9,207	16,834	13,809	25,000	33,000	42,000	54,000	61,000	69,000	77,000	86,000
	Tons/TEU	11	10	10	9	10	10	10	10	10	10	10	10
	Tons	96,692	95,373	164,373	127,484	259,000	342,000	437,000	552,000	627,000	706,000	791,000	884,000

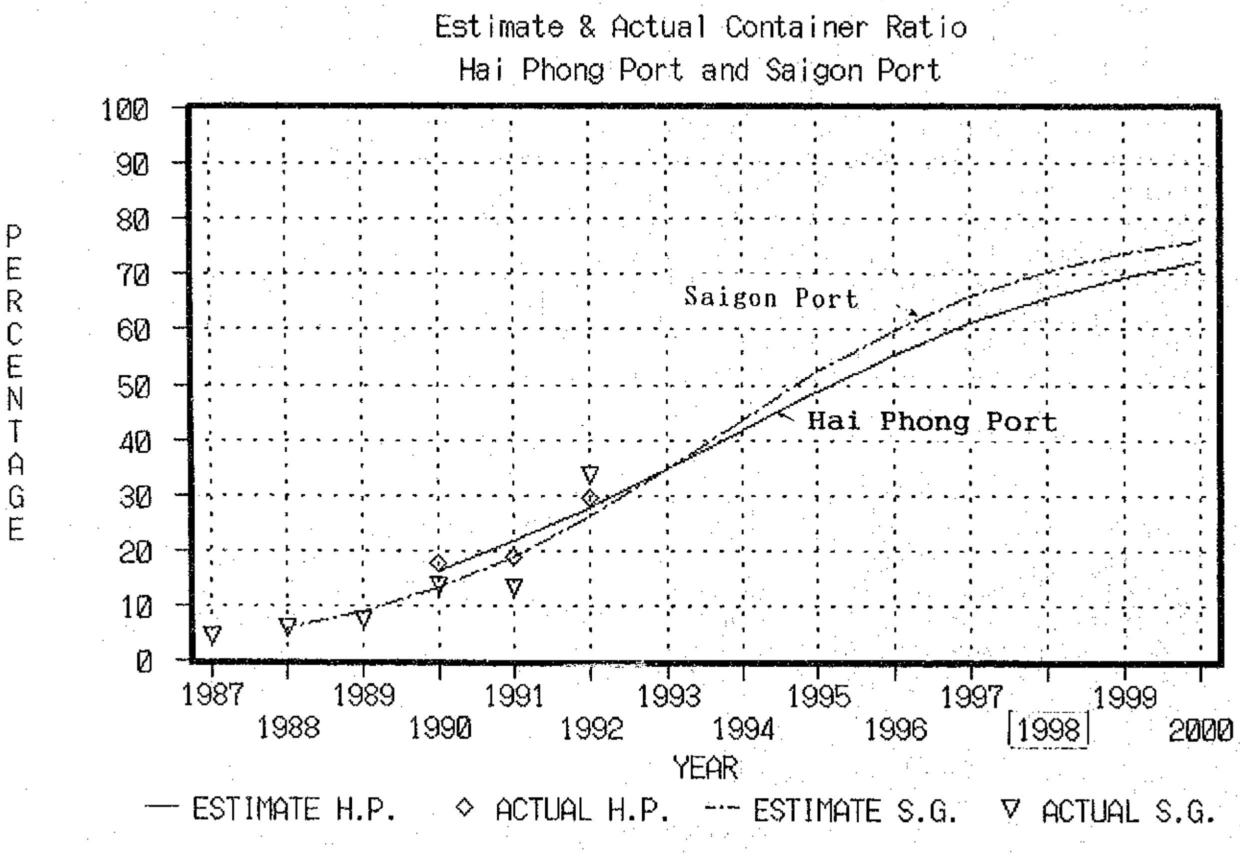


Fig.4-2-2 Container Ratio / Actual and Forecast

distance, official access into China was guaranteed with the recent opening of the border at Lao Cai.

Under these circumstances, Hai Phong Port expects 2 to 5 mil. tons of cargoes from Ynnan province around the year 2000.
However, a long history lie on the border of these two countries, and there still remains such a political tactics as suspending containers to China at Hai Phong Port for a long time. Moreover, there are many sorts of Chinese general goods and materials that can already be found in Hai Phong city. Accordingly, it shoul be noted that the present cargo volumes already include a certain amount of Chinese cargoes.

Therefore, volume of cargo from China is adjusted to one million tons in the target year and the year 2000.

4-2-7 Summary

Table 4-2-5 summarizes each elements of the preliminary demand forecast:

Table 4-2-5 Summary on Preliminary Demand Forecast

Year		1998	2000	Remarks
Cargo Volume (in 10,000tons)		470	570	600,000tons in Year 2000 to Cai Lan Port
		570	670	Incl:Chinese Cargo
Container	Volume	120	160	in 10,000tons
	T E U	15	20	in 10,000TEU

It should be noted that the forecast has been made upon the following conditions;

(1) The estimation is basically according to the growth of Gross Product of Industry (GPI).

(2) The GPI has been assumed to reach the high targets set in the national economic plan. Thus, the figures in the forecast accordingly reflect the optimistic values.

(3) The Chinese cargo volumes may not be firm, but, the volume will steadily increased if diplomatic relations between Vietnam and China proceed under favorable condition.

4-3 Forecast of Vessel Type and Size

4-3-1 Present Situation of Entering Vessels

Fig.4-3-1 to Fig.4-3-4 give numbers of each type of cargo vessels and container ships calling Hai Phong Port in 1992. The figures are obtained from records of the calling vessels presented by Hai Phong Port. The numbers in the figures include vessels lightered at Ha Long Bay. The gross tonnage (GRT) in the records has been converted to dead weight tonnage (DWT) by using a formula stated in "Technical Standards for Port and Harbour Facilities in Japan".

The average vessel size for each type of vessel shows 5,250DWT for bulk cargo vessel, 4,834DWT for general cargo vessel, 9,139DWT for bagged cargo vessel, and 4,414DWT for container cargo vessel.

On the other hand, Fig.4-3-5 and Fig.4-3-6 show the frequency at which those vessels entered the Access Channel in 1989 and 1992 respectively . Vessels that lightered at Ha Long Bay have been excluded from the figures to obtain the frequency of direct entering. As explained in 3-1, the number of vessels over 10,000DWT had been declining during those three years, while the number of vessel, less than 6,000DWT, had increased.

4-3-2 Forecast of Vessel Size

On the basis of the present situation of entering vessels, the planned vessel size has been determined as follows:

(1) Distribution of Vessel Size

A shift to larger sized vessels is to be considered in the long term forecast. However, since there remain only six years to the target year, and the water depth restriction in the Access Channelwill remain, it is predicted that future distribution of vessel size will be similar to that in 1992. Accordingly, if the maximum average size of vessels can be used for the planned vessel size, then 9,000DWT in 1992 may be applied to the planning as referred to in Fig.4-3-1.

(2) Entering Frequency to the Access Channel

It is predicted that the past entering frequency will be recovered after the implementation of the Urgent Rehabilitation Plan, and the condition of calling vessel in the target year will be the similar to that in 1989. With reference to Fig.3-1-3 which shows the entering draft in 1989, it is found that the vessels over 6,000DWT were required to lightered their loads before access to the Channel, and the average size of those vessels is 10,900DWT. In other words, if 10,900DWT is applied to the Rehabilitation Plan, the entering frequency in the target year will be similar to the one in 1989.

(3) Planned Vessel Size

After consideration of both (1) and (2), it is determined that 10,000DWT is to be applied to the Rehabilitation Plan.

(4) Draft of Planned Vessel Size

The full draft of each vessel size used for the design of the Access Channel is shown in Fig.4-3-7, and Fig.4-3-8 proofs a propriety of the design draft by indicating the actual entering draft of calling vessels in 1989 and 1992.

The draft of the planned vessel size 10,000DWT, therefore, is 8.3m using Fig.4-3-8.

(5) Overall Length (LOA) of Planned Vessel

The LOA of each converted DWT class vessel in 1992 is plotted on Fig.4-3-9. The LOA of the planned vessel size 10,000DWT, is determined as 140m from the figure.

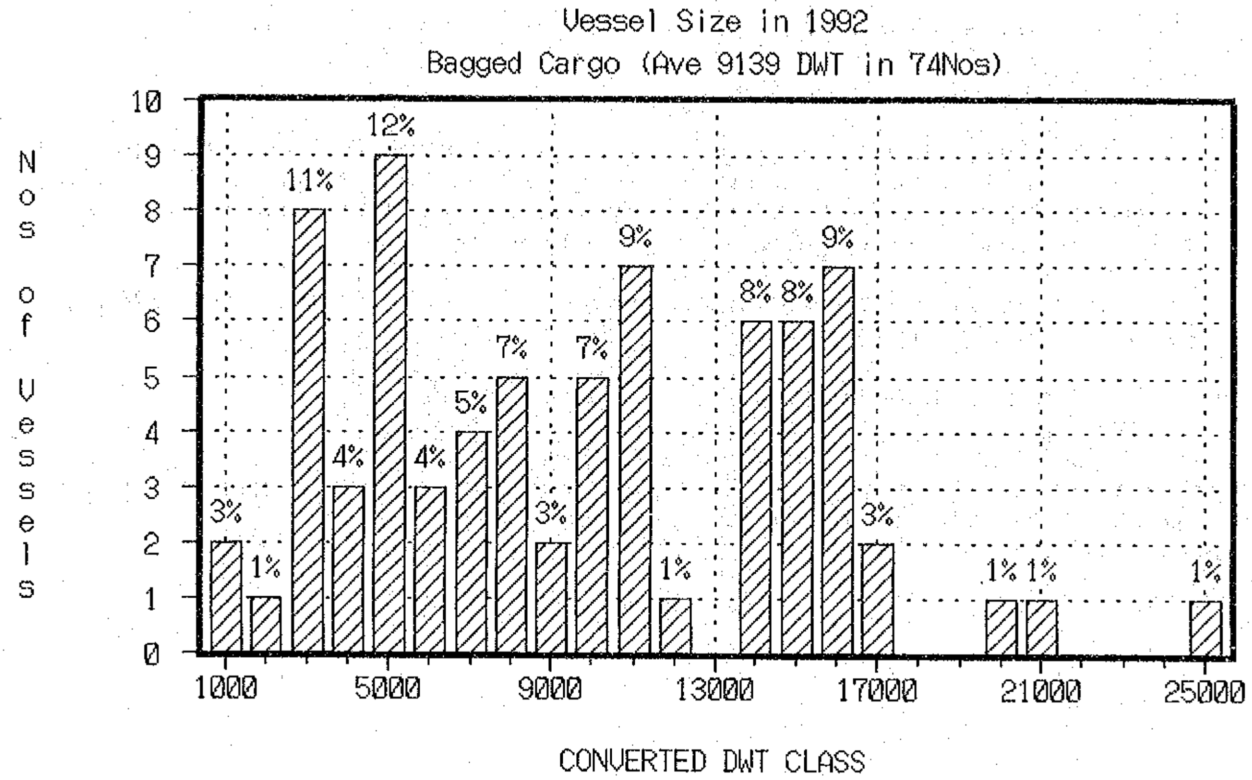


Fig.4-3-1 Vessel Size Bagged Cargo Vessel (1992)

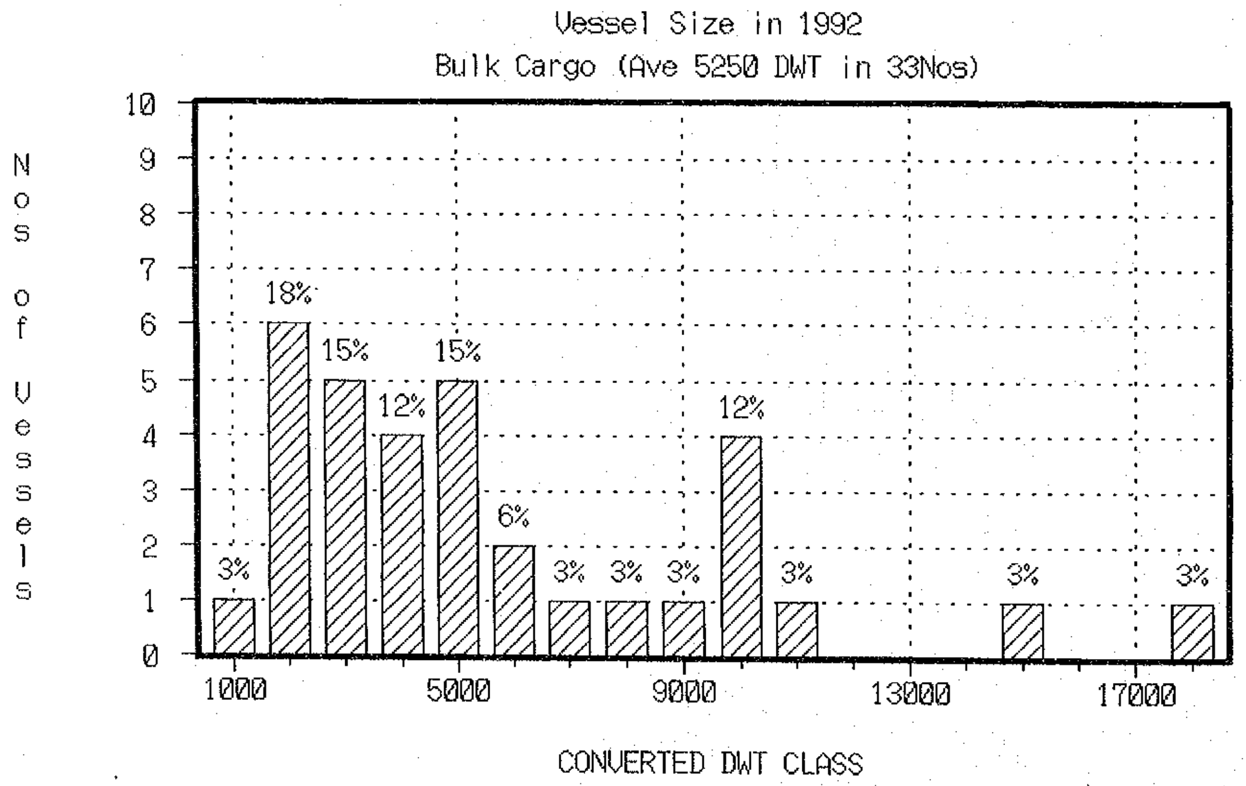


Fig.4-3-2 Vessel Size Bulk Cargo Vessel (1992)

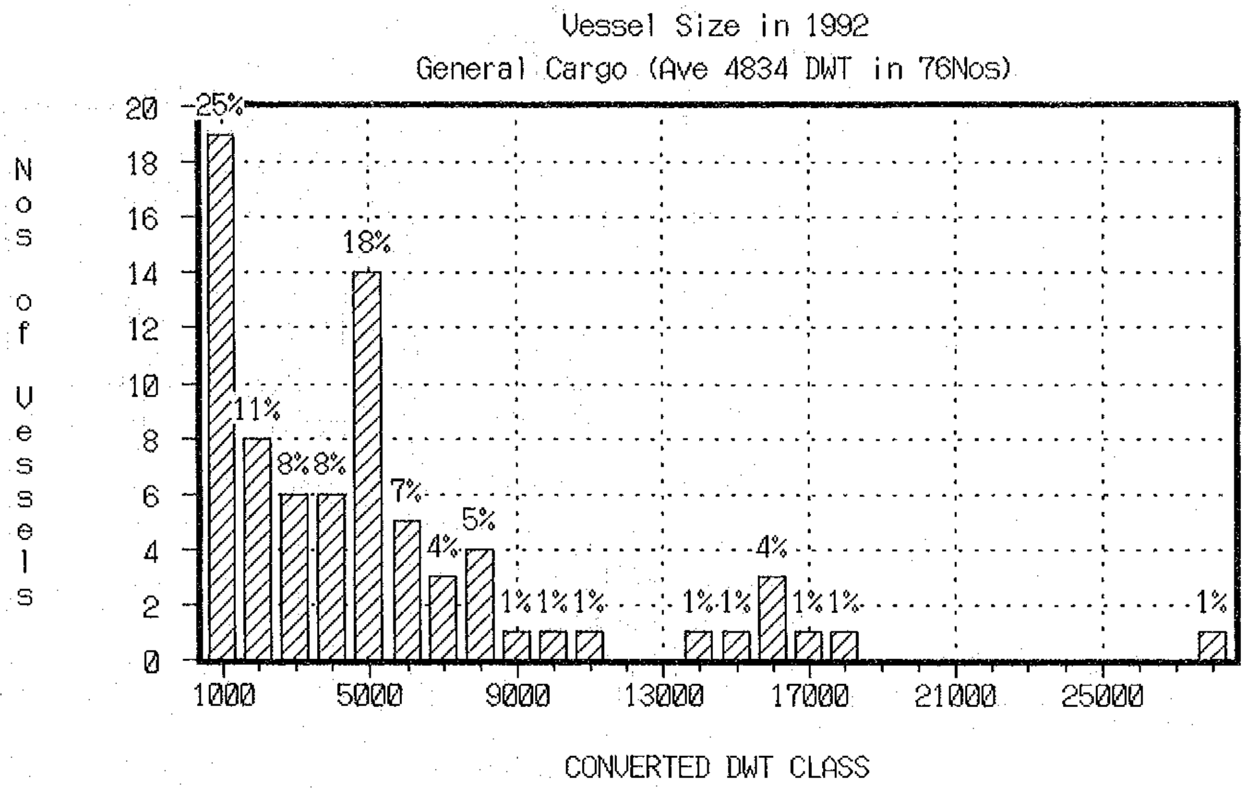


Fig.4-3-3 Vessel Size General Cargo Vessel (1992)

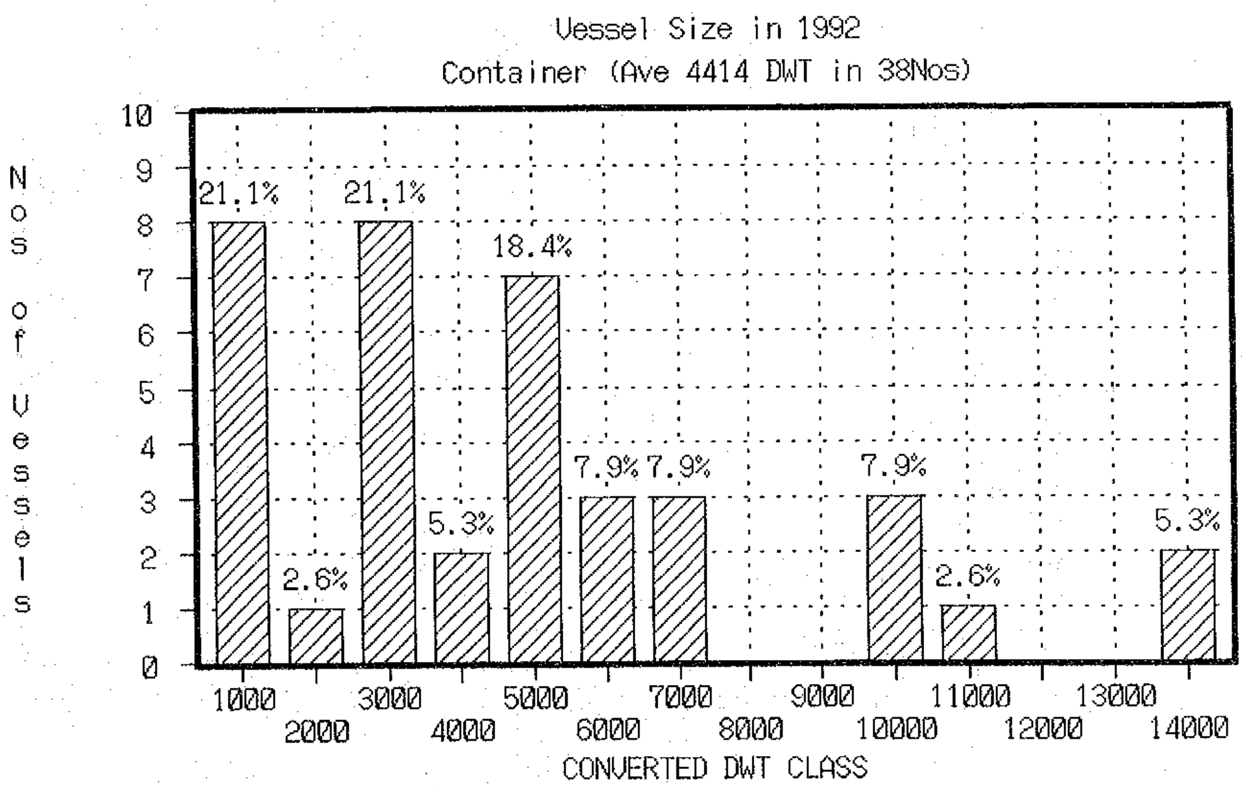


Fig.4-3-4 Vessel Size Container Cargo Vessel (1992)

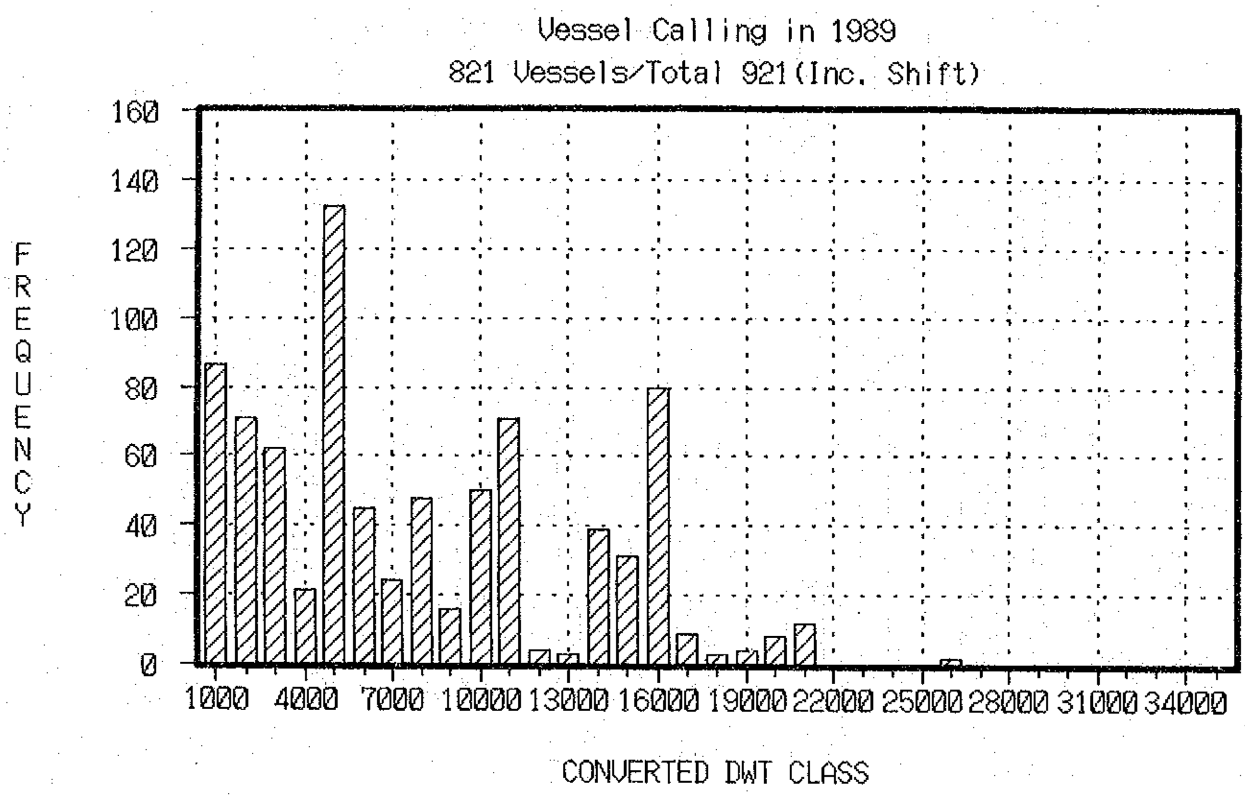


Fig.4-3-5 Frequency of Calling Vessels (1989)

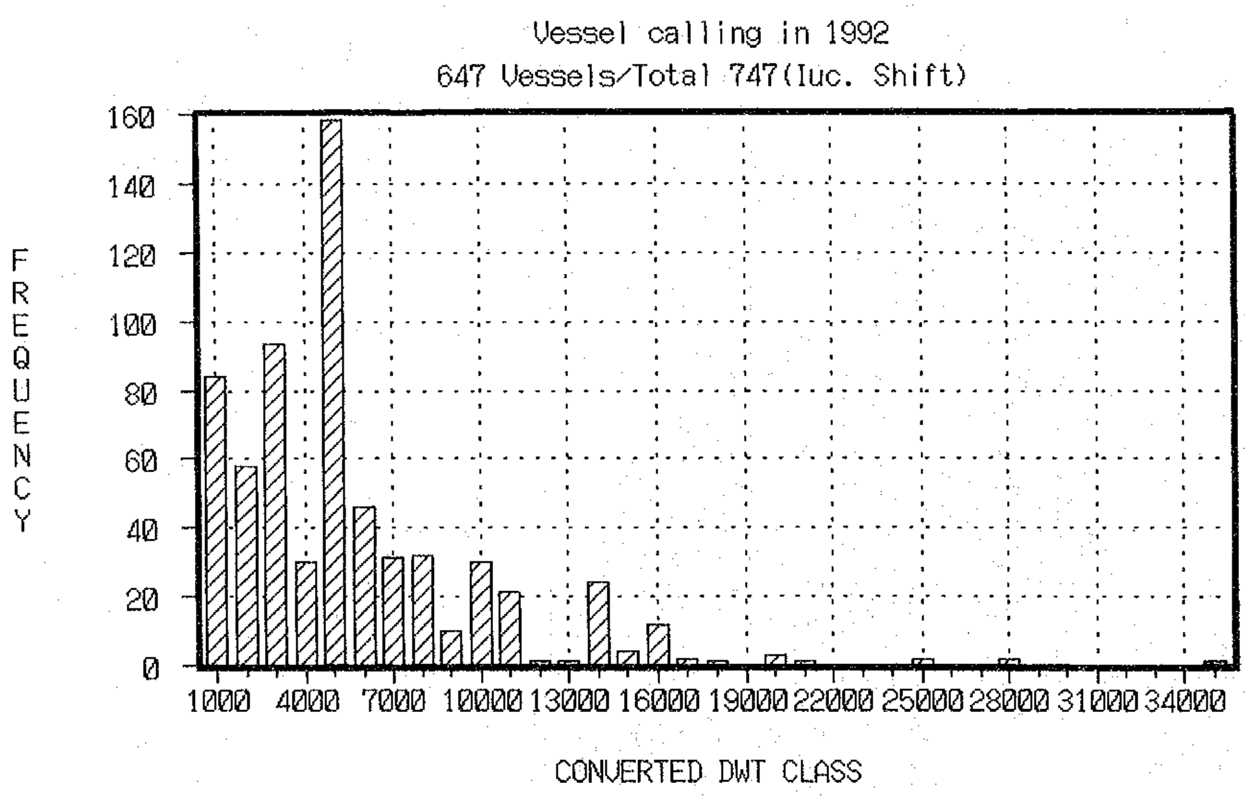
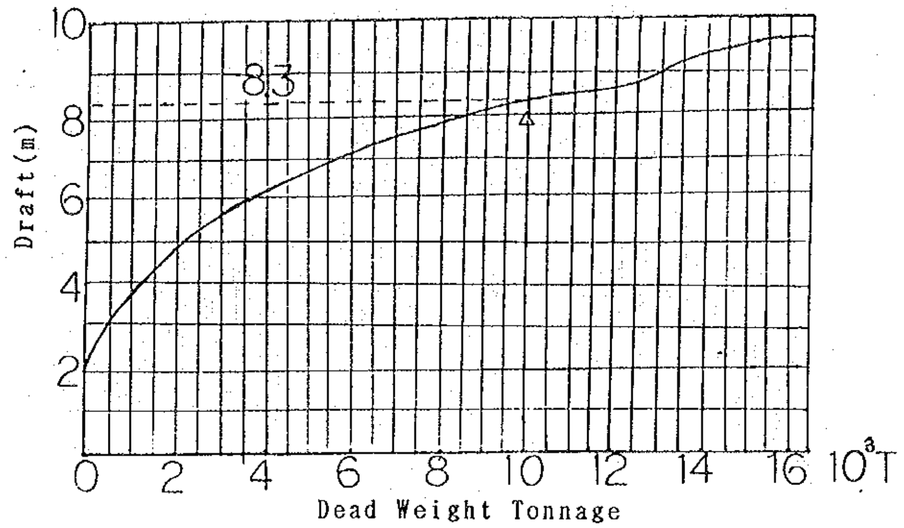


Fig.4-3-6 Frequency of Calling Vessels (1992)



Sorce:「The Process For Designing Sea Channels」 From VINAMARINE

Fig.4-3-7 Full Draft of Vessel Size used for Channel Design

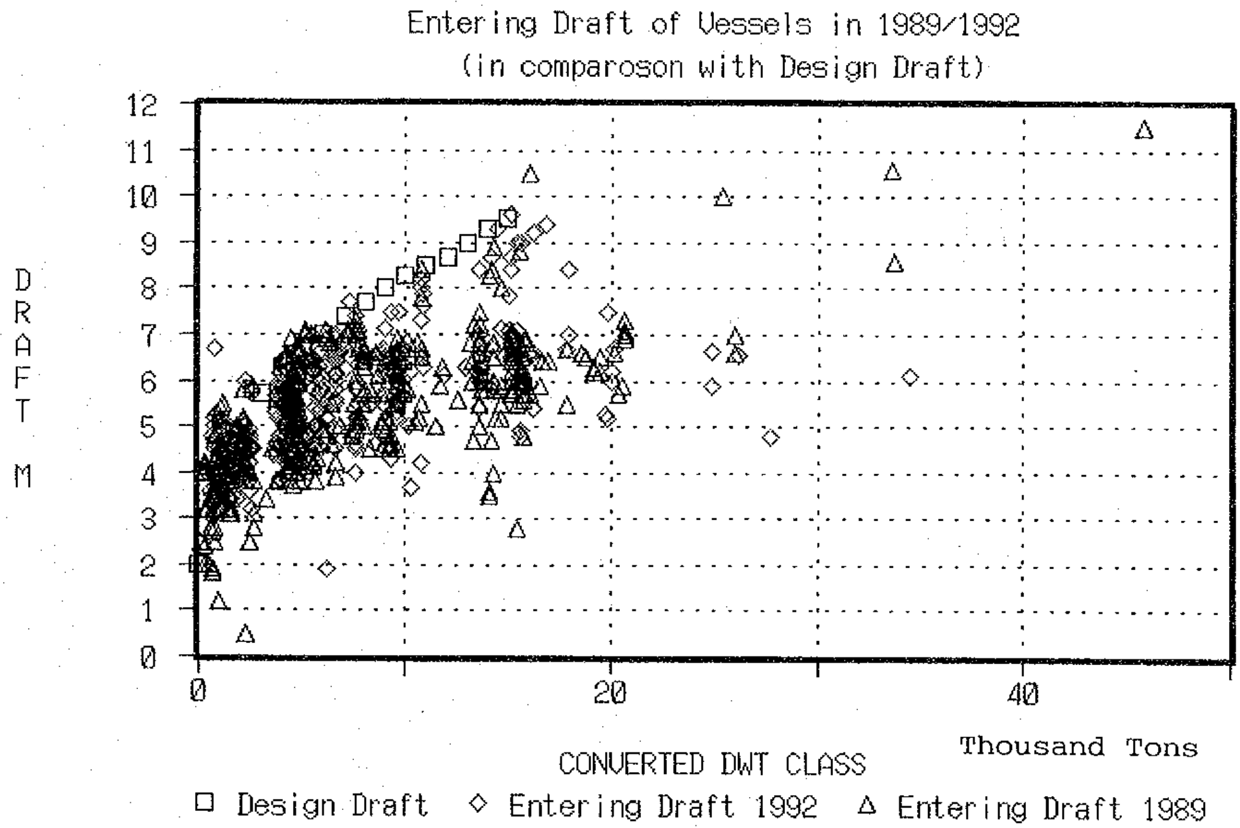


Fig.4-3-8 Entering Draft of Vessels (1989/1992)

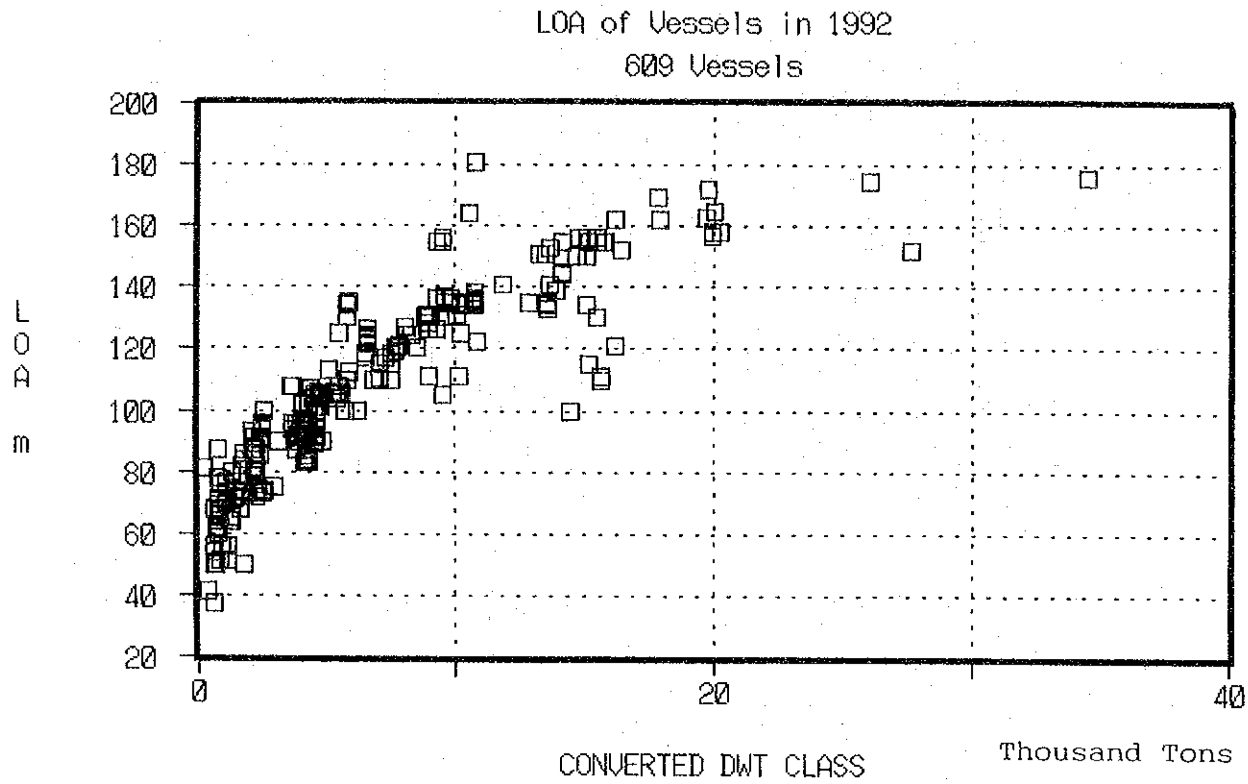


Fig.4-3-9 LOA of Vessels (1992)

Chapter 5 Principle of the Rehabilitation Plan

Chapter 5 Principle of the Rehabilitation Plan

5-1. Relationship with Cai Lan Port

5-1-1. Present Situation of Cai Lan Port

Cai Lan Port is located on the other side of the bay which also has Hon Gai Port, eastward of Hai Phong Port. The direct line distance and the land route distance between Hai Phong Port and Cai Lan Port are approximately 40 km and 50 km, respectively, and it is approximately 130 km from Hanoi to Cai Lan Port and 105 km from Hanoi to Hai Phong. (Refer to Fig. 5-1-1) Since large vessels can be accommodated with relative ease due to the fact that the water depth of Cua Luc channel is -7 - -8 m and the average tidal level is 3.1 m, Vietnamese Government began construction of a 10,000 DWT berth in 1989 that will be completed this year. The forecast cargo volume is shown in Table 5-1-1. Ten berths are planned to accommodate this cargo as shown in Fig. 5-1-2.

Table 5-1-1 Planned Cargo Volume of Cai Lan Port

	1990	1995	2000	2005
Export	55	305	435	670
Apatite		200	300	500
Cement	50	85	85	100
Others	5	20	50	70
Import	180	542	930	1095
Metal	95	175	285	335
Equipment	25	52	85	100
Grain	50	100	150	150
Fertilizer		125	235	310
Grease Coal		50	75	100
Others	10	40	100	100
Domestic		210	290	285
Cement		95	150	100
Grain		15	20	25
Wood/Timber		10	10	60
Others	3	4	5	6
Total	235	1057	1655	2050

Unit: Thousand Tons
Source: Capital Appealing Project for Investment on The Development of Cai Lan Port 1992;
Ministry of Transport-Communications

5-1-2. Relationship between Cai Lan Port and Hai Phong Port.

VINAMARINE is managing the project of one -9 m berth now under construction without any governmental aid, and it could be completed with additional two million dollar budget. It is also said that it can construct one sea berth per year. However, the 3.5 km railway to Ha Long station has not been constructed yet and there is no utilities on berths as electricity and water supply. Moreover, it is necessary to utilize two ferries to reach Hanoi. The road condition is not in good condition and its transportation capacity is limited. Consequently, even when Cai Lan Port begins operation, a substantial handling volume cannot

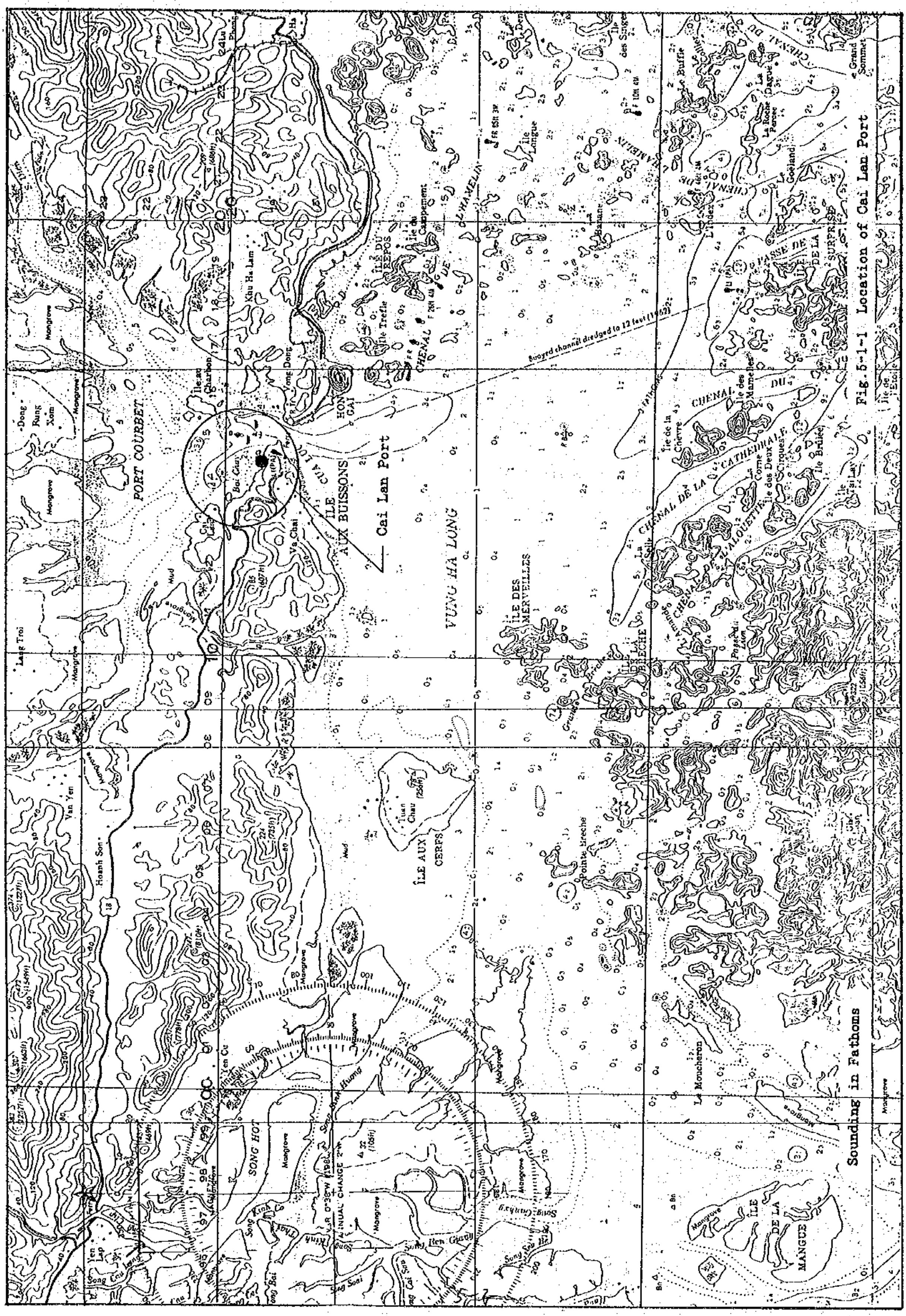


Fig.5-1-1 Location of Cai Lan Port

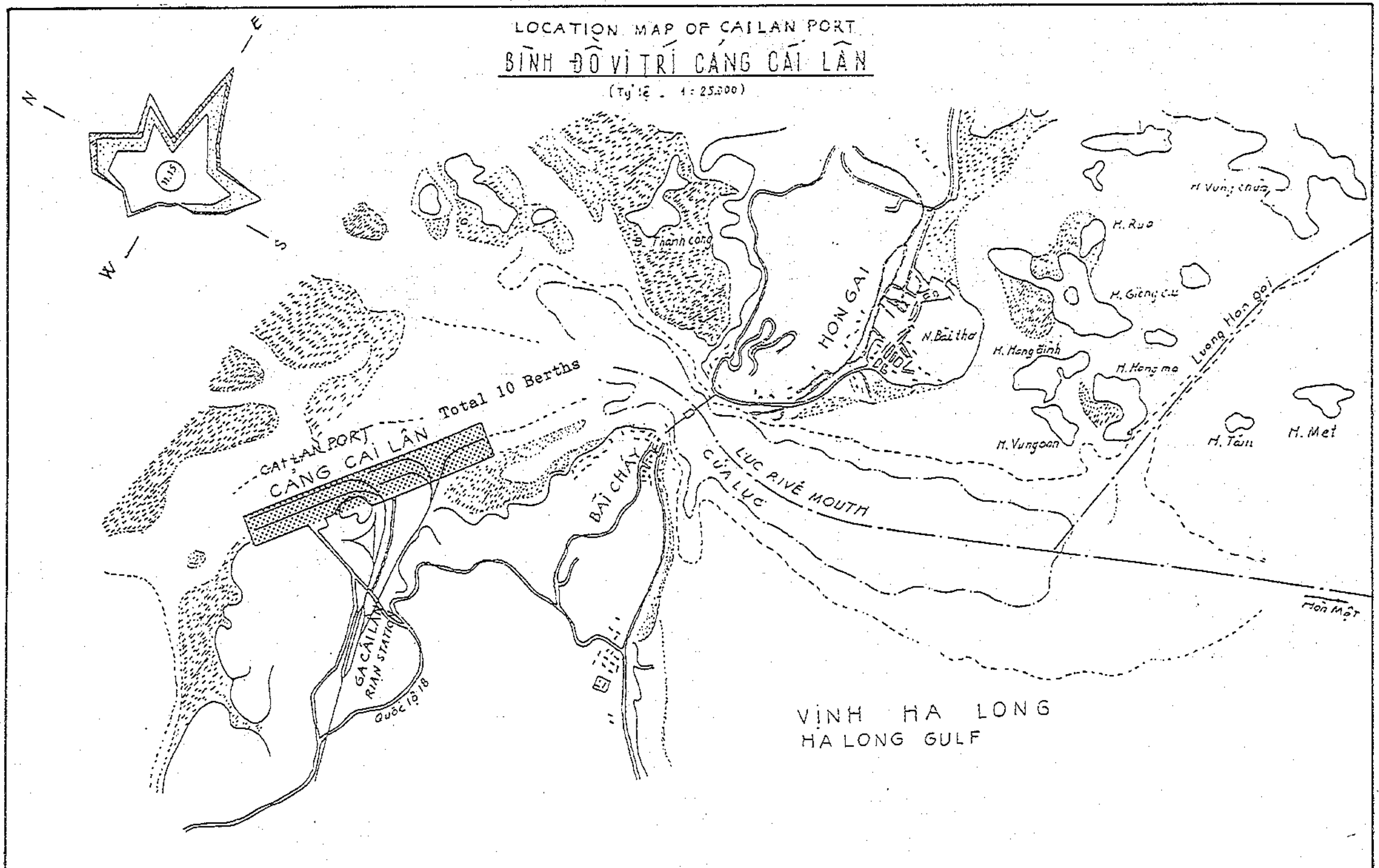


Fig.5-1-2 Master Plan of Cai Lan Port

be expected for several years. Therefore, in this study,

Handling volume of Cai Lan Port is not considered.

None the less, as for the forecast of cargo in the year 2000, the handling cargo of Hai Phong Port shares the export of Apatite with Cai Lan Port transported by railway from Lao Cai, as explained in chapter 4.

5-2. Target Year

This Urgent Rehabilitation Plan is considered to be put into practice in 1994. Considering total investment cost, construction schedule, and necessary period for improvement of management and operation, the target year for this Urgent Rehabilitation Plan is determined as follows.

The plan is completed in 5 years and the target year is 1998.

Each item of the plan is evaluated according to its priority and is finalized upon a full discussion with the Vietnamese side.

5-3. Cargo Handling Volume

As predicted in chapter 4, the total cargo handling volume of Hai Phong Port at the target year of 1998 is as follows and this volume is utilized for the plan.

4.7 million tons including 1.2 million tons of container cargo (0.15 million TEU)

As explained in 2-1, Hai Phong Port consists of four port areas, which are Vat Cach Port Area, Main Port Area, Old Chua Ve Port Area, and Chua Ve Port Area, respectively from the upstream of the river. Ha Long Bay has a floating berth, which is functioning as a port for lighter. Considering the various kinds of handling cargo based on the former facilities and the future development plan, the total cargo handling volume is distributed as shown in Table 5-3-1, and these figures in the table are used for the Rehabilitation Plans.

Table 5-3-1 Cargo Share in Hai Phong Port

Year / Unit	1992 (Container) 1,000T	1,000TEU	1998 (Container) 1,000T	1,000TEU
Total	2378	(273) 34	4700	(1240) 150
Vat Cach Port Area	310		620	
Main Port Area	1516	(104) 14	2770	(600) 75
Old Chua Ve Port Area	68		70	
Chua Ve Port Area	165	(169) 20	600	(600) 75
Halon Bay Lighter	319		640	

5-4. Access Channel and Basin

5-4-1. Planned vessel size and depth of the Access Channel

The planned maximum vessel size (which can go in and out of the port during all tidal conditions) is determined as explained in chapter 4 as follows.

> Maximum vessel size is planned as 10,000 DWT class in full-loaded condition.

This class is equivalent to the averaged large vessel size (the average of the vessel more than 6,000 DWT) that formerly entered to the Access Channel formerly without problems, and the design water depth (-8.4 m) of the Access Channel and the former berth can accommodate 10,000 DWT class vessel (fully loaded). However,

> Considering the actual maintained water depth of the Access Channel, 7,000 DWT(fully loaded) vessel size is also planned.

The design water depth of the Access Channel is analyzed by the Study Team based on the actual observation of tide and a tidal table, considering the present situation of utilizing high tide; that is, whether the tidal operation is safely done without any difficulties and how long to keep the operation period under high tide condition. This procedure comes from the idea of so-called "guaranteed tidal height" (what percentage of the time is the minimum necessary tidal height available).

5-4-2. Alignment and Width of The Access Channel

(1) Alignment of the Access Channel

The Access Channel of Hai Phong Port is approximately 36 km in length from the entrance of the port to Main Port area, consisting of three main areas, the 16 km Nam Trieu Channel, 12.5 km Bach Dang River Channel including 1.2 km Dinh Vu Canal, and 7.4 km Cua Cam River. Nam Trieu Channel facing offshore has the most siltation among those channels and various methods are now under consideration to reduce the siltation rate. One of the methods is to straighten the alignment of Nam Dang Channel, which is now oriented at 303 degrees passing the mouth of the Bach Dang River. An intensive study of this method has been carried out mainly by TEDI (Transport Engineering Design Institute) under the guidance of UNDP since 1990. This research is scheduled to be completed in March of 1994, such that most of essential data at sites are to be obtained by the end of September this year.

Since the mechanism of siltation at Nam Trieu Channel is very complicated, it is not clear at this moment how much siltation can be reduced when changing the alignment of the Access Channel. As a consequence,

> The plan of the Access Channel is proposed in accordance with the prediction of siltation under the condition of the present alignment of the Access Channel.

However, as for a new alignment of Access Channel, an additional precise technical evaluation is requisite to determine whether it is appropriate or not before the implementation of the project.

In this Study, in case that the alignment of Nam Trieu Channel is to be altered,

> The investment cost (the initial dredging cost) is estimated for the straight line alignment, and it is examined whether the investment cost is appropriate or not.

(2) Width of the Access Channel

Except for one part of the Bach Dang River Channel, the present width of the Access Channel is set to 80 - 100 m, and most areas of the channel allow only one-way traffic, though the area described in 2-3-4 (Buoy No. 15-22, Buoy No. 29-31) permits two-way traffic for large vessels. According to the Japanese standard (Technical Standards for Port and Harbour Facilities in Japan), the width of the access channel shall have at least one ship length (150 m in case of 10,000 DWT ship) even for one-way traffic. However, widening the Access Channel enlarges dredging volume and siltation volume of the channel, and consequently it becomes uneconomical. Therefore, under the condition that the safe navigation shall be maintained and excess maintenance volume shall be minimized,

The Access Channel Plan shall be set up such that the width of the channel is not enlarged as much as possible.

5-4-3. Construction of Dikes

Cua Cam Access Channel has nine training walls, which are called "Dikes" at the sites. They form submerged stone mounds with the height of +2.0 and 100 - 150 m length, perpendicularly jutting out from river banks, and the purpose of them is to maintain the present water depth.

They prevent floating soil near river shore from siltation due to disturbance of the current, and also help floating soil go down the river by increasing the current at the bottom of the river in front of them. With these effects, the dikes may possibly maintain the present water depth.

Construction of these dikes began in 1991, and with two dikes yet to be completed. The shoreline of Bai Nha Mac Island in Bach Dang River has 0 m water depth with approximately 3 km length and 1 km width, and it is the source of soil which induces siltation. A plan to building four long dikes is now under consideration. These technical methods have been effective as empirical methods by Vietnamese Government and they have been applied to the other ports such as Hanoi Port. Therefore,

These dikes shall be taken into consideration after corroborating their technical basis introduced by Vietnamese Government.

5-4-4. Basin

Since the present channel is only 80 - 100 m in width, large vessels can pass by each other only at restricted areas. Therefore,

The Study Team is to investigate site conditions to find an appropriate navigation system and to propose an improved system if applicable.

In order to enhance the transit capacity of ships during the time band of high water level, additional turning basin is necessary in front of the main port berths. At present, there is a 250 meter turning basin in front of No.4 - No.5 berth in Main Port Area. However,

After examining the necessity of an additional turning basin, improvement of turning basins is to be considered.

5-4-5. Prediction of Siltation and Maintenance Dredging Volume

It is not easy to estimate siltation and maintenance dredging volume because the mechanism of siltation is not clarified yet. It is desirable to estimate the volume with aid of computerized simulation and/or model tests. On the other hand, on condition that past siltation quantities and actual maintenance dredging volume are obtained precisely in numerical values, it is feasible to estimate those volumes with those past values, and it might be the best procedure for the purpose of this Study.

Dinh Vu Dam, completed in 1982, changed the former hydraulic environment in a drastic manner and this change put an end to natural hydraulic mechanism. Moreover, dikes first introduced in 1990, have also had a great impact on the hydraulic condition; therefore, those hydraulic data shall be analyzed carefully. Utilizing the actual past data, which is considered to be indefinitely valid, the following steps are proposed in this study.

(1) First of all, as for the mechanism of siltation, what kind of phenomenon is to occur is classified based on various sources and interviews with specialists.

(2) Secondly, as much past data on siltation and maintenance dredging volume as possible are scrutinized and classified.

(3) Thirdly, by utilizing those classified actual data, past siltation rate is summarized and the siltation in case that the Access Channel is deepened by dredging is to be estimated.

(4) Finally, the siltation rate of each area is obtained by analyzing past data, and the future siltation volume is estimated. On the other hand, the planned dredging volume includes the siltation volume while executing this Rehabilitation Plan. (This is considered as excess volume during construction.)

5-4-6. Introduction of Dredging Fleet

The dredging fleets presently owned by Vietnamese Government are as shown in Table 9-3-4. The entire fleets are considered to be out of date. None the less, after investigating how old they are and what their executing abilities are, In order to maximize the efficiency of maintenance dredging, appropriate dredging fleet in terms of quantity, capacity, and type shall be examined carefully.

5-5. Port Facilities

5-5-1. Main Port Area

(1) Improvement Plan of Main Port Area

At Main Port Area, all facilities such as apron, roads, marshalling yard, buildings, warehouses, cranes, railways, and so on are damaged and/or very old. In order to utilize those facilities in the long term, they would require complete revision, which might not be a good idea considering the investment cost and effects. Therefore, in order to increase the handling capacity,

An improvement plan will be drafted after determining the priority of the above facilities.

(2) Rehabilitation Plan of Layout

The layout will be improved such that each berth is specialized for each designated handling cargo.

1) Handling of Containers

Containers are presently handled at berth No.7, but the field behind the berth is narrow enough to cause inefficiency in handling them. Therefore,

Containers are arranged to the same area, and berths No.1- No.3 are improved to handle containers intensively.

Berth No.7 will be used only for general cargo. Generally, it is said that a quay crane (gantry crane) should be installed when container volume per berth exceeds 50,000 TEU. However, in Vietnam even Saigon Port does not have a gantry crane depending rather upon geared cranes on vessels. But, considering that container vessels will be gearless types in future and that the volume of container is likely to increase, the introduction of gantry crane is indispensable.

In the current situation, it is difficult to install a gantry crane on the present berth structure, thus it is necessary to reinforce the berth. Proposed handling volume of containers is 75,000 TEU, which is almost limit of geared crane's handling capacity, but considering to take use of a jib crane (14 ton capacity) in spite of its tiny performance,

In this Study, only expansion of yard and enhancement of yard capacity are considered.

When volume of handled containers increases or when the jib crane (14 ton) is of no use, introduction of a gantry crane might be examined in the next stage.

2) Berth No.9

The warehouse behind berth No.9 is considered as a bond transit shed, and it is equipped to handle foreign cargo such as EPZ.

(3) Railways on Quay

Railways on quay have not been used extensively, and some railways are not utilized now. However, considering the possibility of long distance transportation to such places as Ynnan Province of China and that the another organization is responsible for the cost of removing the railway,

Only the railways on the berth that pose obstacle to the transportation system shall be removed.

The area beyond the present boundary of Main Port Area has been utilized for the downtown activity, and in this Study,

The boundary shall remain the same.

As for the facilities such as electricity, water supply, and buildings for offices, the concept of "Scrap and Build" is adopted to enhance overall management efficiency.

5-5-2. Container Terminal at Chua Ve

(1) Rehabilitation Plan of Chua Ve

Container terminal at Chua Ve began operation in late 1990, and its backyard of two berths is utilized by three ship companies, CIS SHIPPING LINE, VOSA SHIPPING LINE, and EAC SHIPPING LINE. The terminal is a relatively new facility. However, various parts of the terminal shall be improved for the following reasons. Small deformation has occurred in the area behind the berth due to overload on the quay. The access road is partly unpaved and the quay crane is jib-typed with relatively low efficiency. Handling the containers in marshalling yard is dependent on old mobile cranes and forklifts with insufficient capacity. A fundamental study is prerequisite for the Rehabilitation Plan including management, operation, and documentation aspect.

(2) Land Plan

Handling cargo is expected to increase from now on, and the increase of vessel size is also considered. As a consequence, the berth shall be extended. In that situation, the extension is towards the yard down the river, which is now vacant. In any case,

A specialized container berth with high efficiency shall be under study to improve the handling capacity, including land reclamation plan.

5-6 Cargo Handling Equipment

(1) Cargo Handling Equipment in Main Port Area

The main handling equipment in Main Port Area is a jib-typed crane, and 25 cranes from 5 ton to 16 ton capacity are utilized.

These jib cranes shall be replaced except for ones handling bulk cargoes and heavy cargoes for the following reasons.

1) Superannuation

Over 50 % of jib cranes are more than 16 years old, and eight of them exceed 20 years. Therefore, the much maintenance cost is required and they are in dangerous condition in case of typhoon's attack.

2) Effective Rate of Operation

The average effective rate of operation of jib crane is 22 %, which is very low. Its handling efficiency of general cargo and bagged cargo is almost equivalent to that of ship gears. Therefore,

Handling of general cargo and bagged cargo shall be left to ship gears.

3) Container handling crane at the berth No. 1 through the berth No. 3

If the berths No. 1 - No.3 are transformed into container berths, two or three gantry cranes specialized for handling containers would be required. However, it is necessary to scrutinize structure of the berth considering whether gantry cranes can be mounted on the berth or not.

4) Minor Equipment

Present minor equipment such as forklift trucks shall be replaced by new ones as necessity dictates.

(2) Equipment in the Chua Ve Area

1) Gantry Crane

In case that the expanded berth is implemented, one gantry crane handling container cargo is required.

2) Yard Equipment

The optimum yard equipment shall be determined considering whether up-graded equipment such as transfer crane and straddle carrier is required or not.

5-7. Management and Operation Systems

As for the management and operation systems, eleven enterprises have managed to establish a self-supporting accounting system under Hai Phong Port Authority. However, it is considered that there are many components left over from the past system operated directly under governmental organization that require reform.

(1) When implementing the Rehabilitation Plan, the management and operation systems related to the plan are first chosen and those systems are considered to be improved. (2) Efficient cargo handling operation system as well as treatment of documentation for container handling will also be proposed.

Chapter 6 Improvement Plan of The Access Channel and Basin

Chapter 6 Improvement Plan of the Access Channel and Basin

6-1 Natural Conditions of The Access Channel and Basins

6-1-1 Present Conditions of The Access Channel

The access channel connecting the Hai Phong Port with the deep sea of Tongking Gulf has a length of 36Km. The channel is divided into three sections namely; Nam Trieu, Bach Dang and Cua Cam based on river flows, and into four as follows:

	Nam Trieu Channel	Bach Dang River	Dinh Vu Channel	Cua Cam River
Channel Entrance .... Main Port Area				
	16.0Km	11.3Km	1.2Km	7.4Km
Left Navigation	No.1	NO.19	No.29	No.47
Right Navigation Buoy	No.2	No.20	No.28	No.30

Before 1902, the Cua Cam had been used as access channel river and its natural depth is -2.0m and -4.0m in the Nam Trieu River.

In 1912, the Dinh Vu channel had been dredged up to a depth of -6.5m by France, despite its planned depth of -7.0m and its depth has been kept unchanged.
In 1982, the Dinh Vu Dam located at Cua Cam River had been constructed to connect the Dinh Vu area, after which the mechanism of sedimentation in the access channel has been remarkably changed; the Nam Trieu channel sedimentation rate will be increased significantly, accompanied by coastal erosion on the Cat Hai shoreline at Ha Nam Island.
Changes in the Nam Trieu over time are shown in the following diagram. The dredged volume of 5-year average and its dredged depth are shown in Table 6-1-1.

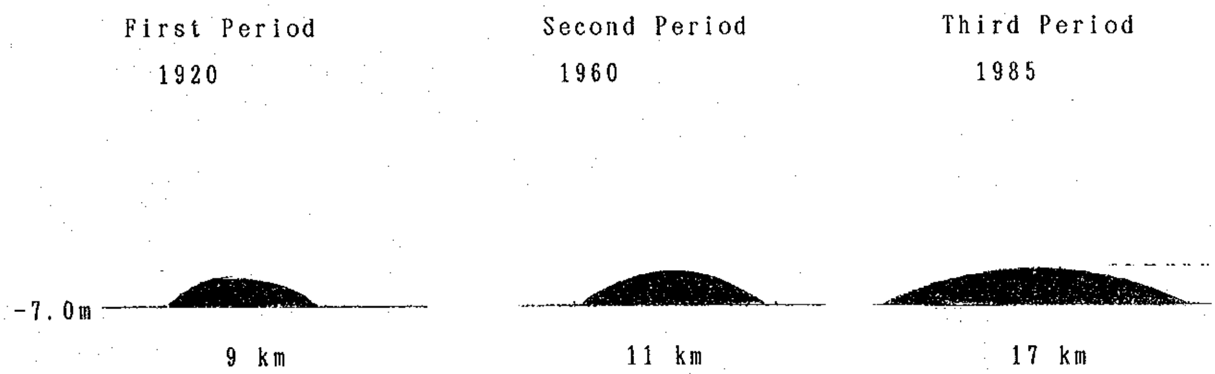
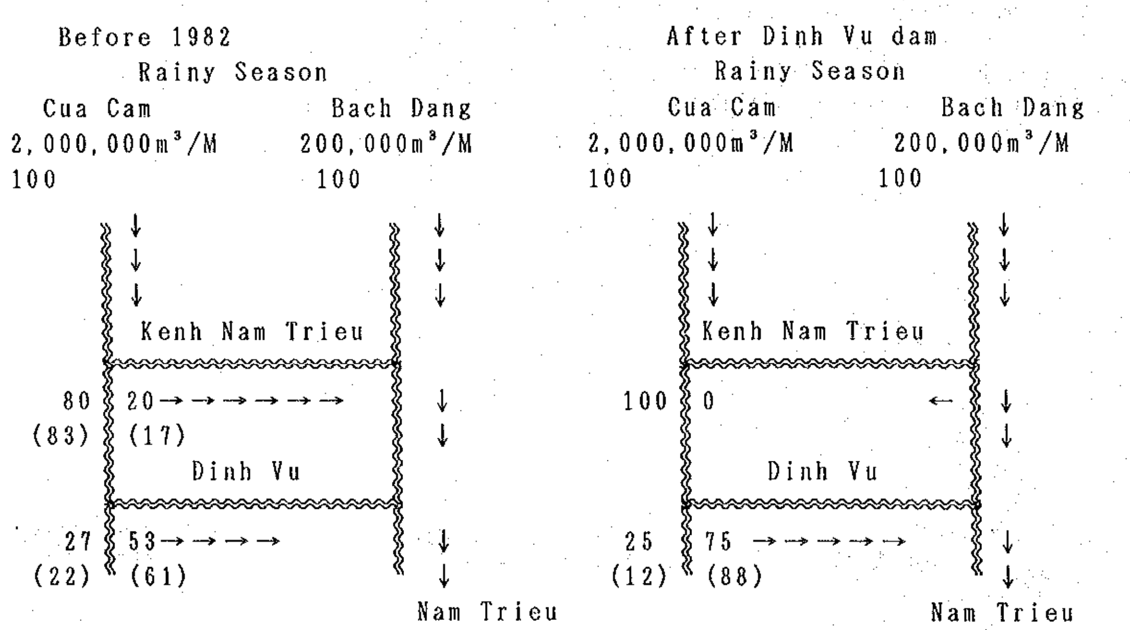


Table 6-1-1 The Dredged Volume of 5 Year Average and Its Depth

Unit: 1000m3

Year Period	Volume	Depth	Year Period	Volume	Depth
1915 ～ 1920	703.2m³	-6.0m	1960 ～ 1975	---m³	-4.2m
1921 ～ 1925	994.8	|	1975 ～ 1980	2185.4	|
1926 ～ 1930	1218.4	|	1981 ～ 1985	2014.4	|
1931 ～ 1935	1363.4	-6.5m	1986 ～ 1990	3217.6	-4.5m
1936 ～ 1960	1846.6				

The effects of current volume which are shown in water flowing system bellow, both rivers of Cua Cam and Bach Dang, are analyzed based on the study report of Soviet Union in 1963 then after completion of Dinh Vu Dam.
The sedimentation volume of the Nam Trieu channel each year increased steeply, as a result of a change in the direction of flow due to the closure of the Cua Cam River after the construction of the Dinh Vu Dam. It is easy to understand how the sedimentation of the Nam Trieu channel was accelerated.
The rate of sediment transport is calculated G=pq. p represents the density of muddy flowing water and q is the amount of discharge.
The rainy season is four months from June to the end of September, and November to February is the dry season.
The rest of the months are in between. During the dry season, the rate of discharge in both rivers is less than 1/7 of the rainy season figure, as a result the total sediment load is a sharp decrease in dry season.
The below figure shows the relation between the rate of the discharge and its total sediment load before and after the construction of the Dinh Vu Dam. The numbers in parenthesis represent the rate of total sediment load in percentage.



Sediment Transport 27% increase

The rate of sediment transport is complicatedly caused by discharged density, current speed, grain size, etc.
Statistics show that sediment transport in the Nam Trieu channel area amount to 880,000 tons/month in the wet season and 25,000 tons/month in the dry season, with an annual total of 4,500,000 tons.
The above sedimentation mechanism is summarized based on hearing from Mr. Dao Nguyen KIM (Director Enterprise for Port Waterway Survey Design & Construction, formerly TEDI).
At present, large-scale observation and analysis of sedimentation mechanism and its effects are being carried out jointly by UNDP and TEDI (see the attached appendix). The new sedimentation mechanism will be more analyzed based on the on-going above study.
However at present sedimentation mechanism will be expected to analyze on limited collected data.

6-1-2 Natural Conditions in Nam Trieu Channel

(1) Wind

There is a long-established observation facility for weather and sea condition in Hon Dau located about 15km West of the Nam Trieu channel. These provide meteorological data including tidal levels and wave height. The statistics data of wind complied from 1961 - 1982. According to the statistics data, the frequency of winds exceeding a velocity of 10m/sec is 3.3% of the total and only 0.13% of the winds exceeding 25m/sec which were caused by a typhoon hitting and two or three times per year. Frequency of the wind blew mostly from the east and southeast throughout the year. (See Figure 6-1-2)

(2) Waves

Observation records on waves are also kept at Hon Dau. The statistics period is from 1956 to 1962, and the other one is 1962 - 1982 are shown in Fig. 6-1-2 indicating frequencies by direction and height of waves. The trend of wind direction, which is hard to determine, is found to be somewhat different in the two groups. More recent data show that most of the wind blows from the east. In general, it is known that wave action of over 50m high effects to sediment transport in the shallow sea water depth and its frequency is 82% in Nam Trieu channel area. The rate of 62.4% frequency of waves in the directions of east to southeast and east to south, which are caused to have a greater effect on the sedimentation of the Nam Trieu channel. (Data for 1961 - 1982)

Figure 6-1-3 shows the stratums of the areas along the Cua Cam River and figure 6-1-4 shows the stratums, connecting the Du Hang located in Hai Phong city with Dong Hai, has a length of 5.5km. Since these deltas are formed for a long time by the total sediment transport from rivers flows like a its effect due to make shallow areas in the rivers and marshes then these areas become land, the present river flows has caused from above water flows systems for a long time. Therefore, the soil layer is constituted silty clay and soft mud.
In the survey, channel bottom material were clay collected from three point and the grain size accumulation curve is shown in Figure 6-1-5.
The average grain size is Do=0.08mm and the character of this

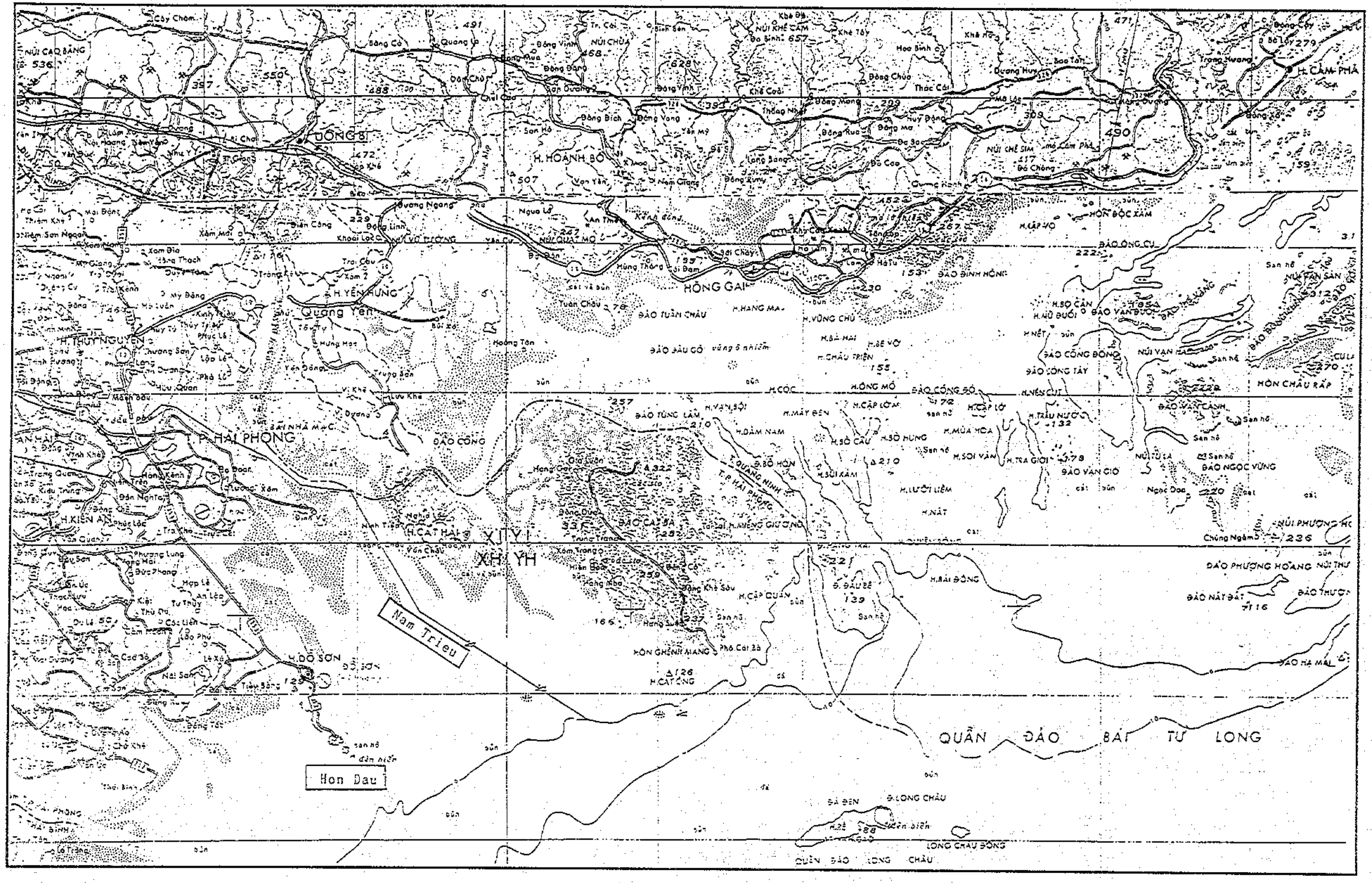


Figure 6-1-1 Nam Trieu Channel Location

SƠ ĐỒ HOA SÓNG VÀ HOA GIÓ TRẠM HÒN DẤU

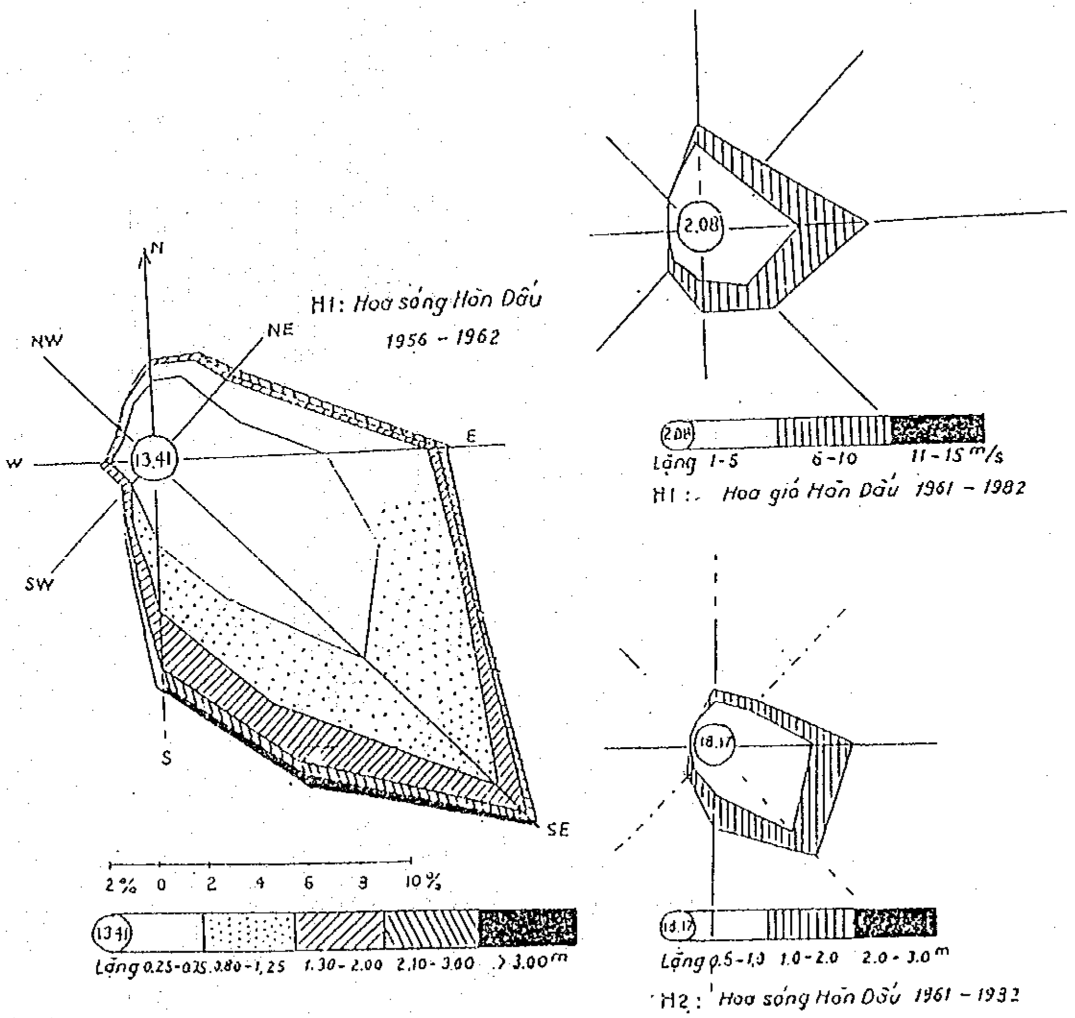


Figure 6-1-2 Frequency of Winds and Waves

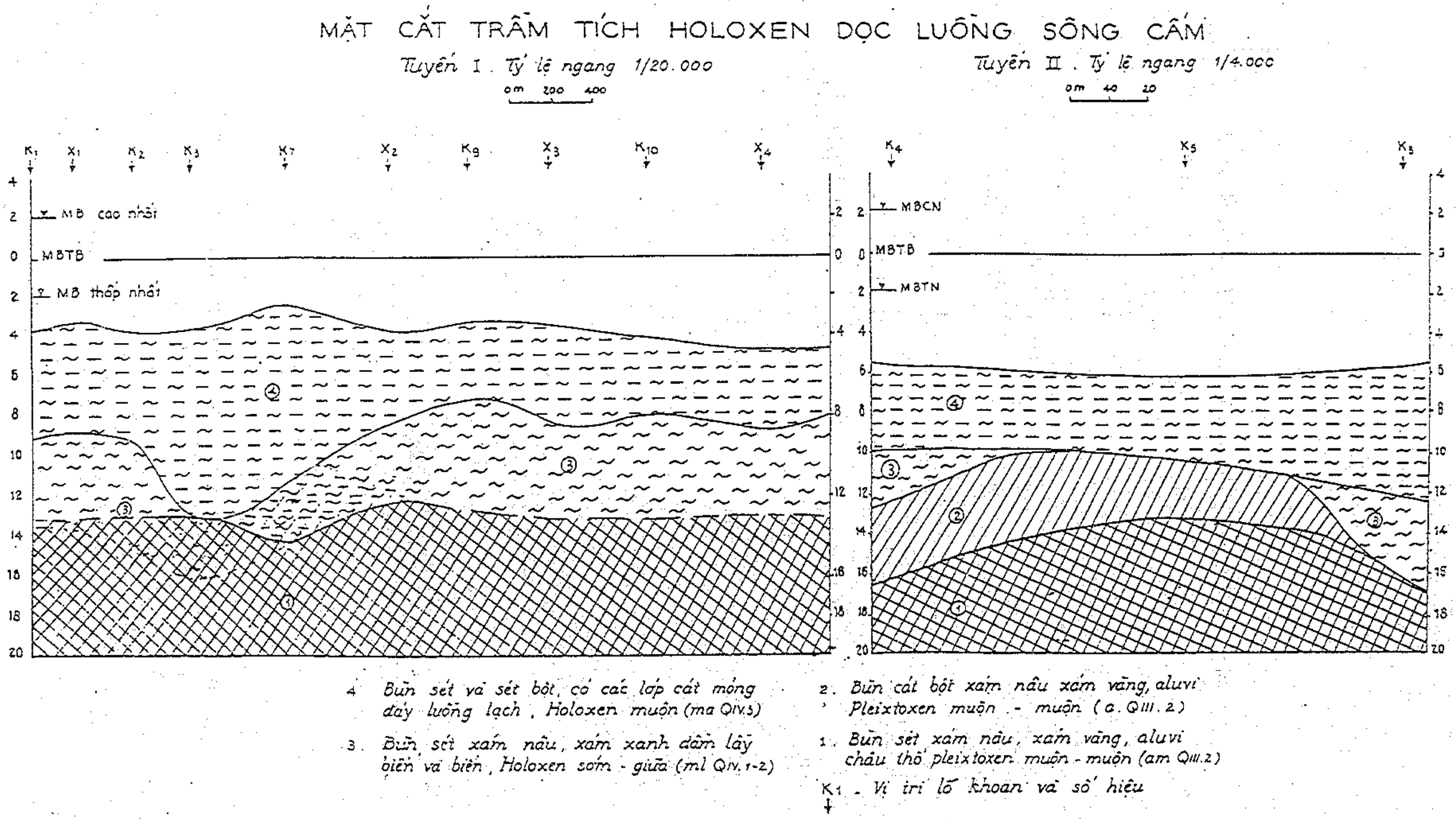
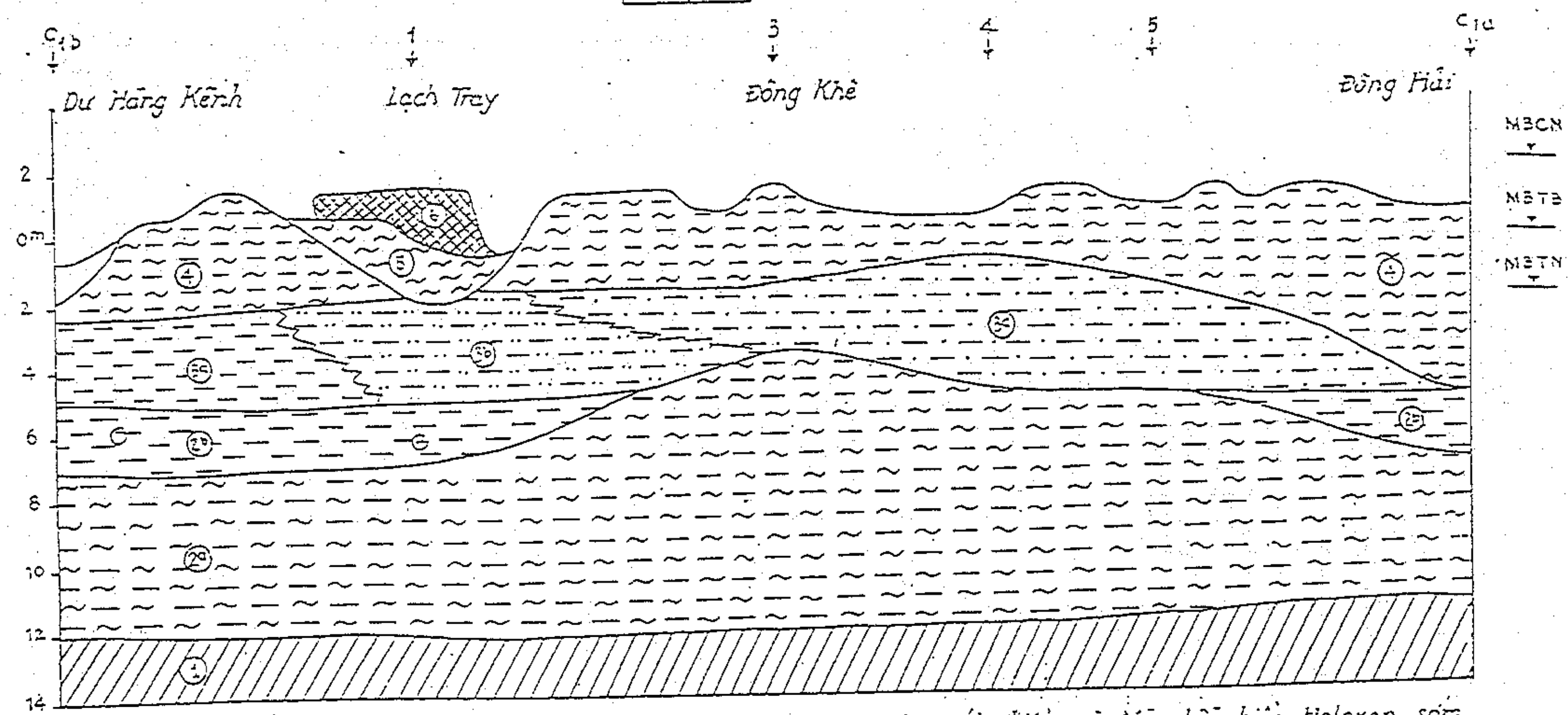


Figure 6-1-3 The Stratums of Cua Cam River

MẶT CẮT TRẦM TÍCH HOLOXEN DƯ HÀNG - ĐÔNG HẢI

Tỷ lệ ngang 1 : 25.000



6 - Đất đắp nền

5 - Bùn sét bột hồ, đầm lầy hiện đại

4 - Trầm tích Holoxen muộn (QIV3) bùn bột và bột sét biển (phần dưới) và sông biển (phần trên)

3 - Trầm tích Holoxen giữa - hồ đầm lầy (QIV.2)

2 - Trầm tích biển và đầm lầy biển Holoxen sớm-giữa (QIV.1-2) 2a - Chứa di tích mùn thực vật. 2b - Chứa nhiều vỏ thân mềm biển

1 - Trầm tích aluvi sông pleixtoxen muộn - muộn (QIII.2) sét, bột sét loang lổ nâu đỏ - trắng xám

⊥ - Vị trí và số hiệu lỗ khoan

Figure 6-1-4 The Stratums of Hai Phong-Dong Hai

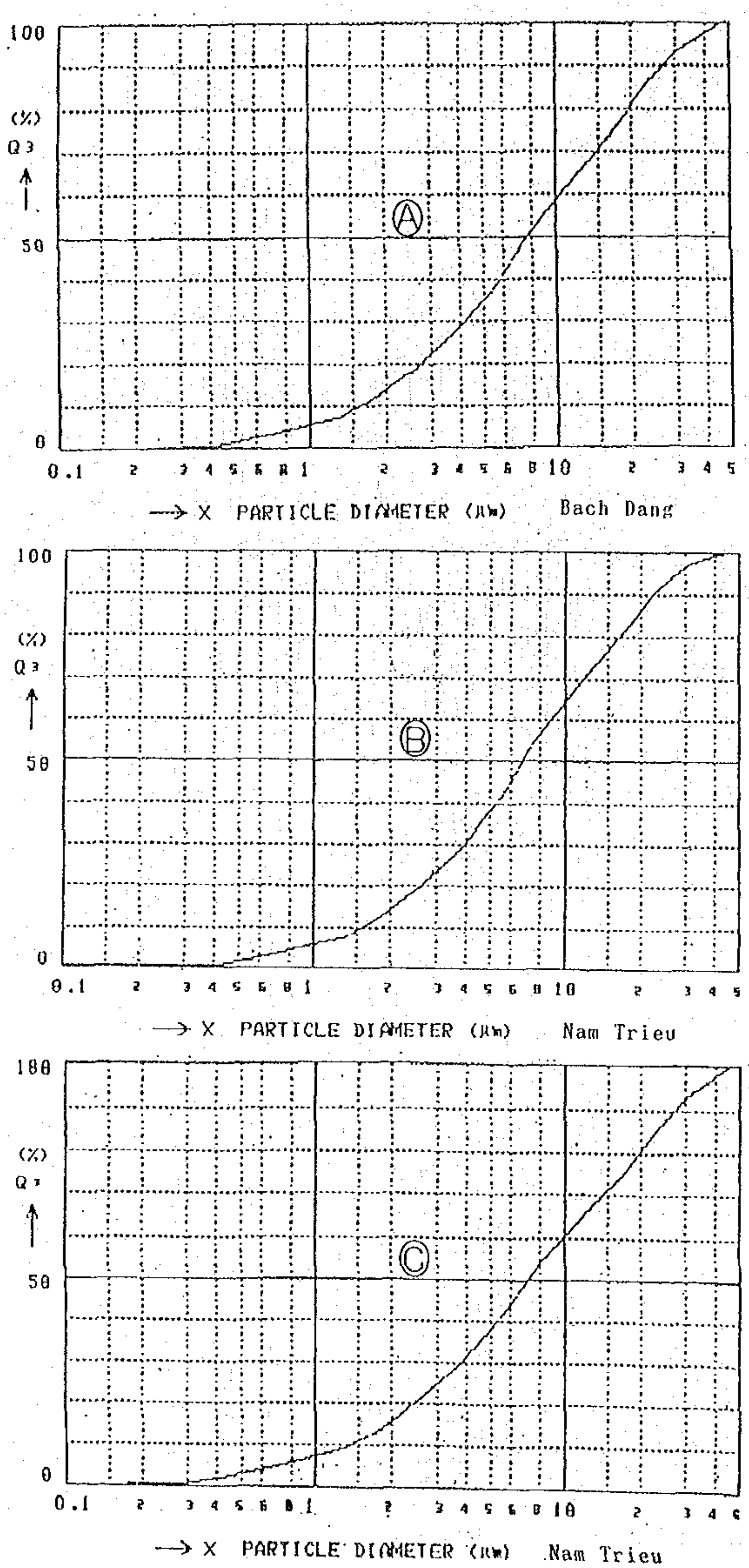


Figure 6-1-5 Grain Size Accumulation Curve in Access Channel

grain size will be easily transported and flowed as suspended load with current speed and/or wave action.

6-1-3 Sedimentation Mechanism

(1) Geographical change in the river

Although the sedimentation mechanism in the Cua Cam River was certainly changed by dredged of the Dinh Vu channel in 1912 due to connect with Cua Cam river and Bach Dang river, the depth of the Cua Cam River was not conspicuously changed except that part of its flows (hollowed sport) route was sedimented (see Fig. 6-1-7(1)). In the Nam Trieu channel, the flows center of the river shifted but the depth was not significantly changed, with the exception of an area around section IV in Figure 6-1-7(2). This area shallowed in depth by about 1.5m, probably due to coastal erosion on the Cat Hai shoreline of Ha Nam Island.

The most significant change occurred after the construction of the Dinh Vu Dam. Since this dam which has a top elevation of +4.5m constructed only for using as a connecting with Dinh Vu Island without study on the flows mechanism between Cua Cam River and Bach Dang River, its resulted in a rise of the water level on the rear by 30cm and Figure 6-1-7(2) indicates the far reaching influence on the Cua Cam River and Nam Trieu channel.

(2) Sedimentation Mechanism

Some of elements that trigger sedimentation are usually mixed-up, and this makes it difficult to accurately understand the sedimentation mechanism. Since we had a time constraint, the study was limited to estimate of sedimentation volume corresponding to each depth to analysis based on the record of dredged volume. Still, it was essential to establish guidelines about the sedimentation mechanism and some facts were collected from interviews with people concerned and by other means. Following is an outline of the information thus gathered;

1) Cua Cam River

The main port area, the flowing of Cua Cam River is hitting the in front of the Jetty facilities and the sediment load has washed out, its result to maintain the water depth. In particular, Berth No.11 is located on the upstream side and its depth has dept sufficiently -10.0m without maintenance dredging work by along stream of Jetty.
Nine dikes which have a length of 100 - 150m and masonry made, constructed along left bank in Cua Cam River from 1991 to 1992. Its function is water control structure such as allowing the turbulent diffusion, therefore some of fine grain size will be floating and transport to further downstream, also other function is increase the rate of current speed on the river bed nearby end of dike. Figure 6-1-8 shows salt water wedge. In the dry season, salt water wedge that are formed in upstream from the main port area and moves to downstream in rainy season. The salt water wedge line is rising up to the bend of the Cua Cam river (Vat Cach port area).
River water containing the suspended sediment have been transported from upstream and its flow is coming over the salt water wedges line, a chemical reaction causes more accelerate agglutination in this boundary zone, letting each suspended sediment (grain size). The river water is clear in the dry

SƠ ĐỒ PHÂN BỐ MẶT CẮT DỌC VÀ NGANG

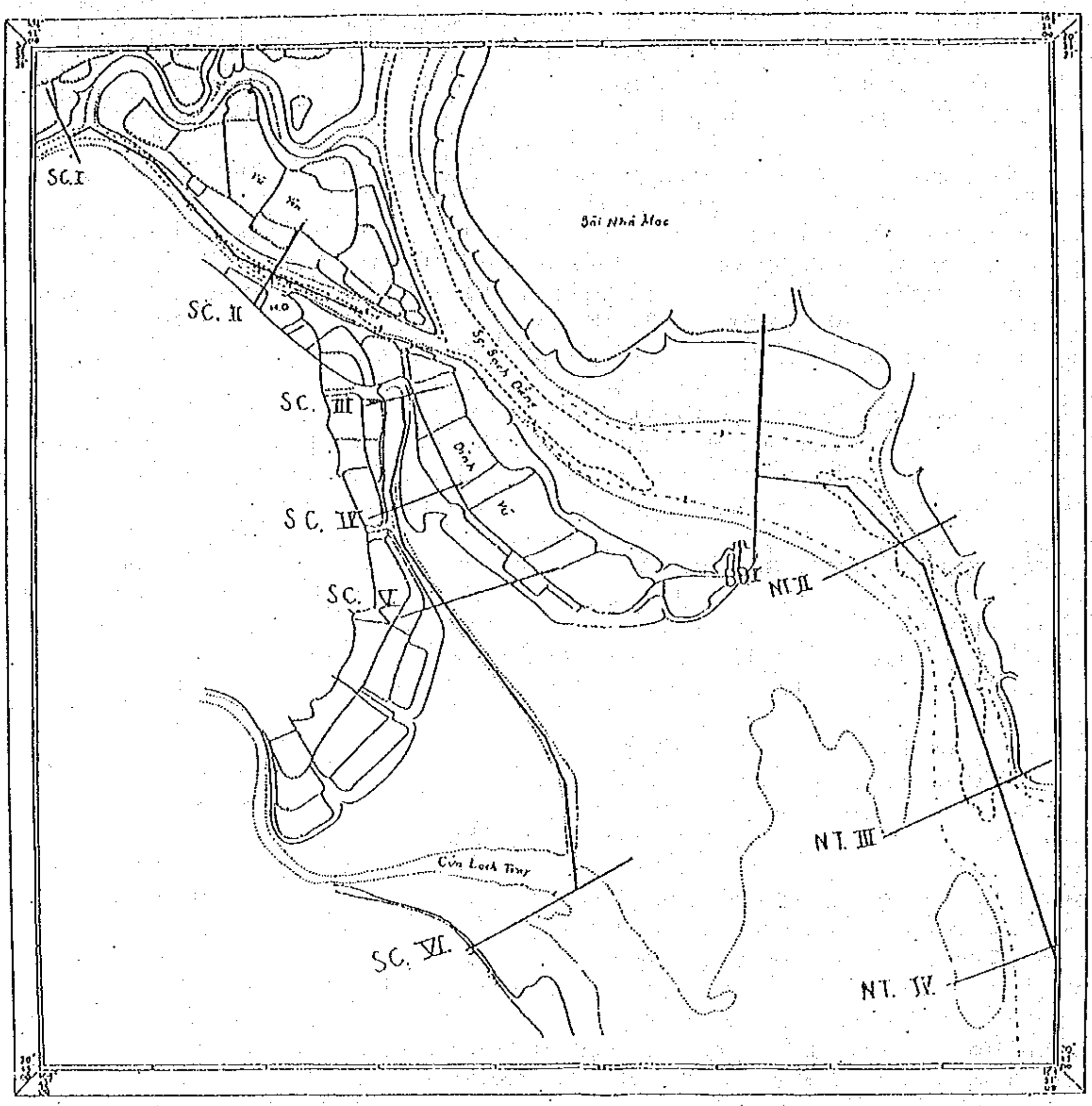


Figure 6-1-6 Bottom Conditions of Cua Cam and Bach Dang Rivers

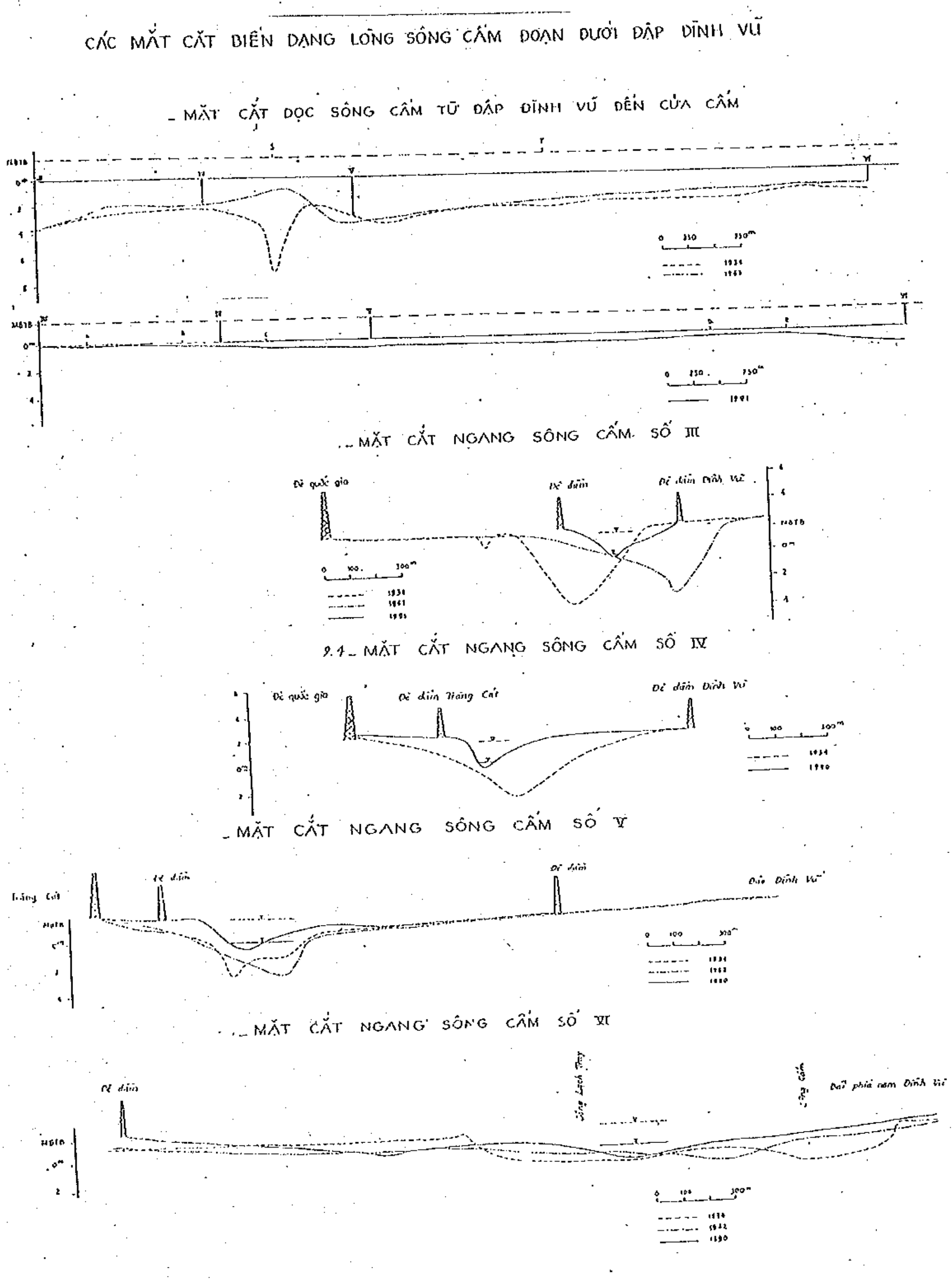


Figure 6-1-7(1) Bottom Conditions of Cua Cam River

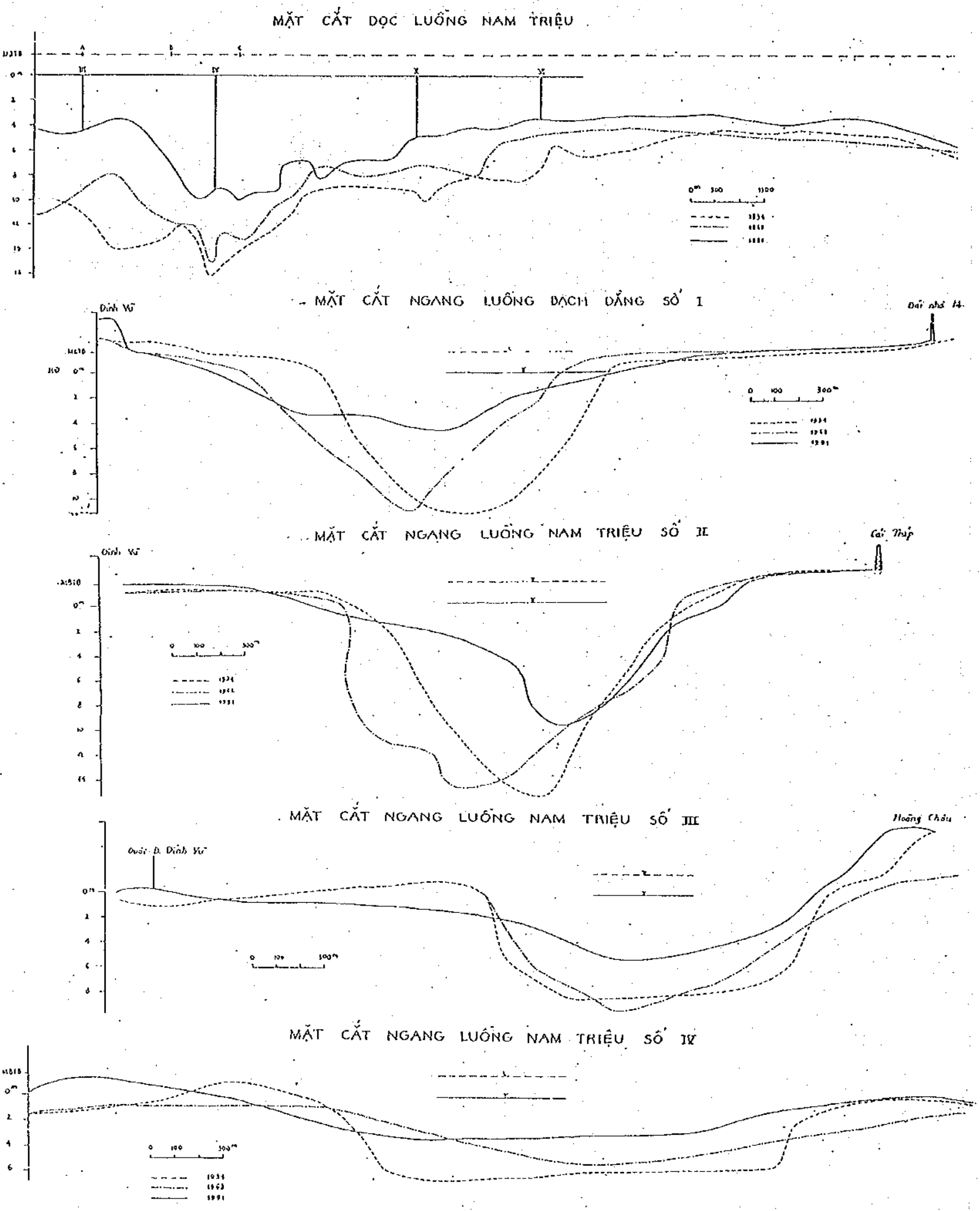


Figure 6-1-7(2) Bottom Conditions of Bach Dang River season, with only a small amount of suspended sediment, and the salt water wedge is positioned move upstream in this time, thus, it is assumed decreasing the sedimentation in the boundary zone.

2) Dinh Vu Channel

Because of the relatively small cross section of this part in the access channel, the water always flows fast except at high tide, and the suspended sediment is transported downstream (maximum 2m/sec. at low tide). the fine grain size (suspended sediment) has not been sinking in this part. Figure 6-1-9 shows the stratums soil condition of Dinh Vu Island. Sandy, silt fine sand is spread in this part. The erosion of slop of both banks have caused soft material and current speed, in a result, in these fine sandy silt have transported to downstream due to sediment of the access channel.
Therefore, the plan of new parallel dikes in order to protect these slope and keep the flow, was planned, because of some facilities construction in French period and this made it good result.

3) Bach Dang River

The river flow in this section will be more than 2km in width and even over 3km in the river-mouth section adjacent to the Nam Trieu channel. There are two deep areas supposed to have been formed by the bedload transport just downstream of the Dinh Vu channel and at the junction with the Nam River. Due to their depths exceeding -10m and widen this section and used by two-way navigation and as anchorage area. Since this widen area have been used dumping area for dredging work, and also the rate of sedimentation will be increased by slowly current speed and salt water wedge, the navigation depth is not enough as they used. Thus measures are required to maintain their depth. The shore of Bai Nha Mac Island has a water depth of 0.0m, and is over 3km long and 1km wide. It is now a supply source of the littoral drift. The view point of geographical, this section is likely to be sediment by suspended sediment, therefore, flow control is indispensable such as construction of dikes.

4) Nam Trieu Channel

This channel is the worst sedimentation volume section, and its phenomenon has caused a lot of complex elements. There are two factors that cause siltation: one is the sinking of sediment load flowing down from the river, the other is waves and tides stirring up the fine grain size mud from seabed (deposits) and transport in the channel. In this siltation included sand grain, it is considered to be a result of the coastal erosion on the Cat Hai shoreline of Ha Nam Island. figure 6-1-10 shows the littoral current in front of Cat Hai area. South and southeast waves affected by the geographical of sea bottom condition have concentrated on the Cat Hai shore, as is move clear from making a refraction diagram. this wave action will make a wave current which associated with a tidal current, creates a strong littoral current. Figure 6-1-11 shows the stratums in a vertical section of Cat Hai Island. The ground surface is covered by 4m thickness sand. The shoreline of Cat Hai has receded by about 3km in the past 50 years. The rate of erosion is equivalent to approximately 60m per year.
A vast amount of sand has gone to the seabed. Masonry revetment

for bank protection has been constructed partly along the receded shoreline, but it is by no means enough against the retreat.
As shown in Figure 6-1-10, the littoral current comes up along the shoreline into the Bach Dang River and keeps transporting erosion soil (mud and sand) from the beach to the Nam Trieu channel. To decrease the rate of sedimentation volume, this littoral current (transfer of sand) has to be prevented.
On the premises of the above discussion, an estimate of the sedimentation volume of the channel was worked out.

The change on rate of sedimentation in relation to dredged depth in Nam Trieu channel area during the period of 1991-1993 is graphically shown on Figure 6-1-12.

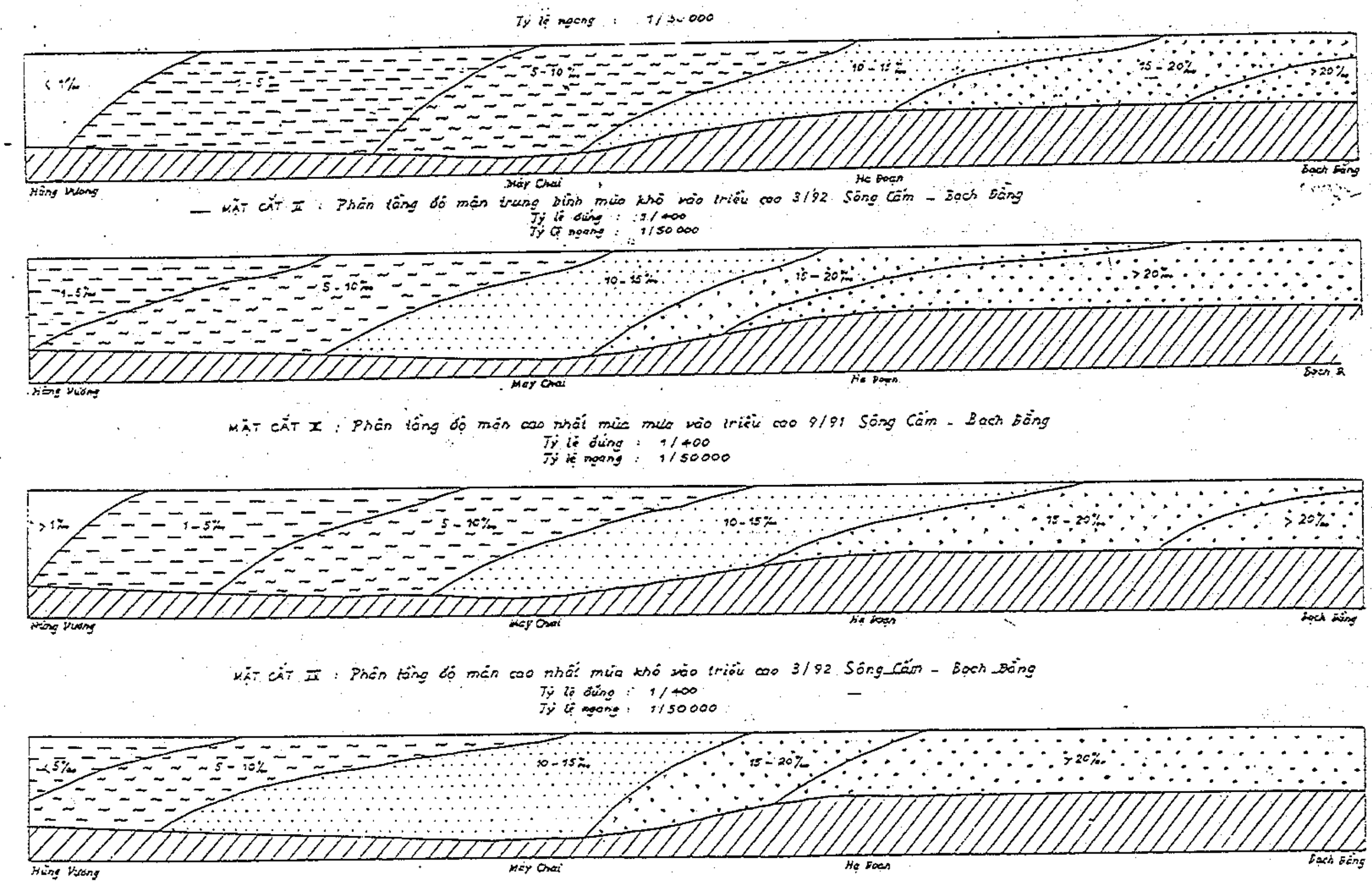


Figure 6-1-8 Salt water Wedges

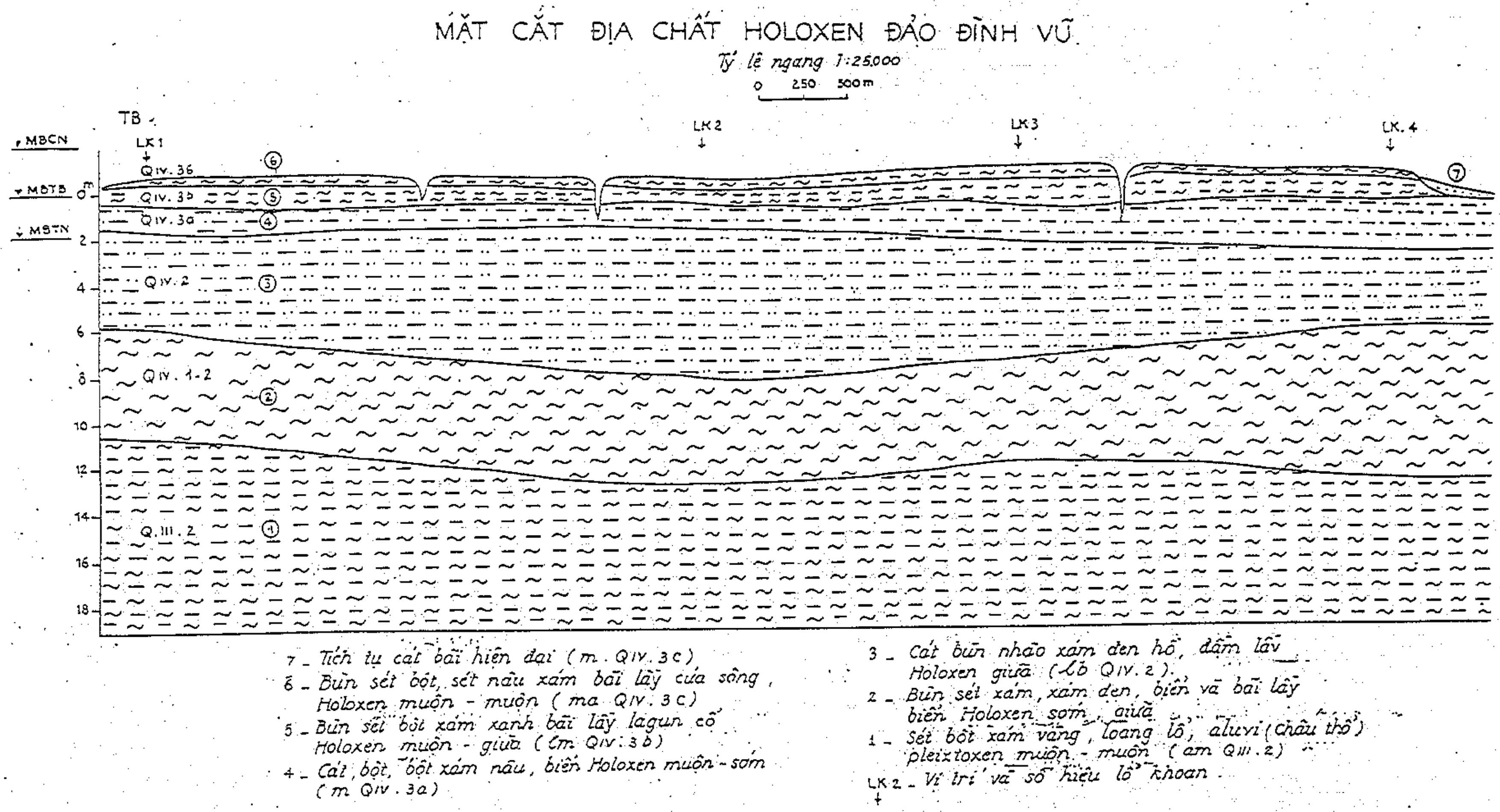


Figure 6-1-9 The Stratums of Dinh Vu Island

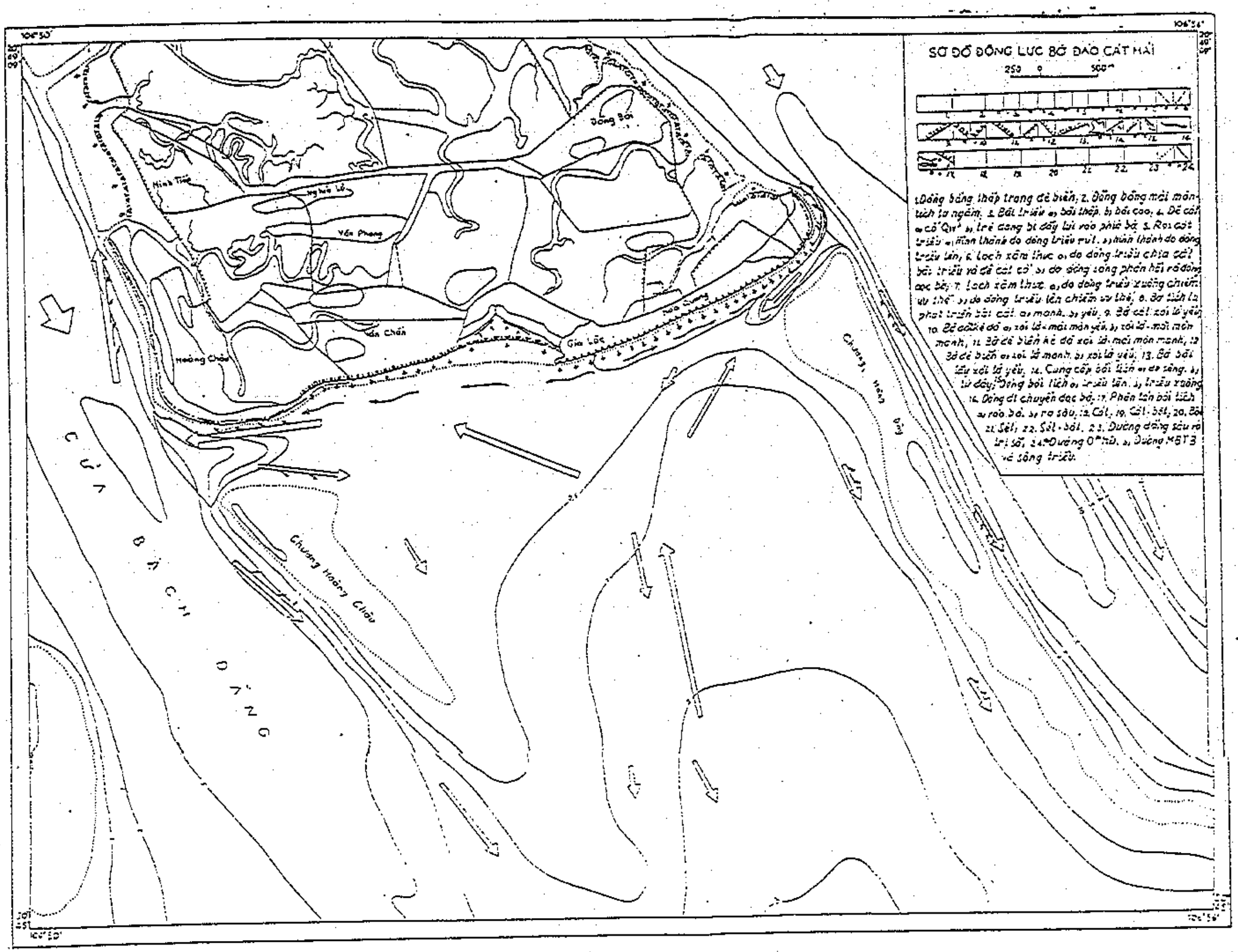
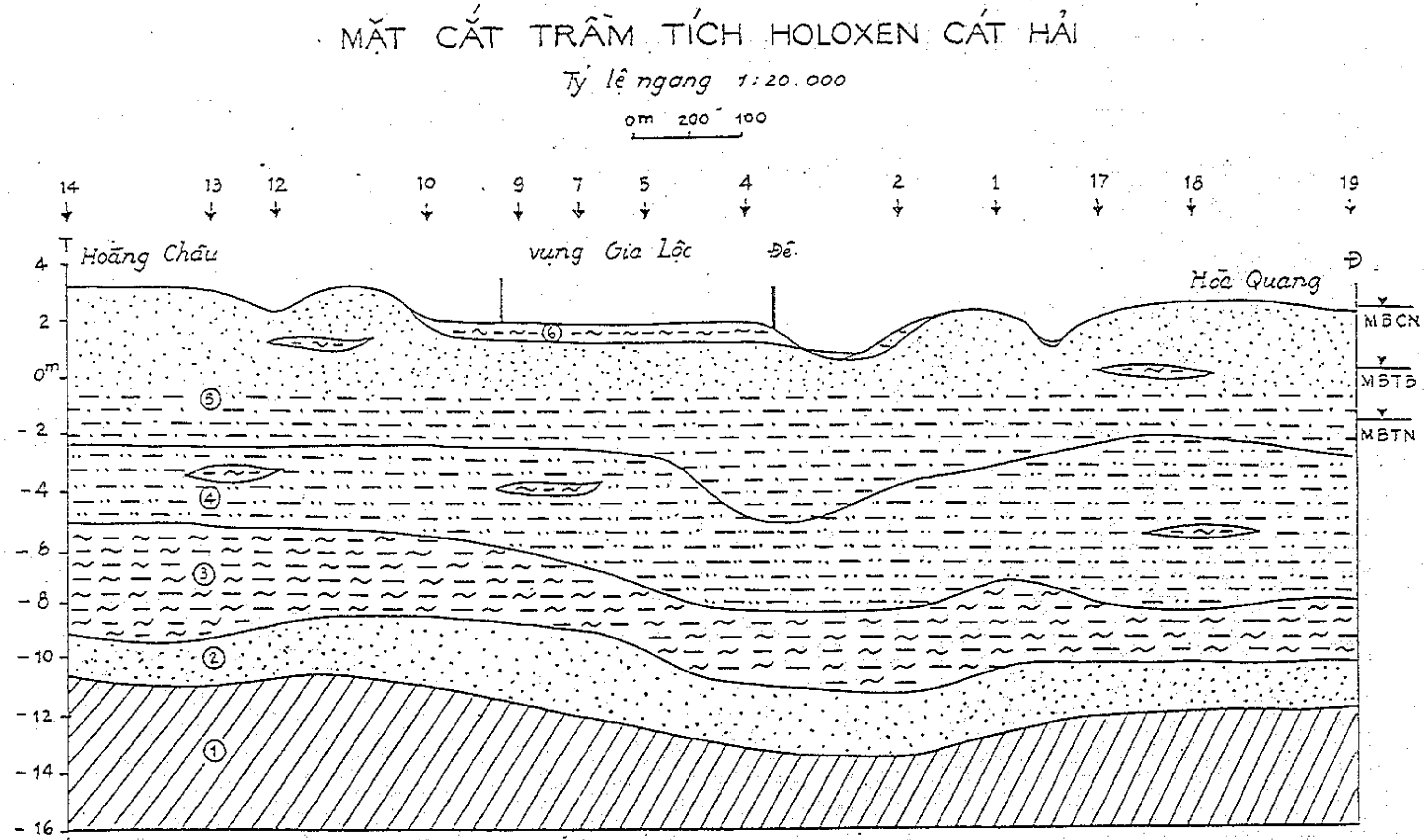


Figure 6-1-10 The Littoral Current in front of Cat Hai Area



6. Bùn bột sét bãi lầy biển Holoxen muộn - muộn (bm QIV.3c)
5. Cát nhỏ và cát bột biển Holoxen muộn - sớm và giữa (m QIV.3 a-b)
4. Cát bùn xám đen, chảy hồ đầm ven biển Holoxen giữa (ml QIV.1-2)
3. Sét bột xám xanh, bãi lầy biển và biển Holoxen sớm-giữa (ml QIV.1-2)
2. Cát nhỏ vàng nhạt, aluvi sông, Holoxen sớm (a QIV.1)
1. Nền sét bột quánh vàng xám loang lổ aluvi sông, pleixtoxen muộn - muộn (a QIII.2)
13. Vị trí và số hiệu lỗ khoan (viện các KHTĐ, 1987)

Figure 6-1-11 The Stratums of Cat Hai

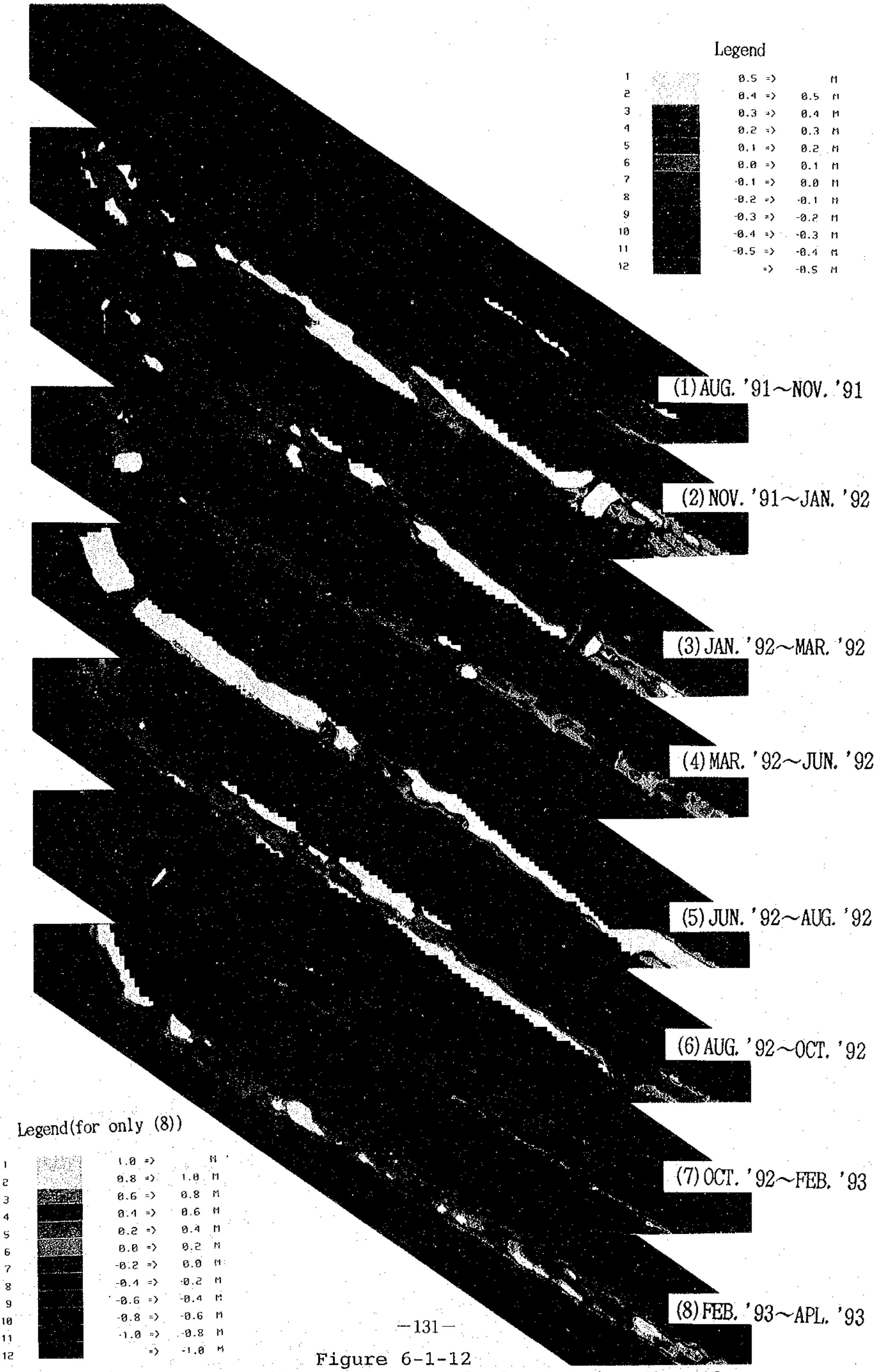


Figure 6-1-12
The rate of Sedimentation Speed of Nam Trieu Channel from 1991 to 1993

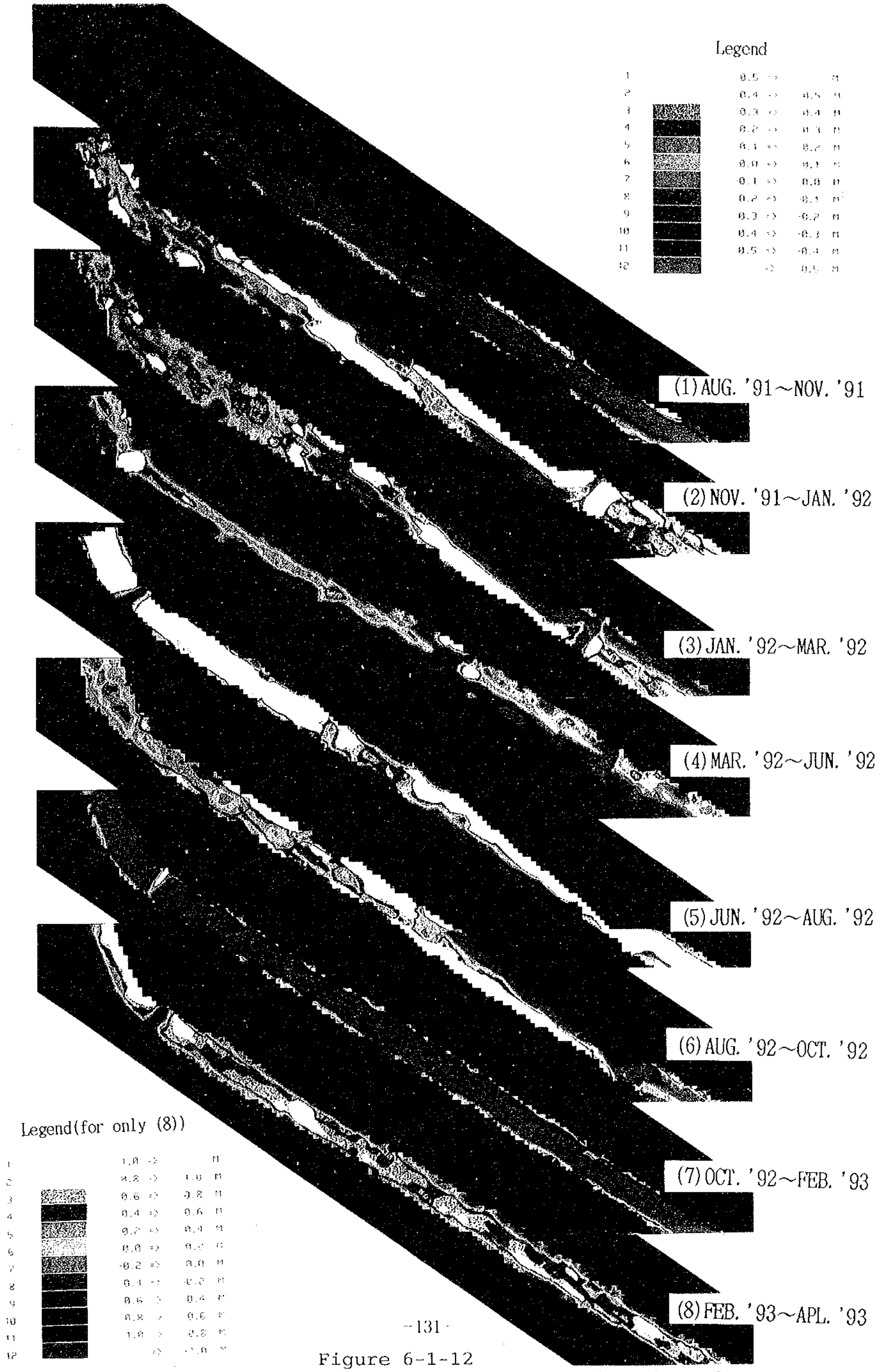


Figure 6-1-12
The rate of Sedimentation Speed of Nam Trieu Channel from 1991 to 1993

6-2 Nautical Aspect

(1) Ships Operation

Hai Phong Port is located 20 miles upstream of the estuary of Bach Dang river. When receiving the confirmed arrival information of ship to Hai Phong Port, the pilot drives up to Hon Dau and sail with a pilot boat to the point of N-20-40 and E-106-51 where the pilot boards the ship. (Long time ago, the pilot boat sailed from Hai Phong Port over a long distance through Cua Cam river up to the ship waiting off-shore near the zero buoy. This old practice forced somewhat inconvenient and time-consuming operation;)

Once the pilot on board, he maneuvers the ship until completing about 2.5 hours journey through the narrow channel. Currently, pilotage is compulsory for all foreign ships. In case of Vietnamese ship, this regulation is somewhat relaxed. The ships smaller than 1,000 DWT can call in and out of the Port without pilot, while local ship larger than 2,000 DWT shall be compulsorily piloted and the ships between 1,000 DWT and 2,000 DWT can come into the Port, steered by the captain holding the pilot license.

The ship, when passing through the outer-section of Nam Trieu channel(about 15 km long), navigates at a cruising speed of 7-8 knots. During this passage, sometimes the ship are severely influenced by waves and currents crossing the channel.

The inner-section of Nam Trieu Channel, sheltered by coastal plains and islands, provides more calm sea condition all through the year. The pilot maintains the cruising speed of 7-8 knots from the inner-section of Nam Trieu channel to Back Dang Channel. When approaching the very narrow 80 m wide section of Dinh Vu channel (1.3 km long), the pilot slows down the cruising speed to 3-4 knots, carefully passing through this section. Generally, the pilot adjust the timing of passing through this section so as not to be affected by frequently occurring flooding currents.

After passing this critical section, the pilot manoeuvre the ship slowly, less than 3 knots, paying attention to many binds of local ships sailing around nearby. When reaching the port area, the pilot, if necessary to berth to the starboard side, turn the ship in the designed turning basin between Berth No.4 and No.6, which is 250 m wide, allowing the turning of ship up to 156 m LOA.
In case of port side berthing, the ship docks at the berth allocated without turning (tug assistance for the vessel is compulsory for vessel larger than 3,000 DWT).

At the time of sailing out, the pilot handles the ship, following almost the same manoeuvre pattern. Most noteworthy, when passing the Dinh Vu section, the pilot pays utmost attention to handle the ship under the strong currents, from her stern, which are induced by both tide and river flows. The pilot usually re-checks the current condition when passing Dinh Vu section and adjust the de-berthing time of the ship in advance.

The existing navigation channel is 80-100 m wide and -4.1 m deep, only allowing one way traffic except in the two sections, one is between buoy No.15 and buoy 22 where the natural water is deeper than -4.0 m in the width of more than 300 to 500 m and another in between buoy 29 and buoy 31 which provides 400 m wide channel deeper than -4.0 m. While these deep and wide sections of navigation channel enable the ships to pass each other, most of ships prefer passing each other in wider section between buoy 29 and buoy 31.

The existing channel depth is as shallow as -4.1 m, so that most of larger vessels navigate through the channel under tidal operation. Larger vessels require significant tidal effect. Some vessels need high water tide of 3.5 m and most of large-size ships 2.5 m tidal level. In addition, the ships, when travelling the channel, require some under keep clearance, thus securing the safety passage under various environmental and vessel conditions. According to the pilot of Hai Phong Port. The under-keel clearance commonly used is 0.3 m at minimum. This figure seems considerably small, compared to other ports in the world. Even so, the sea bottom of the navigation channel is widely covered by about 1.0 m thick muddy soil, very soft, not to cause fatal problem for ship to manoeuvre touching the soft layer.
Taking into this sea bottom allowance, it can be said that actual under-keel clearance would be more than 1.0 m.

Most of the vessel calling at Hai Phong Port use high tide zone continuing from 4 to 6 hours, which vary in response to required tidal levels and the day.

For example, 2.5 m water level are available between 1,801 hours and 1,816 hours in 1994. The vessel, approaching to the Port in a cruising speed of 7-8 knots, takes about 2.5 hours to pass through the channel. According to the Hai Phong Port, the time intervals between each sailing ship should not be less than 30 minutes, so that the maximum channel transit capacity during this high-tide band can be estimated at 8 vessels in total.

(2) Navigation aids

Figure 6-2-1 shows the positions of navigation aids.

Marine Safety takes care of navigation aids. The access channel is indicated by 12 navigation aids (odd-numbered buoys) on the right, 22 (even-numbered buoys) on the left and six leading lights. The access channel range lights are installed on the Nam Trieu section and the Bach Dang section. The range on the Nam Trieu section are in called the Aval located on the line along which the curved section (ST.15) can be seen from the zero buoy. The other range, on the Bach Dang side, is now situated on land in Bai Nha Mac, not on the center line of the alignment of channel. But it is still used as an indicator for counting time to the curve (ST.12) by the pilots.

Some of the buoy lights employ a solar system, while the rest use batteries type. Batteries type are consumed unexpectedly fast due to temperature and other meteorological conditions, and there are some lights that do not lit brightly enough at night.

(3) Gross underkeel clearance

Usually, a gross underkeel clearance is determined after taking into account sinking of the hull, rolling and pitching of vessels, underkeel clearance, etc. For the access channel, the gross underkeel clearance was set at 0.3m over before 1976 and this is still remain the same. The value appears to be too small in consideration of the above factors. In fact experience has shown that the channel bottom is formed thickness of a 0.5m-1m fine silt stratums (r=1.20kg/m3), which density is judged to be almost the same as water. Hence, its thickness is included due to navigating in the above underkeel clearance. At present, the method of survey is carried out to use by a 200Hz echo sounder, therefore the measurement of water depth represents from the top of this fine silt stratums.

(4) Tidal operation

Since 1976, large vessel entering the port have been navigated by tidal operation, due to the limited depth of the access channel. As mentioned in Chapter 2-3-4, tide level of above +2.5m are considered with operating of in view of the time of navigation on the channel. The possibility of navigation draft of a vessel that needs to use a tide level is calculated from the actual channel depth and its the gross underkeel clearance. For instance, in 1992 the access channel depth (Nam Trieu) was about -4.3m; maximum vessel draft can be operated (4.3m existing+0.3m underkeel+tidal=7.1m). Any others vessel with a over above draft shall use a barge handling before port entrance. This is also known from a amount of the drafts of incoming vessels in 1992 (Figure 3-1-4, Chapter 3). Hon Dau's tidal chart was based on estimate for tidal operation. As there is a time-lag between Hon Dau and the main port of Hai Phong, as shown in Figure 6-2-2, its can be available operating longer navigation period than obtaining from the calculated tidal one.