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Ministry of Transport (MOT),The Socialist Republic of Vietnam

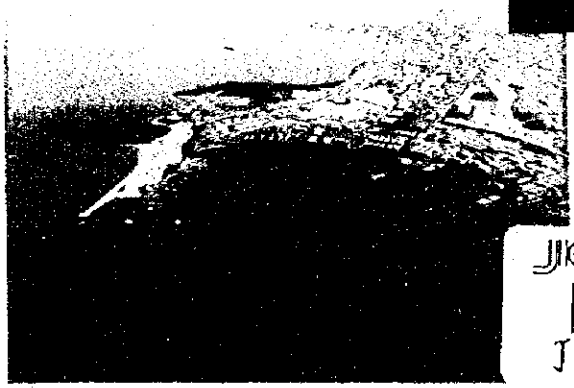
NO. 52

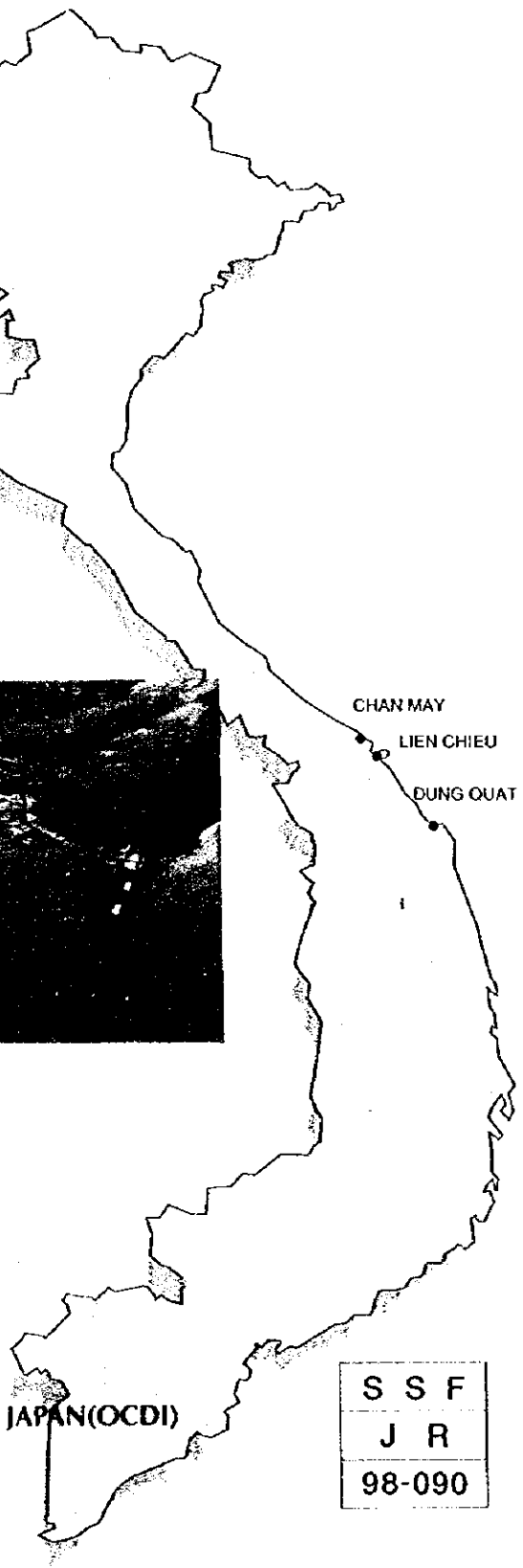
THE STUDY ON THE PORT DEVELOPMENT PLAN IN THE KEY AREA OF THE CENTRAL REGION IN THE SOCIALIST REPUBLIC OF VIETNAM

FINAL REPORT

SUMMARY

AUG 1998





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FINAL REPORT
THE STUDY ON THE PORT DEVELOPMENT PLAN IN THE KEY AREA

Exchange Rate

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(As of December, 1997)

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THE OVERSEAS COASTAL AREA DEVELOPMENT INSTITUTE OF JAPAN(OCDI)
JAPAN PORT CONSULTANTS,LTD(JPC)

PREFACE

In response to a request from the Government of the Socialist Republic of Vietnam, the Government of Japan decided to conduct the study on the port development plan in the key area of the central region and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Vietnam a study team headed by Mr. Yukio Nishida, senior executive director of the Overseas Coastal Area Development Institute of Japan, from February 1997 to May 1998.

The team held discussions with the officials concerned of the Government of Vietnam, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to officials concerned of the Government of the Socialist Republic of Vietnam for their close cooperation extended to the team.

August 1998

Kimio Fujita
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

August 1998

Mr. Kimio Fujita
President
Japan International Cooperation Agency

Sir,

I have the honor to submit herewith the Report for the Study on the Port Development Plan in the Key Area of the Central Region in the Socialist Republic of Vietnam.

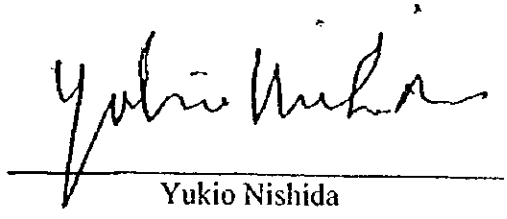
The study team which consists of the Overseas Coastal Area Development Institute of Japan (OCDI) and Japan Port Consultants, Ltd. (JPC), headed by myself, conducted a survey in the study area from February 1997 to May 1998 as per the contract with the Japan International Cooperation Agency.

In line with the scope of work agreed upon in September 1996 between both governments, long term development plans (target year 2020) of the three study areas, namely, Chan May, Lien Chieu and Dung Quat have been formulated. In addition, a short term development plan (target year 2010) of the selected area, Lien Chieu has been formulated and a feasibility study has been conducted. Furthermore, initial stage development plans of other two areas, Chan May and Dung Quat, have been formulated and a pre-feasibility study has been conducted in accordance with the discussion with the Government of Vietnam.

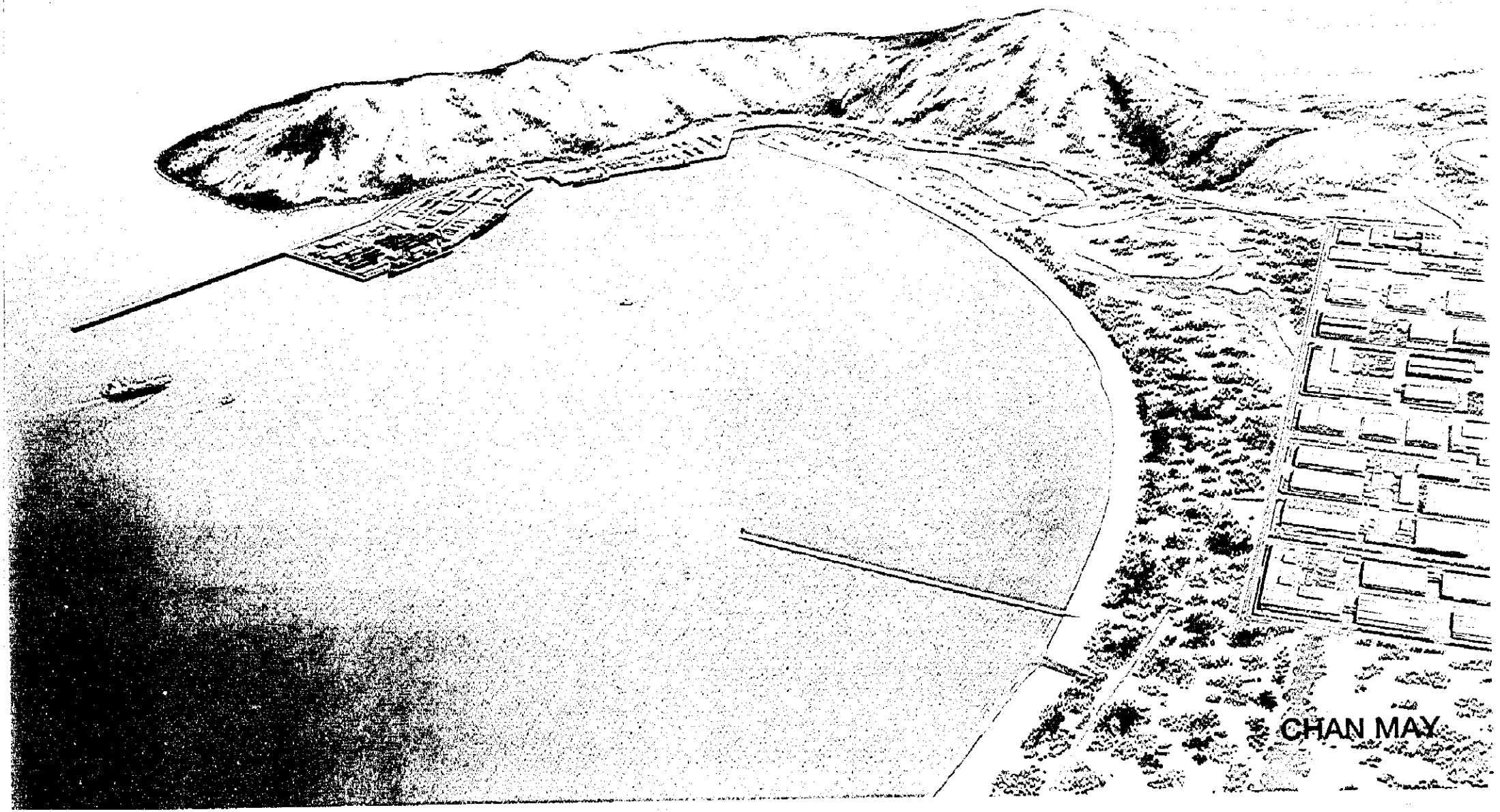
On behalf of the study team, I would like to express my deepest appreciation to the Government of Vietnam, Ministry of Transport and other authorities concerned for their brilliant cooperation and assistance and for the heartfelt hospitality which they extended to the study team during our stay in Vietnam.

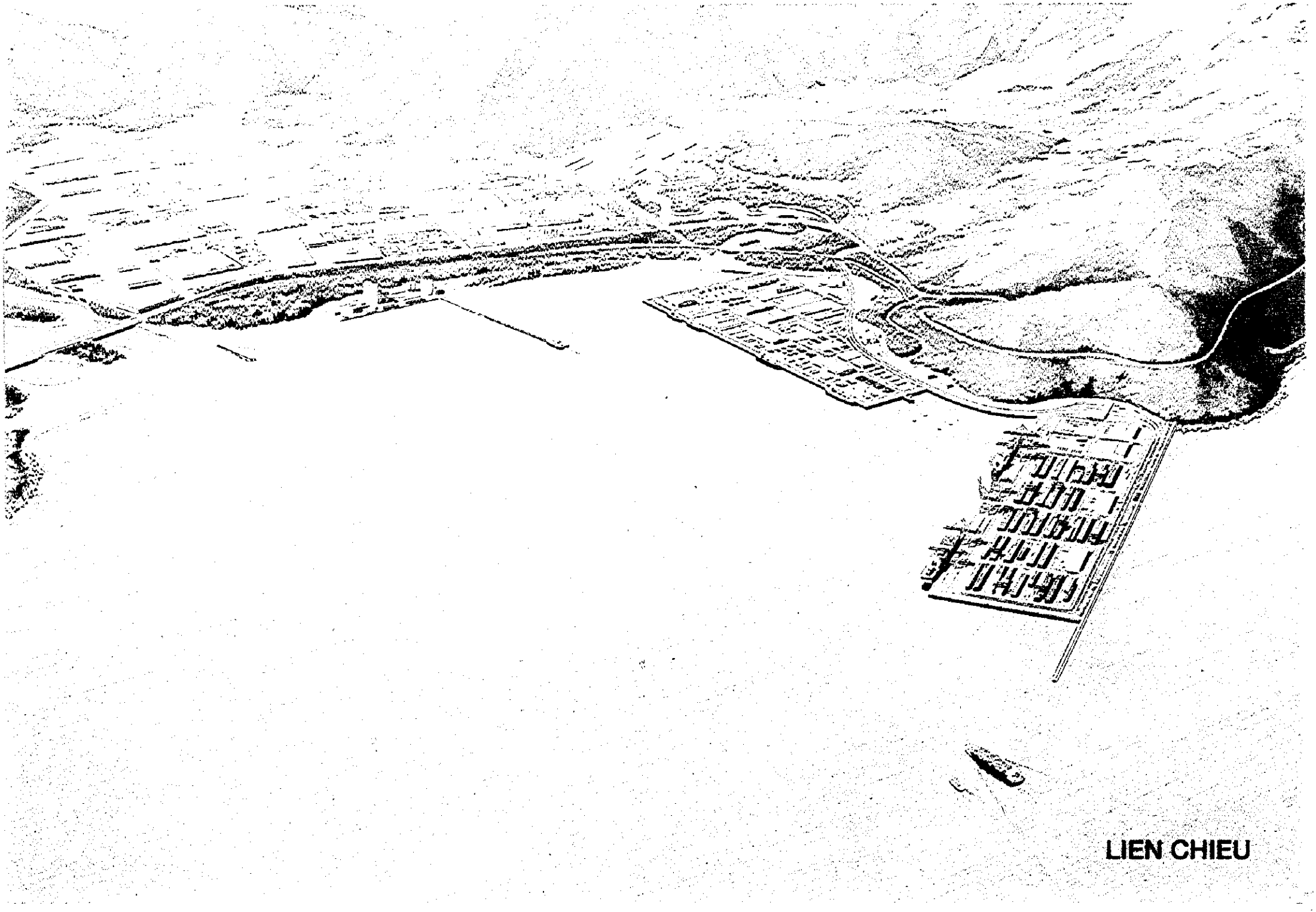
I am also greatly indebted to the Japan International Cooperation Agency, the Ministry of Foreign Affairs, the Ministry of Transport, the Overseas Economic Cooperation Fund, Japan and the Embassy of Japan in Vietnam for giving us valuable suggestions and assistance during the preparation of this report.

Respectfully,



Yukio Nishida
Leader of the Study Team for the Study
on the Port Development Plan
in the Key Area of the Central Region


CHAN MAY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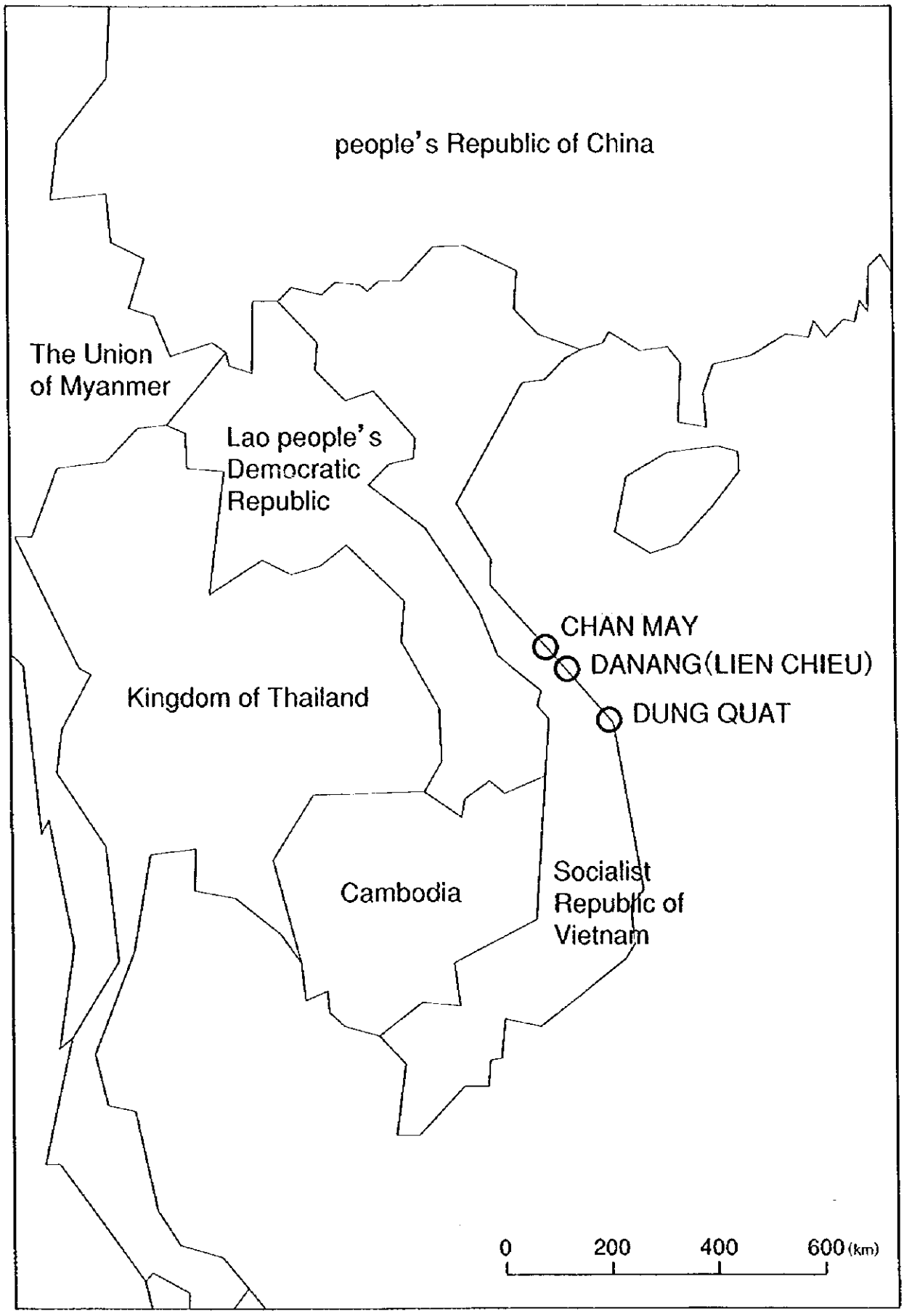

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Abbreviations

ADB	Asian Development Bank
ASEAN	Association of South-East Asian Nations
AFTA	ASEAN Free Trade Area
BOD	Biochemical Oxygen Demand
BOQ	Bill of Quantity
BOT	Build-Operate-Transfer
CDL	Chart Datum Level
CFC	Conversion Factor for Consumption
CFS	Container Freight Station
CM	Chan May
CIF	Cost, Insurance and Freight
COD	Chemical Oxygen Demand
CY	Container Yard
DEPIZA	Quangnam-Danang Export Processing and Industrial Zones Authority
DQ	Dung Quat
DWT	Dead Weight Tonnage
EIA	Environmental Impact Assessment
EIRR	Economic Internal Rate of Return
EPZ	Export Processing Zone
FCL	Full Container Load
FDI	Foreign Direct Investment
FIRR	Financial Internal Rate of Return
FOB	Freight on Board
FTZ	Free Trade Zone
GDP	Gross Domestic Product
GRT	Gross Registered Tonnage
GSO	General Statistics Office
HHWL	Highest High Water Level
HWL	Mean Monthly-Highest Water Level
IEE	Initial Environmental Examination
ICOR	Incremental Capital Output Ratio
ISP	Initial Stage Development Plan
IWB	Inland Waterway Bureau
IZ	Industrial Zone
JICA	Japan International Cooperation Agency

JPC	Japan Port Consultants, Ltd.
LC	Lien Chieu
LLWL	Lowest Low Water Level
LWL	Mean Monthly-Lowest Water Level
MHHWSL	Mean Higher High Water Springs Level
MHMC	Marine Hydro-meteorological Center
MLLWSL	Mean Lower Low Water Springs
MOC	Ministry of Construction
MOSTE	Ministry of Science, Technology and Environment
MOT	Ministry of Transport
MPI	Ministry of Planning and Investment
MSL	Mean Sea Level
NEA	National Environment Agency
OCDI	Overseas Coastal Area Development Institute of Japan
ODA	Official Development Assistance
OECF	Overseas Economic Cooperation Fund, Japan
PETROLIMEX	Vietnam National Petroleum Export-Import Co.
PMU	Project Management Unit
Ro/Ro	Roll on/Roll off
SCF	Standard Conversion Factor
SS	Suspended Solid (Material)
TEDI	Transport Engineering Design Incorporation
TDSI	Transport Development and Strategy Institute
TEU	Twenty Footer Equivalent Unit
VINALINES	Vietnam National Shipping Lines
THB	Thai Baht
VINAMARINE	Vietnam National Maritime Bureau
VMS	Vietnam Maritime Safety Agency
VSC	Vietnam Steel Corporation
VNCC	Vietnam Cement Corporation
VND	Vietnam Dong

EXECUTIVE SUMMARY

Executive Summary

(Natural Conditions)

Wind observations were also carried out in each project area throughout a year. The most frequent wind directions are N and SE in Chan May, NE and W in Lien Chieu, and ESE to SSE in Dung Quat.

Offshore waves were observed at two points on the coast of the central region. One ultrasonic – cum – water pressure – type wave recorder was placed on the seabed in the mouth of Danang Bay and another one was positioned off the Ky Ha Cape in Quang Nam Province. The maximum waves observed were 5.7[1/] m at the Danang bay mouth and 5.1 m at the Ky Ha offshore observation point.

Based on the observations and statistical analysis of 30 historical typhoons, offshore wave height for the return period of 50 years was estimated at 9.7 m in the deep sea off the Danang Bay and Chan May Cape, and at 8.8 m in the deep sea off Dung Quat Bay. Design wave height for the main breakwater of each port is 7.2 m for Chan May, 6.0m for Lien Chieu and 6.6 m for Dung Quat (Master Plan).

(Seabed Soil Conditions)

Soil boring investigations revealed that a thick clay/clayey sand layer exists in Chan May bay and Lien Chieu waters. A stratum of fine sand was identified at the depth of -20 to -28 m in Chan May and at the -16 to -28 m in Lien Chieu. Seabed soil in Dung Quat mainly consists of sand and sandy clay, with the bearing stratum at a depth between -20 to -25m.

(Demand Forecast)

A considerable increase in cargo throughput is envisaged in the central region owing to economic growth and industrial development. Projected seaborne dry cargo from/to the central region will reach 10-20[2/] million tons in the year 2020. Expected cargo throughput in 2020 is about 5.4 million tons at Chan May port, about 10.7 million tons in Danang port complex (of which 8.5 million tons at Lien Chieu area), and about 30.6 million tons at Dung Quat.

[1/] Significant wave height ($H_{1/3}$)

[2/] excluding crude oil and oil products

(International Transit Cargo)

Southern provinces of Lao PDR and northeast Thailand are deemed as the hinterland of the new port subject to the completion of R9 and Route R16/R18 of the East West Transport Corridor project. Projected cargo volumes in 2020 are 647,000 tons through R9 and 823,000 tons through R16/18. It is assumed that R9 will be developed firstly followed by R18. R16 is deemed to have a low development priority.

(Master Plan)

Chan May port is planned to have one multi-purpose berth for container cargo vessels and general cargo trampers; one deep draft conventional berth for car carriers, passenger ships and general cargo trampers; five conventional berths for general cargo and bulk/liquid cargo. Lien Chieu port development plan has two full size container berths, one multipurpose berth and 8 conventional general cargo berths. Dung Quat Port is planned to have two deep sea tanker berths, four berths for coastal shipping tankers, two deep sea bulk berths and 10 berths for coastal shipping vessels.

(Initial Stage Development Plan)

The development of each of the three ports is possible if industrial development of their hinterlands is realized and the demand for a new port is confirmed. Since a new port development generally requires a large initial investment in breakwater and/or channel dredging at the first stage, an appropriate scale of development is necessary for the project to be feasible. ISP is proposed as a package plan for the first stage of development in Chan May, Lien Chieu and Dung Quat.

(Implementation of Lien Chieu Development)

It is predicted that if the Tien Sa No.6 is developed, the first berth of Lien Chieu will become necessary by 2006/2010 depending on high/low cargo growth. In case that the Tien Sa No.6 is not developed, Lien Chieu will become necessary by 2004/2007 depending on cargo growth case. It is concluded that Lien Chieu has an advantage in land transportation, future development and rational development of hinterland although Tien Sa has an advantage in terms of less initial investment.

(Port Facility Design)

After comparing several designs of breakwater and quaywall, it was concluded that composite gravity type structure with hybrid caisson will be appropriate for deep sea breakwater and quaywall from the viewpoint of technical and economical aspects. In particular, the proposed structure will be suitable for the marine structure with high design wave heights and soft foundations.

(Cost Estimates)

The costs for the Initial Stage Development Plan are estimated at US$151 million for Chan May, US$158 million for Lien Chieu and US$119 million for Dung Quat. Cost estimates include infrastructures, dredging, cargo handling equipment, navigation aids, tug boats, engineering services, contingencies and tax. Preliminary cost estimates of each Master Plan are about US$ 258 million for Chan May, US$359 million for Lien Chieu and US$353 million for Dung Quat.

(Economic Analysis)

The results of the economic analysis indicate that port development projects of each site are viable from the viewpoint of the national economy. Economic Internal Rate of Return of ISP is shown below including sensitivity tests.

	EIRR of ISP	Sensitivity tests[3/]
Chan May:	17.2 %	14.7 %
Lien Chieu:	19.4 % (High growth)	16.3 %
	18.4 % (Low growth)	15.5 %
Dung Quat:	20.8 %	18.2 %

(Port Administration and Operations)

Although several port administration and management bodies are identified in Vietnam, such as Vinamarine, Vinalines, local government and the military, Vinamarine will be an adequate body for the development of the new commercial port in the central region. For the development of Dung Quat Port, it will be appropriate that dredging work and breakwater construction be performed using public funds and oil related port facilities be build by the oil company to be established.

(Financial Analysis)

FIRR is estimated at 5.7 % (high growth case) and at 5.1 % (low growth case). Owing to the fairly large investment in breakwater construction and capital dredging in the first stage, financial return of the Lien Chieu port development is not so attractive for the private investment, however, it is in a feasible range for the public sector subject to the procurement of soft loans like ODA.

(Environmental Survey)

Field surveys covered waves, currents, water pollution, shoreline sediments, terrestrial flora and fauna, and local residents and cultural assets. Although coral reefs were found near the project area, their location is limited and generally in poor condition.

3/ subject to 10% increase in development costs and 10% decrease in economic benefits

Bottom habitat of particular high value/importance has not been detected. The hinterland is unfertile, low productivity farm land and the area likely to be lost to waterfront use is currently low value, low populated land.

(Preliminary EIA for Lien Chieu)

To assess the impact of the port development, changes in tidal currents, beach accretion and erosion, the dispersion of water pollution and disposed materials are identified by means of computer simulation. Relocations of inhabitants are assessed at about 20 for the implementation of ISP of Lien Chieu. As a result, no significant adverse effect is shown in the preliminary EIA.

(Overall Evaluation of the Project)

Maritime transportation borne by the port development will greatly contribute to the development of the central region in terms of foreign currency earnings, job opportunities, trade promotion and industrial development. However, the development of a new port requires a fairly large capital investment in breakwaters and reclamation work in the deep sea area, so that financial feasibility is very critical in connection with construction cost and port revenues. As seen from EIRR, the port development projects in the three sites are economically effective and will have no particular difficulty in technical, environmental aspects. Consequently, the timing of the development of Chan May Port and Dung Quat Port should be carefully decided in connection with the industrial development of their hinterland. For the development of Lien Chieu, it will be feasible if a soft loan is available due to the fact that FIRR is calculated at 5.1-5.7 % while other financial indicators lie in a preferable range.

(Recommendations)

Duplication of port functions and facilities should be carefully avoided in view of the rational allocation of resources. Commercial port function shall be developed in the Danang Bay complex so as to attract shipping lines and international transit cargo through the scale of economy. Chan May has the potential to form a member of Danang Port complex and to be a multi-functional port, however, it will be appropriate in the initial stage to develop minimal port facilities for the planned Chan May industrial zone.

The current port administration of Vietnam rests on various organizations and lacks harmonious port development and management. MOT may be requested to make further coordination in the port development projects of private companies, government agencies and port authorities. Private sector participation shall be encouraged from the

viewpoint of the mobilization of private funds, however, port infrastructure can be developed by and remain with the public sector.

A considerable series of wave observations shall be continued for the detailed design of offshore breakwaters. Periodical surveys on the shoreline and bathymetry are important for safe, economical and successful construction. Periodical review of the master plan is also essential to meet any change in socio-economic conditions. The improvement in port statistics will be necessary for effective port management and planning.

Natural and social environment conservation shall be carefully planned at every stage of construction and operation. In order to reduce adverse effects, it will be necessary to establish an environmental policy for port development including water quality monitoring and a contingency plan for possible accidents.

The development of the Tien Sa area should be sufficient to meet the urgent demand. However, due to its limited expansion space and to prevent congestion on city roads, the scale of development shall be minimized. Therefore, it will be appropriate to immediately rehabilitate the Tien Sa No.1-4 berths and to upgrade the 11 km access road and Nguyen Van Troi Bridge, and then to develop the Lien Chieu area without Tien Sa No.6 berth. The scenario to develop Tien Sa No.6 before the development of Lien Chieu is given second priority (the case in which economic turmoil in Asian countries affects economic development of Vietnam severely thereby deferring development of the Lien Chieu area). Since this study did not include a detailed development plan of the Tien Sa area due to another on-going study, more detailed study on the improvement of the Tien Sa area may be helpful to clarify the development strategy.

Dung Quat Port requires large scale port development in the early stage of the industrial development. It will be necessary to develop the breakwater and turning basin using public funds to initiate the industrial development.

SUMMARY

1. Introduction

The Vietnamese economy, particularly in the south and north regions, has advanced remarkably in recent years, however the central region lags behind the north and the south and thus advancing this area has become a priority of the national government. The central region is also expected to be the gateway to Lao PDR and Northeast Thailand as part of the East-West Transport Corridor Project, which involves the regional countries, international funding agencies, and donor countries.

To encourage the development of the central region and to improve the transport infrastructure for the East-West Transport Corridor, port development projects are proposed in several coastal areas of the central region. In particular, port development in Chan May, Lien Chieu and Dung Quat is of interest to the national government not only for the development of the central region but also for international transit.

This study aims at formulating long-term port development plans for Chan May, Lien Chieu, and Dung Quat and at proposing the initial stage development plan for the three sites, which consists of a package of the port facilities required for the first stage of a new port development. The objectives of the Study are:

1) to formulate long-term port development plans for the period up to the year in and around 2020 for the three development sites;

2) to formulate an initial stage plan encompassing the package of port facilities to be developed at the first stage of the development; and

3) to make a financial analysis and environmental impact study for a selected initial stage development plan to assess the feasibility of the project as a short term development plan up to the year in and around 2010.

The study team collaborated with the counterpart team organized by TEDI and TDSI. A steering committee was established by the MPI, MOT and other related organizations to direct and coordinate the study. Members of the steering committee, counterpart team and JICA study team are listed below:

Members of the Steering Committee

Mr. Pham Quang Tuyen	Leader, Vice Minister of MOT
Mr. Nguyen Vuong Ta	Director, Department of Infrastructure and Urban, MPI
Dr. Tran Doan Tho	Director, Planning & Investment Department, MOT
Mr. Bui Duc Nhuan	Vice Chairman, Vinamarine, MOT
Mr. Tran Van Dung	Chairman, TEDI, MOT
Mr. Nguyen Vinh Loc	Vice Director, Department of International Cooperation, MOT
Mr. Pham Dinh Vinh	General Director, Management Project Unit of Eastern Sea Construction, MOT
Mr. Nguyen Quang Bau	Director, Transport Development Strategy Institute, MOT
Mr. Nguyen Ngoc Tran	General Director, Management Project Unit No. 85, MOT

Members of Counterpart Team

Mr. Tran Van Dung	Leader, Chairman, TEDI
Dr. Nguyen Ngoc Hue	Director, TEDI port, TEDI
Mr. Nguyen Xuan Chien	Manager Technical Department, TEDI
Mr. Tran Trung	Business Management Department, TEDI
Mr. Nguyen Van Tien	Port Department, TEDI
Ms. Ngo Thuy Quynh	Port Department, TEDI
Ms. Le My Hanh	Technical Department, TEDI
Mr. Pham Van Xuan	Environmental Expert, TEDI
Ms. Nguyen Thi Vuot	Demand Forecast Expert, TDSI
Mr. Nguyen Dinh Tranh	Technical Department, TEDI
Ms. La Hong Hanh	Port Department, TEDI
Mr. Le Toan Thanh	International Cooperation Department, TEDI

Members of JICA Study Team

Mr. Yukio Nishida	Leader, Overall Management, OCDI
Mr. Sumio Suzuki	Deputy Leader, Port Planning/Environmental Consideration, OCDI
Mr. Toshihiko Kamemura	International Freight Transportation, OCDI
Mr. Naoki Kudo	Demand Forecast/Economic Analysis, OCDI
Mr. Motoshi Koga	Port Management & Operations/Financial Analysis,OCDI
Mr. Kohei Nagai	Natural Conditions, JPC
Mr. Takahisa Sogabe	Facility Design/Soil Investigation, JPC
Mr. Kiyoshi Watanabe	Construction Planning/Cost Estimates, JPC
Mr. Stephen R. Nicholls	Natural Environment Study, JPC
Prof. Dr. Nguyen Van Truong	Social Environment Study, JPC
Mr. Yuuichi Sasaki	Coordination(1), OCDI
Mr. Hideki Kobayashi	Coordination(2), OCDI
Mr. Masahiro Nakamura	Coordination(3), OCDI
Mr. Ryu Mizukoshi	Interpreter, OCDI

2. Overview of the Project Area

2.1 Socio-economic Conditions

(1) Location

The three study site, namely Chan May in Thua Thien-Hue Province, Lien Chieu in Danang City and Dung Quat in Quang Ngai Province are located along the South China in the central region of Vietnam.

(2) Climate

The coastal area of central Vietnam are characterized by its tropical monsoon climate with two distinct seasons, the rainy and dry season. The annual average temperature is 25°c, while the maximum is 30°c and the minimum is 20°c approximately. The annual rainfall is from 2,400 to 3,100mm, mainly from September to December.

(3) Population and Labor Force

Province	Population	Labor (thous. persons)			
		Total	Agriculture & Forestry	Construction Industry	Services
Thua Thien - Hue	1,003	407	273	50	85
Danang & Quang Nam	1,984	934	669	105	159
Quang Ngai	1,184	552	443	35	73
All Vietnam	73,959	34,700	25,200	4,700	4,800

Source: General Statistical Office, Statistics in 1995

(4) Area and Land Use

Unit: m^2 per capita

Province	Natural Land	Agri. land	Forestry used land	Special used land	Home stead land	Waste land
Thua Thien-Hue	5,032	469	1,724	156	112	2,571
Quang Nam-Da Nang	6,138	573	2,478	320	41	2,726
Quang Ngai	4,384	736	1,305	142	53	2,148
All Vietnam	4,565	1,016	1,367	155	99	1,928

Source: General Statistical Office, Statistics in 1995

(5) Economic Situation

Province	GDP (million USD)	GDP per capita (USD)
Thua Thien-Hue	253.0	252.2
Danang and Quangnam	488.2	246.1
Quang Ngai	176.2	148.8
All Vietnam	21,021.0	288.0

Source: Transport Development and Strategy Institute, Statistics in 1994

2.2 Lao PDR and Northeast Thailand

Lao PDR

Five provinces of the south region in Lao PDR, namely Savannakhet, Champasack, Saravane, Attapeu and Sekhong, are recognized as the hinterland of central Vietnamese ports. The population of this area represents 34.5% of the whole country; it accounts for 28% of the country's land area; and 29.2% of the nation's industrial establishments are found here.

Northeast Thailand

Northeast Region of Thailand includes 19 provinces, namely Nakhon Ratchasima, Buri Ram, Chaiyaphum, Surin, Ubon Ratchathani, Si Sa Ket, Amnat Charoen, Yasothon, Khon Kaen, Kalasin, Maha Sarakham, Roi Et, Udon Thani, Nong Bua Lam Phu, Loei, Nong Khai, Sakon Nakhon, Nakhon Phanom and Mukdahan. The Northeast Region is spread over a wide area and the western part of the region is closer to Bangkok than Vietnamese ports; for example, Nakhon Ratchasima is 259 km away from Bangkok and 383 km away from Mukdahan. The hinterland of the Vietnamese ports is slightly east of the line that connects Sakon Nakhon and Yasothon and is estimated to be 65 km away from Mukdahan and 80 km away from Ubon-Ratchathani.

Trade Flow in Greater Mekong Sub-Region

Trade within East Indochina has increased annually but trading volume is still small. In the case of Lao, total trade volume is small, but trade within the East Indochina represents a large portion. Thailand has the same scale of trade with Vietnam as Lao. But Vietnam has a small scale of trade with Lao compared to Thailand.

The traffic data at Lao Bao, Lao-Vietnam border, indicates that the volume of border trade and border traffic has decreased since 1991 and remains at a stable level from 1993.

The Road Route 9 is a major corridor for current freight transportation between Lao and Vietnam. Major commodities traded are electric products from Thailand, daily goods from China, gypsum from Lao, oil products from Vietnam and so on. Before the political reform of the USSR, cargoes from the eastern countries to Lao via Danang were considerably larger than these days.

3. Ports (Danang Port)

3.1 Location

Danang Port, located in the middle part of the country, has an important position as the third largest seaport of Vietnam. This port is comprised of two distinct parts: one is in Tien Sa district facing Danang Bay and the other is in Song Han district facing the Han River which is flowing into the bay.

3.2 Port Facility

Tien Sa District has two piers, each of 186m long, 27.3~29.3m wide, and water depth is -11m, consisting of four berths for 30,000 DWT ships at maximum. A third pier 165m long and water depth -12m is now being under construction for container ships near existing two piers. The total area is 18.3ha, of which the yard occupies 90,000m^2 and 3 warehouses of 15,945m^2.

Song Han District, extending along the left bank of the Han river, has a length of 750m with 8 berths of -6 to-7m depth for 5000DWT ships at maximum. The Port occupies an area of 3.4ha where open storage yard of 8,000m^2 and 3 warehouses of 8,225m^2 are being used for cargo handling and storing.

3.3 Cargo Throughput

The major import commodities are chemical fertilizer, cement, kaolin, iron steel, equipment and tar. The major export commodities are pulp, sand, and food grain. Trends of cargo volume of export/import and domestic are shown in Table 3.1.

Table 3.1 Cargo Throughput of Danang Port Unit: Ton

Item		1994	1995	1996	1997
Foreign	Export	119,510	149,424	198,187	279,726
	Import	489,811	631,657	582,057	433,489
Domestic	Loading	2,352	3,564	5,770	6,489
	Unloading	55,072	45,597	61,886	162,514
(Total)		666,745	830,242	847,900	882,218

Source: Danang Port ***

4. Natural Conditions

Available data on various **hydro-meteorological conditions** are collected and analyzed at Chan May, Lien Chieu and Dung Quat, which includes such phenomena as tide, wind, wave, ocean current, tidal current, storm surge, rainfall, and sediment transport. Information essential for planning, design and construction of port facilities were arranged such as tidal levels.

On the other hand, the JICA Study Team / POWECO itself carried out site surveys of important conditions and phenomena. Wind has been observed on the coasts of Chan May, Lien Chieu, and Ky Ha (Dung Quat) for one year. Wave records were taken at the mouth of Danang Bay for six months and off Ky Ha Cape for 11 months. Sizes of sediment on the seabed were measured at the three sites. Change in beach width was monitored at Chan May Beach for a half year. Tidal current, longshore current, bathymetry, topography, and river discharge were surveyed at Danang. The results of these surveys are presented in the main text.

Wave is one of the most important and characteristic conditions revealed in this Study. The highest maximum wave height recorded was 9.0 m at Danang and 7.9 m at Ky Ha which were created by Typhoon 9721 (*Fritz*) in September 1997 as shown in Figure 4.1. High waves by Typhoon 9726 (*Lynda*) were also successfully recorded. Existence of long period waves as long as 16 seconds was found at these stations. In order to assess statistically the extraordinary wave with a return period of 50 years, hindcast of waves generated by the past 30 typhoons from 1961 was done by a wave spectral method. Actual waves by Typhoon 9721 were utilized to verify the accuracy and set parameters of the method. As the result, the offshore deepwater wave height estimated was 9.7 m at Chan May, 9.7 m at Danang, and 8.8 m at Dung Quat as shown in Figure 4.2. Ordinary waves were also calculated for two years from 1993 to 1994 to obtain the frequency distributions of daily waves by direction, height and period at the three Study Areas.

Applying the above surveyed data, anticipated changes of shorelines were simulated by One Line Theory at the three beaches for the planned layouts of ISP and Master Plan. The changes are not expected to be serious. The sedimentation volume in the access channel and basins is also computed by means of Local Sand Drift Model for ISP of Lien Chieu. It is concluded that the sedimentation volume could be an order of 50,000 to 100,000 m^3 per annum in this case.

As the development plans at the three Study Areas all have to be carried out under the above severe sea conditions, among other items waves due to typhoons and the northeast monsoon, it is recommended to make efforts to continue wave observation and other related surveys.

Another important natural condition is the **geo-technical condition**. Available soil data for port development in Chan May, Lien Chieu and Dung Quat was assimilated from TEDI and other Vietnamese organizations. On top of that, JICA Study Team / POWECO carried out 12 borings and laboratory tests in the three Study Areas from the end of August to early November.

As the soil profiles in Figure 4.8.6 (1) to (4) in the main report show, the upper layers of these bore holes consist mostly of cohesive soils, of which N-values by SPT are under 5 except Nos. 1 and 2 holes in Dung Quat. Most of these cohesive soils are classified into silty clay, which have low plasticity. This means, when the layers consist of these soils are loaded by the weight of upper structures, the subsidence of underlying foundation will not occur very much quantitatively.

The bearing layers appear at the depth of CDL –20 to 28m at Chan May, -16 to 28m at Lien Chieu, and -20 to 25m at Dung Quat. In Chan May, these bearing layers are well-graded sand mixed with small quantity of clay and gravel or very stiff lean clay. In Lien Chieu, they are all dense medium sand. In Dung Quat, they are hard sandy lean clay, weathered granite, or well-graded dense sand. All of these bearing layers have N-values of near 50.

To evaluate soil characteristics, 153 soil samples were taken at the three ports and analyzed by various soil tests. Results are tabulated in Table 4.8.2 in the main report.

As an important index for evaluating the strength of soft soils, the value of cohesion is examined. They distribute between 0.1 to 1.3 kgf/cm^2 in Chan May. The values at the lower layers, which have values over 0.85 kgf/cm^2 at two points and over 0.95 kgf/cm^2 at one point, are those of just under silty sand layers that have 10m thickness with N-values of 6 to 21, and of 6 to 20, respectively.

The values of cohesion in Lien Chieu distribute between 0.1 and 0.25 kgf/cm^2. It seems that the strength of the upper soft layers is as same as that in Chan May. However, the thickness of soft layers in Lien Chieu is less than that in Chan May and stiff silty sand appears in the layer of –5m in depth.

The values of cohesion in Dung Quat distribute between 0.25 to 0.8 kgf/cm^2. These values are twice to three times as large as those of Chan May and Lien Chieu. It is necessary, in the next stage, to make more detailed analyses of soil conditions, although Dung Quat has fewer problems in terms of foundation strength.

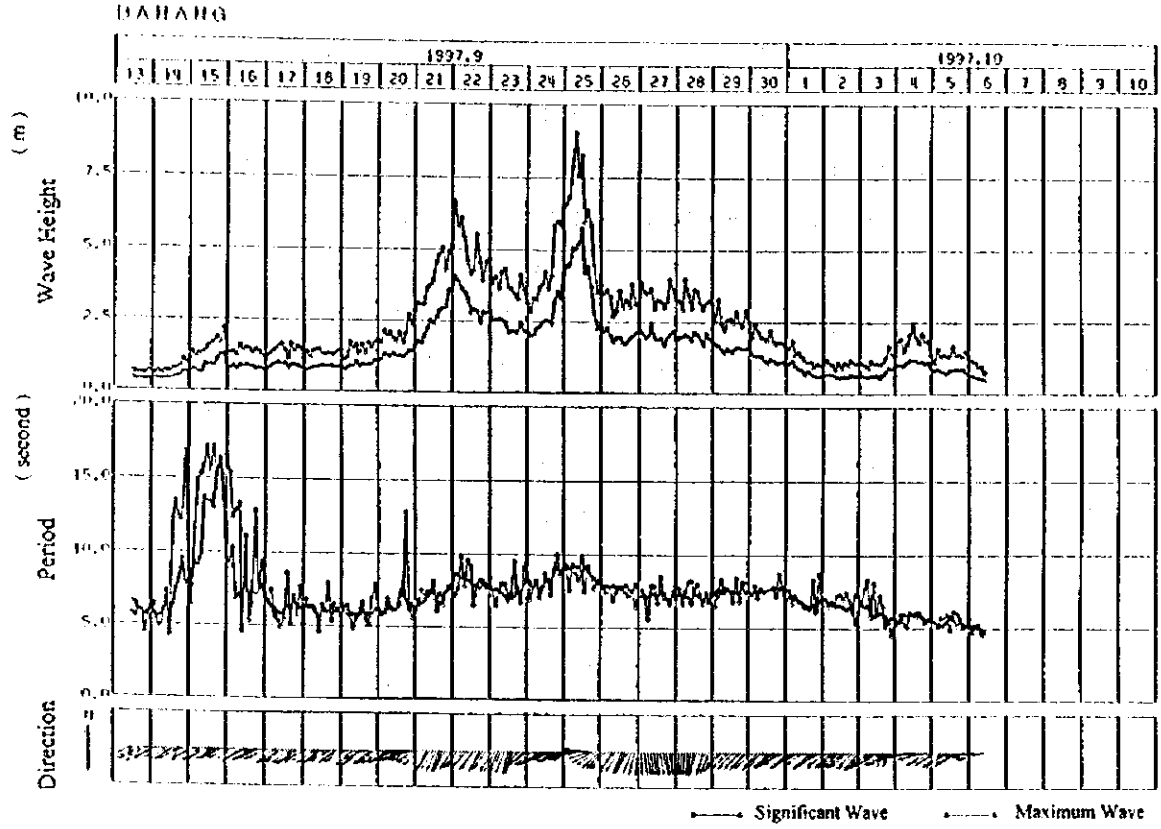


Figure 4.1 An Example of Wave Record at the Mouth of Danang Bay

(Waves by Typhoon 9721 on 25 September and long period wave on 15 September 1997)

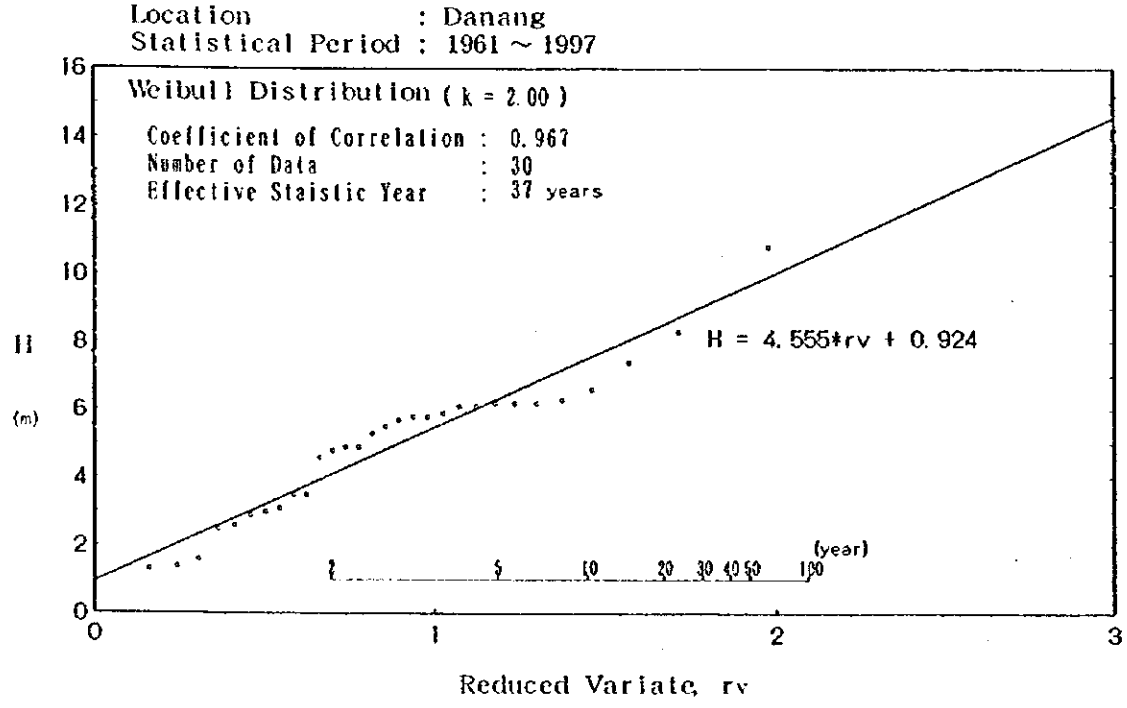


Figure 4.2 An Example of Assessment of Extraordinary Waves at Offshore Danang

(Waves with a return period of 50 years generated by typhoons)

5. National and Regional Development Plan

5.1 National Development Plan

(National Economic Development Plan)

During the early 1990s,Vietnam experienced a rapid change in the transitional process to a market economy. An important policy issue in the late 1990s will be how to accelerate industrialization of the country. "Orientations and Tasks of the 1996-2000 Five Year Plan for socio-economic Development" (Report to the 8th National Congress of the Communist Party of Vietnam, June 1996) and "Socio-economic Development and Investment Requirements for the Five Years 1996-2000" (Government Report to the Consultative Group Meeting, December 1995) deal with this issue.

Main targets by the year 2000 of those reports are follows.

-Share of industry in GDP is projected to be about 34-35 %, agriculture about 19-20 %, and the service sector about 45-46 %.

-The Incremental Capital Output Ratio (ICOR) is projected to increase from 3.0 to 3.3. Thus, the investment requirement needs for the five years from 1996-2000 is estimated at USD 41-42 billion (1995 prices).

-Domestic resources is projected to amount to 15 % GDP for investment in development. This is equivalent to more than half of the total projected social investment.

-Together with domestic resources, external funds will continue to be mobilized mainly in the form of ODA and FDI, in order to achieve the total target for investing in development, during the period 1996-2000, of 30 % of GDP. Development resources are projected as follows.

Investment	Billion USD
Domestic	21
Foreign	20～22
- ODA	7～8
- FDI	13～14

Source: Ministry of Planning and Investment

(National Port Development Master Plan)

Vietnam National Maritime Bureau (Vinamarine) prepared a master plan entitled "Development Plan for Seaports in Vietnam" in June, 1995, and revised the master plan in early 1997. The master plan suggests that the major direction of development is to invest in building big port groups with a view to accommodating container ships of 50,000 DWT, dry bulk cargo ships of 70,000-80,000 DWT and oil tankers of 50,000-200,000 DWT. Pointing out that handling productivity is low compared with neighboring countries, it is also proposes that modern handling technology be introduced in the existing ports to meet the current trend of containerization.

Regarding port planning and management, the master plan emphasized that the development plan and scale of ports should be defined in line with the socio-economic demand of each specific region and the need to promote balanced development of the economic regions of the country.

Cargo throughput in the year 2000 is estimated at 106.5 million tons and in the year 2010 at 267 million tons. While cargo growth rate is not indicated, it is approximately 20% for the period of 1995-2000 and 10% for the period of 2001-2010. There is also another forecast in the master plan which estimates the cargo throughput in the year 2000 at 80 million tons, of which international cargo is 62 million tons, and in the year 2010 at 216 million tons, of which international cargo is 159 million tons.

5.2 Road Development Plan

The following road development projects are planned in central Vietnam.

1) Highway R-1 (Mucnamquan-Hanoi-Hochiminh City-Namcan, 2,289 km)

Highway R-1 is the main trunk road of the country with a total length of 2,289 km. The whole line shall be rehabilitated and upgraded up to the year 2000. Also, several big bridges along Highway R-1 will be constructed up to the year 2005. The improvement project of Route-1 funded by ADB from Hanoi to Vinh commenced in 1996.

2) Highway R-14 and R-14B (HCMC-Dakrong, 1069 km)

Highway R-14 is an important highway for central Vietnam, running through the central highland. R-14B connects the central highland with Danang port.

3) R-9 with the East-West Transport Corridor (Laobao-Donghoi, 83 km)

R-9 plays an important role within the subregional economic cooperation schema for East-West Transport project. This improvement project ensures smooth traffic even during the rainy season. The road is designed to have a width of 12 m from Cua Viet to the 41 km point and to have a width of 9 m from the 41 km point to Lao Bao. Construction commenced on February 1996 with government funds of US$ 10 million.

4) Haivan Tunnel

Haivan Tunnel is one of the big obstacles in transport from North to South. The Haivan tunnel project is given high priority because many people have died in traffic accidents caused by falling rocks.

5) North South Highway

North South Highway will run along the western longitudinal axis and will be the second trans-Vietnam Highway, with Route-1 being the first. It will pass through 14 provinces from Ha Tay to Binh Duong. Major purpose of the highway is to support the potential development of mineral extraction in the north and agriculture in the central mountains.

5.3 Industrial Zone Development Plan

There are various kind of industrial zone development plan in the study area. Outline of the main industrial development plan by province are shown in Table 5.1, 5.2 and 5.3.

Table 5.1 Industrial Zone Development Plan in Thua Thien Hue Province

Name of Industrial Zone	Chan May Centralized	Phu Bai Centralized	Dong Lam	Tu Ha
Area (ha)	700	300	300	300
Main Products	-Construction Materials -Glass Product -Chemical -Machine Equipment -Electronics -Automobile -Textile -Garment	-Construction Materials -Glass Product -Chemical -Porcelain Insulator -Plastic -Machinery -Electronics	-Construction Materials -Cement -Sugar -Confectionery -Turpentine -Fertilizer	-Construction Materials -Cement -Foodstuff -Chemical -Candle -Fodder

Source: Thua Thien Hue Province

Table 5.2 Industrial Zone Development Plan in Danang City and Quang Nam Province

Name of Industrial Zone	Lien Chieu	Hoa Khanh	Dien Nam Diin Ngoc	Danang EPZ
Area (ha)	373.5	423.5	418.0	63.0
Main Products	-Machinery -Steel -Cement -Chemical -Construction Materials -Plastic -Glass Product	-Machinery -Steel -Automobile Assembly -Chemical -Construction Materials -Plastic -Glass Product	-Motorcycle -Electronic Assembly -Refrigeration Appliance -Foodstuff -Textile -Garment	-Textile -Garment -Micro-electronics -Electrical Appliance -Foodstuff -Leather Product

Source: Quangnam-Danang Export Processing and Industrial Zones Authority

Table 5.3 Industrial Zone Development Plan in Quang Ngai Province

Name of Industrial Zone	Dung Quat	West of Quang Ngai Town	Tinh Phong	South of Quang Ngai
Area (ha)	4,505	100	100	300
Main Product	-Oil Product -Steel -Petrochemical -Foodstuff -Construction Materials	-Sugar -Alcohol Beverage	-Construction Material	-Foodstuff -Rubber

Source: Quang Ngai Province

6. Demand Forecast

6.1 Methodology

Two methods, a macro forecast and a micro forecast are adopted to forecast the future cargo volume. The macro forecast estimates the total cargo volume in the port's hinterland by using the statistical correlation between the cargo volume and macro economic indices. The other is a micro forecast which estimates the cargo volume of each commodity individually based on future economic indices, situation of demand and supply and the industrial development plans.

In order to forecast the future cargo volume of the Ports of Chan May, Lien Chieu and Dung Quat located in the study area, the hinterland is assumed to be five provinces and one city, namely, Quang Tri Provinc, Thua Thien Hue Province, Quang Nam Province, Quang Ngai Province, Kon Tum Province and Danang City.

6.2 Socio-economic Framework

Population, GDP, GDP per capita of all Vietnam and the study hinterland in 2010 and 2020 is estimated as shown in Table 6.1. It is based on the population and economic growth rate forecast by Ministry of Planning and Investment-Development Strategy Institute (MPI-DSI) and Transport Development and Strategy Institute (TDSI).

Table 6.1 Socio-economic Framework

Item	Area	2010	2020
Population	Hinterland	6,476	7,217
(Thous.)	All Vietnam	96,174	107,292
GDP	Hinterland	6,459	17,048
(Mill. US$)	All Vietnam	98,347	212,324
GDP per Cap.	Hinterland	997	2,362
(US$)	All Vietnam	1,023	1,979

6.3 Macro Forecast (Dry Cargo)

Cargo throughput forecast of the study hinterland by macro forecast method is shown in Table 6.2. Three scenarios corresponding to different rates of economic growth are assumed.

Table 6.2 Cargo Throughput by Macro Forecast Unit: Ton

Scenario	2010	2020
I	7,496,000	20,194,000
II	5,654,000	15,624,000
III	4,961,000	10,314,000

6.4 Micro Forecast (Dry Cargo)

Micro forecast result of seven ports located in the study hinterland is shown in Table 6.3. Among these ports, Cua Viet Port, Thuan An Port, Danang Port and Sa Ky Port function at present, while Chan May Port, Lien Chieu Port and Dung Quat, the target ports of this study are under planning.

Table 6.3 Cargo Throughput by Micro Forecast Unit: Ton

Province	Port	2010	2020
Quang Tri	Cua Viet	71,000	93,000
Thua Thien Hue	Chan May※	1,985,000	3,947,000
	Thuan An	80,000	90,000
Danang City	Danang Port		
	Lien Chieu※	5,173,000	8,636,000
Quang Ngai	Dung Quat※	750,000	6,077,000
	Sa Ky	42,000	92,000
(Total)		8,101,000	18,935,000

※under planning

6.5 International Transit Cargo

In order to realize the shift from the current trade route via Bangkok port to Vietnamese ports, certain preconditions must be met as follows:

1) Transit cargo can enjoy quick clearance without duty at the border.
2) Transport activities can be performed freely in Thailand, Lao and Vietnam.
3) Road conditions in Lao and Vietnam must be improved through paving and increasing lane width.
4) The service level of Vietnamese ports in terms of cost, security and vessel allocation must be equal to that of Bangkok port.

Forecast result based on above preconditions are shown in Table 6.4.

Table 6.4 International Transit Cargo Throughput Unit: Ton

Route No.	2010	2020
R-9	384,000	647,000
R-16/18	351,000	823,000
(Total)	735,000	1,470,000

6.6 Cargo Throughput in ISP's and Master Plans

Total cargo throughput including international transit cargo and liquid cargo of the three ports is summarized in Table 6.5, 6.6. In the ISP, liquid cargo accounts for 23.0% of the total cargo handled at Chan May, 11.6% of that at Lien Chieu and 94.0% of that at Dung Quat. In the master plan, these figures become 26.0%, 9.6% and 79.8% respectively.

Table 6.5 Cargo Throughput in ISP's Unit: Ton

Port	Foreign		Domestic		International Transit		(Total)
	Export	Import	Loading	Unloading	Out	In	
Chan May	875,000	1,022,000	465,000	233,000	15,000	45,000	2,655,000
Lien Chieu	304,000	2,048,000	710,000	91,000	343,000	286,000	3,782,000
Dung Quat	0	2,600,000	6,250,000	4,400,000	10,000	36,000	13,296,000

Note; Inclusive of liquid cargo

Table 6.6 Cargo Throughput in Master Plans Unit: Ton

Port	Foreign		Domestic		International Transit		(Total)
	Export	Import	Loading	Unloading	Out	In	
Chan May	2,178,000	2,127,000	470,000	588,000	23,000	64,000	5,450,000
Lien Chieu	1,159,000	4,078,000	1,193,000	768,000	608,000	680,000	8,486,000
Dung Quat	279,000	8,411,000	13,388,00	8,399,000	23,000	72,000	30,572,00
			0				0

Note; Inclusive of liquid cargo

7. Master Plan for Port Development

7.1 Functions of Each Port

Chan May Port will play a role of commercial port as a port of Danang Bay port complex and will be developed as a gateway to the industrial park in the hinterland at the first stage. Lien Chieu area of Danang Port can be a commercial port serving for the Key Area of Central Vietnam after the saturation of Tien Sa Port as well as for the Lien Chieu-Hoa Khanh and other industrial zones. Dung Quat Port will firstly serve for the oil refinery to be developed in the hinterland and then for the petrochemical plant and other downstream industries. Commercial port function will be limited..

7.2 Characteristics of Development Sites

Chan May is located 60 km from Hue City and 45 km from Danang City. Port development site is 7 km north from Road No.1 and the water area is sheltered by East Chan May Cape. South west coast of the East Chan May Cape will be favorable for the first berth. The water area is sheltered from NE waves by a 1,800 m long headland, however, it is exposed to N and NW waves and the construction of a breakwater is necessary for port development. Soft clay layer is located in the bay area and the depth of foundation layer is about minus 20-35 m. Hinterland of more than 4,000 ha is available for the development of manufacturing factories, warehouses, port facilities and other transportation facilities.

Lien Chieu area is located 15 km west of Danang city center and 24 km from Tien Sa Port. Road No.1 and railway track are found behind the possible port area while a part of the backyard has already been urbanized. The north water of the estuary of Cu De River can be a development site for the new port and has advantages over Nam O area or Song Han River Estuary areas. Although these development sites are located in Danang Bay, the water area is exposed to NE waves, so that the construction of a new port requires a breakwater. A stratum of fine sand was identified at the depth of -12 to -20 m. The adjacent hinterland is being developed as Lien Chieu-Hoa Khanh industrial zone.

Dung Quat Bay is located 120 km south of Danang and 35 km from Quang Ngai City. The bay is sheltered form NE waves and winds by the 2,200 m long Co Co Cape, however the development site is exposed to N and NNE waves. By building a breakwater, it will be possible to

acquire a large area of deep calm water to develop a deep sea port. Access channel can be developed up to minus 15 m or more without any difficulties. Seabed of the bay is mainly formed with sand, which has enough bearing capacity to build a breakwater, and the foundation layer lies about minus 20-25 m. Backyard of the port is low yielding, low value agricultural land with a total area of 14,000 ha over the territories of Binh Son district of Quang Ngai Province and southern part of Nui Thanh district of Quang Nam Province.

7.3 Port Facilities and Layout

Port infrastructures and the volume of dredging are summarized in the table below and its layout plan is shown in Figures 7.1 (Chan May), 7.2 (Lien Chieu) and 7.3 (Dung Quat).

Chan May

Facilities	Quantity	Remarks
Main Breakwater	1,290 m	Depth at the top: -13.5 m
Berths	1,360 m (-5.5 to -13 m)	
Land Reclamation	492,000 m^2	East & west wharves
Dredging	3,960,000 m^3	Channel depth: -13 m
Groin (West breakwater)	720 m	

Lien Chieu

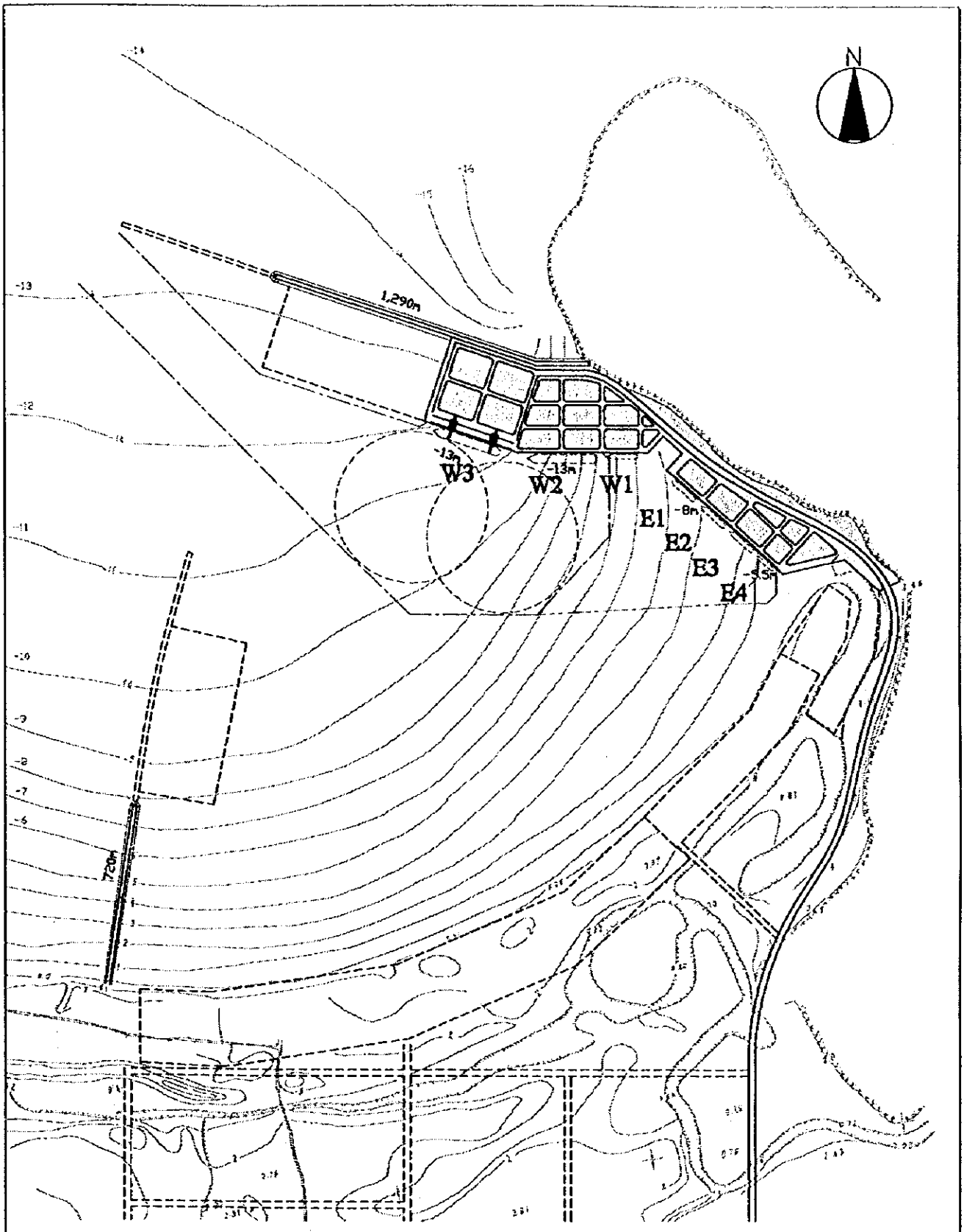
Main Breakwater	1,450 m	Depth at the top: -9.3 m
Berths	1,950 m (-5.5 to -13 m)	
Land Reclamation	962,000 m^2	East & west wharves
Dredging	8,160,000 m^3	Channel depth: -13 m
Groin	200 m	Mouth of Cu De River

Dung Quat

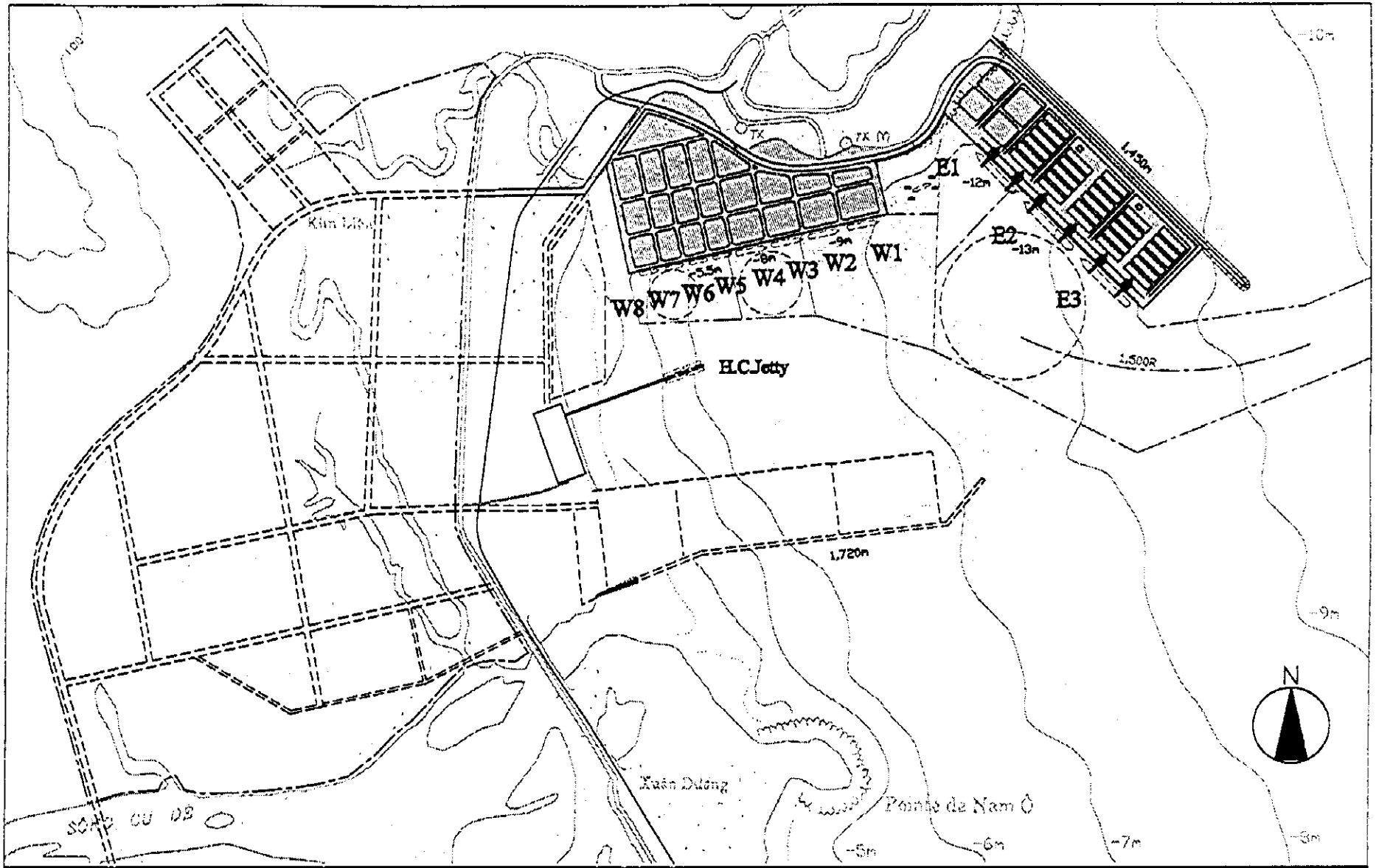
Main Breakwater	1,660 m	Deepest section: -15.5 m
West Breakwater	2,170 m	Depth at the top: -11 m
Berths	Dolphin (-8/-13 m): 8	
	1,800 m (-5.5 to -13 m)	
Land Reclamation	1,370,000 m^2	(East and west wharves)
Dredging	5,050,000 m^3	Channel depth: -13 m
Others	-	Oil handling facilities

7.4 Capacity of Existing Port

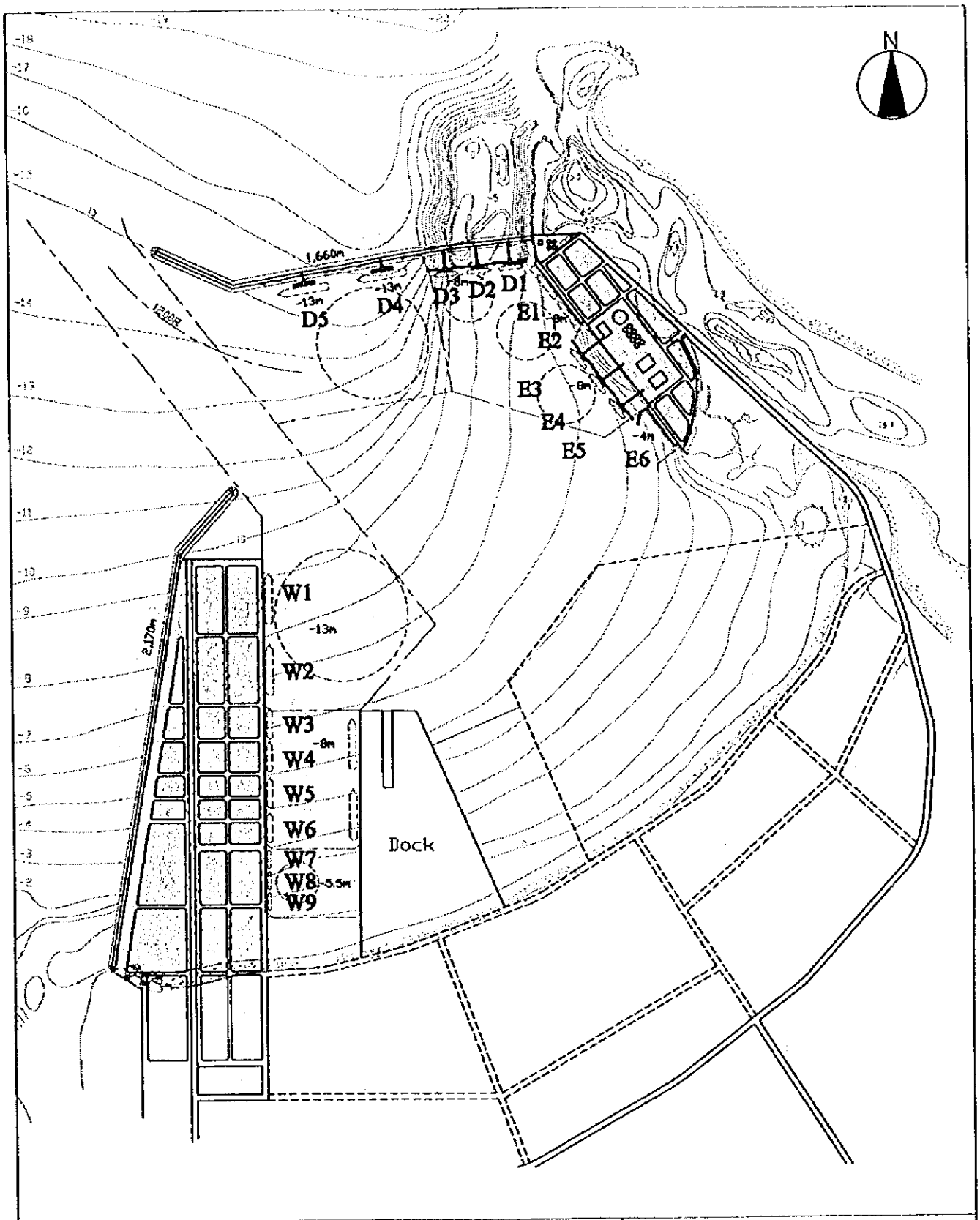
Handling capacity of the existing port is estimated at about 1.7 million tons per annum (including container cargo). After the completion of the Berth No.5, the port will be able to handle 2.2 million tons. If the Berth No.6, which will serve for general cargo trampers and container vessels, is completed, the Tien Sa port will be able to handle about 3.1-3.3 million tons.



JICA Port Development Study in Central Region	Figure 7.1
Chan May Port Development Masterplan	
Final Report 1998	FILE CM-DF-MP-A4



JICA Port Development Study in Central Region	Figure 7.2	Final Report 1998
Lien Chieu Port Development Masterplan	0 200 400 600 800 1,000m	FILE LC-DF-MP-A4



JICA Port Development Study in Central Region	Figure 7.3
Dung Quat Port Development Masterplan	0 200 400 600 800 1,000 m
Final Report 1998	FILE DQ-DF-MP-A4

8 Initial Stage Development Plan

8.1 Stage-wise Development

Scale of development affects the viability of a port development project, in particular at the first stage of the development. Industrial port usually has a base cargo and can invite regular ship calls, however, a commercial port has no guarantee of regular ship calls. A new commercial port requires a close connection with city to provide shippers, consignees and shipping service agents with offices, bank services, telecommunication services and other city services. In this connection, initial stage development plan should be carefully designed from a view point of the scale of initial investment and the timing of completion of the project.

8.2 Port Facilities for ISP

Chan May

A multi-purpose berth with a provisional alongside depth of –12 m (under CDL, to be deepened to –13 m in the future) will be needed to accommodate 40,000 GT class car carriers, 40,000 DWT class bulk carriers, 20,000 DWT class container vessels, and 20,000 DWT class general cargo trampers if Chan May Industrial Park is realized. Two conventional berths with an alongside depth of –8 m are also planned to accommodate 7,000 DWT class Ro/Ro vessels, 7,000 DWT class cement carriers, 5,000 DWT class product oil carriers and conventional cargo ships. Heavy cargo carriers and ocean going passenger ships may call at the port. (see Figure 8.1 for port layout)

Lien Chieu

Taking into consideration that container throughput is not large enough to attract mother container vessels in the initial stage, maximum size of calling container vessel is considered at about 30,000 DWT in the initial stage. Berth E1 is designed as a multi-purpose berth with an alongside depth of –12 m to cater to 30,000 DWT class container vessels, 40,000 GT class car carriers, 20,000 DWT class general cargo trampers and others. As such ships are not expected to call so frequently, the design depth of channel and turning basin is –11 m and the pocket dredging to –12 m is planned in the front of the Berth E1. Two conventional cargo berths, W1 and W2, are included in ISP with a provisional alongside depth of –8.0 m. (see Figure 8.2 for port layout)

Dung Quat

In the initial stage development, Dung Quat Port is required to cater to 1,000 - 50,000 DWT class product oil tankers. Two conventional berths with an alongside depth of

-8 m are planned to accommodate heavy cargo carriers, conventional cargo ships, Ro/Ro ships, cement carriers and others coastal ships. Small craft berth is designed with a length of 200 m and a depth of -4 m to serve for port service ships and work vessels. Prior to ISP, a small scale development will be able to cope with the development of the oil refinery in a half size. Small scale ISP will be able to handle half of the planned product oil, i.e. 3,500,000 tons compared with 6,000,000 tons of ISP. (see Figure 8.3 for port layout)

8.3 Implementation Options for Lien Chieu and Tien Sa

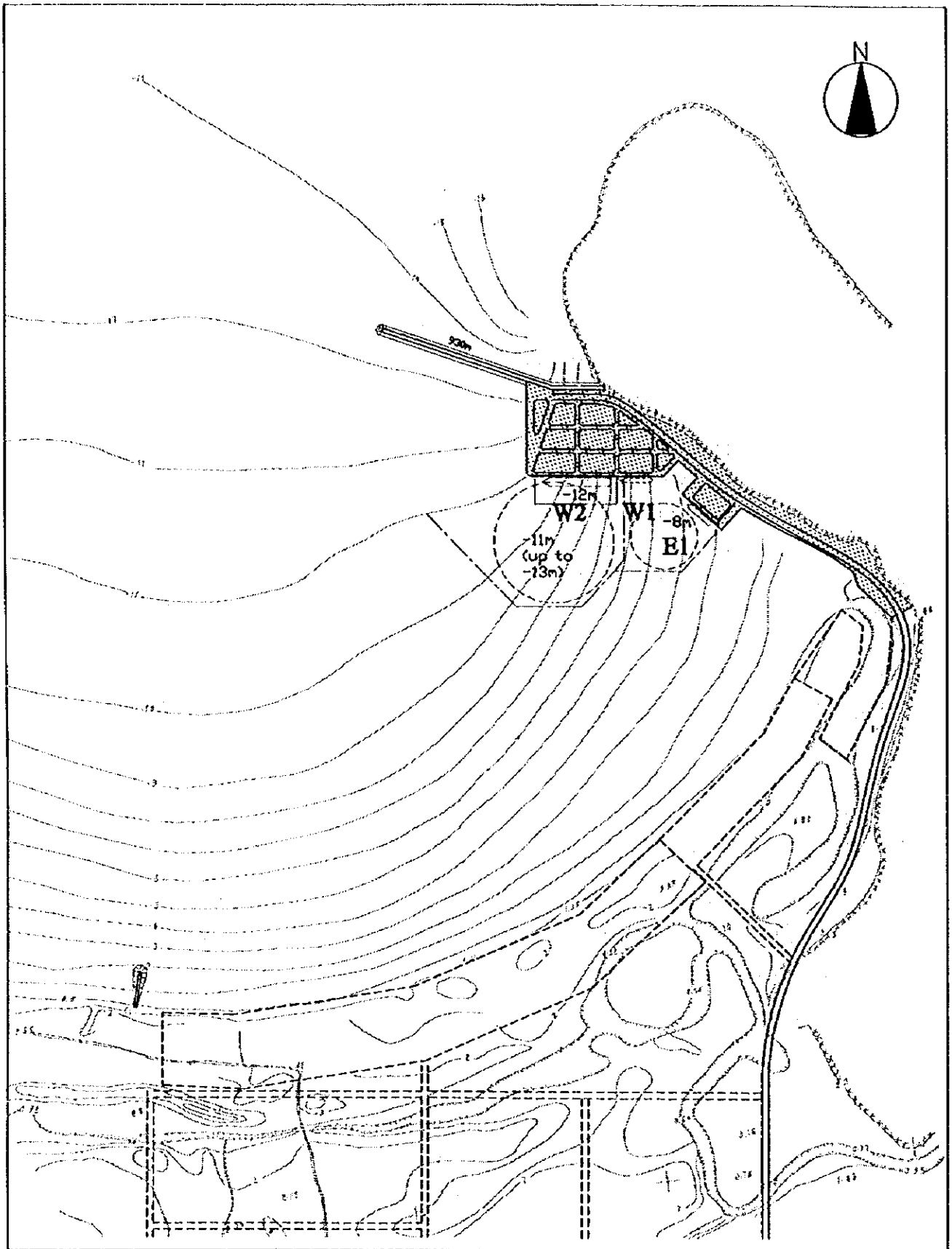
Coping with the cases of Tien Sa area, three scenarios for the development are envisioned as follows:

Scenario 1: Besides the rehabilitation of Tien Sa No.1-4 berths and upgrading the port access road and Nguyen Van Troi bridge, Tien Sa No.6 berth will be developed. In the high growth case of cargo throughput, the development of Tien Sa No.6 will be required by 2004 and then Lien Chieu E1 by 2006. In the low cargo growth case, it will become necessary to develop Tien Sa No.6 by 2007 and Lien Chieu E1 by 2010. Furthermore, in medium cargo growth case, it will become necessary to develop Tien Sa No.6 by 2005 and Lien Chiew E1 by 2007.

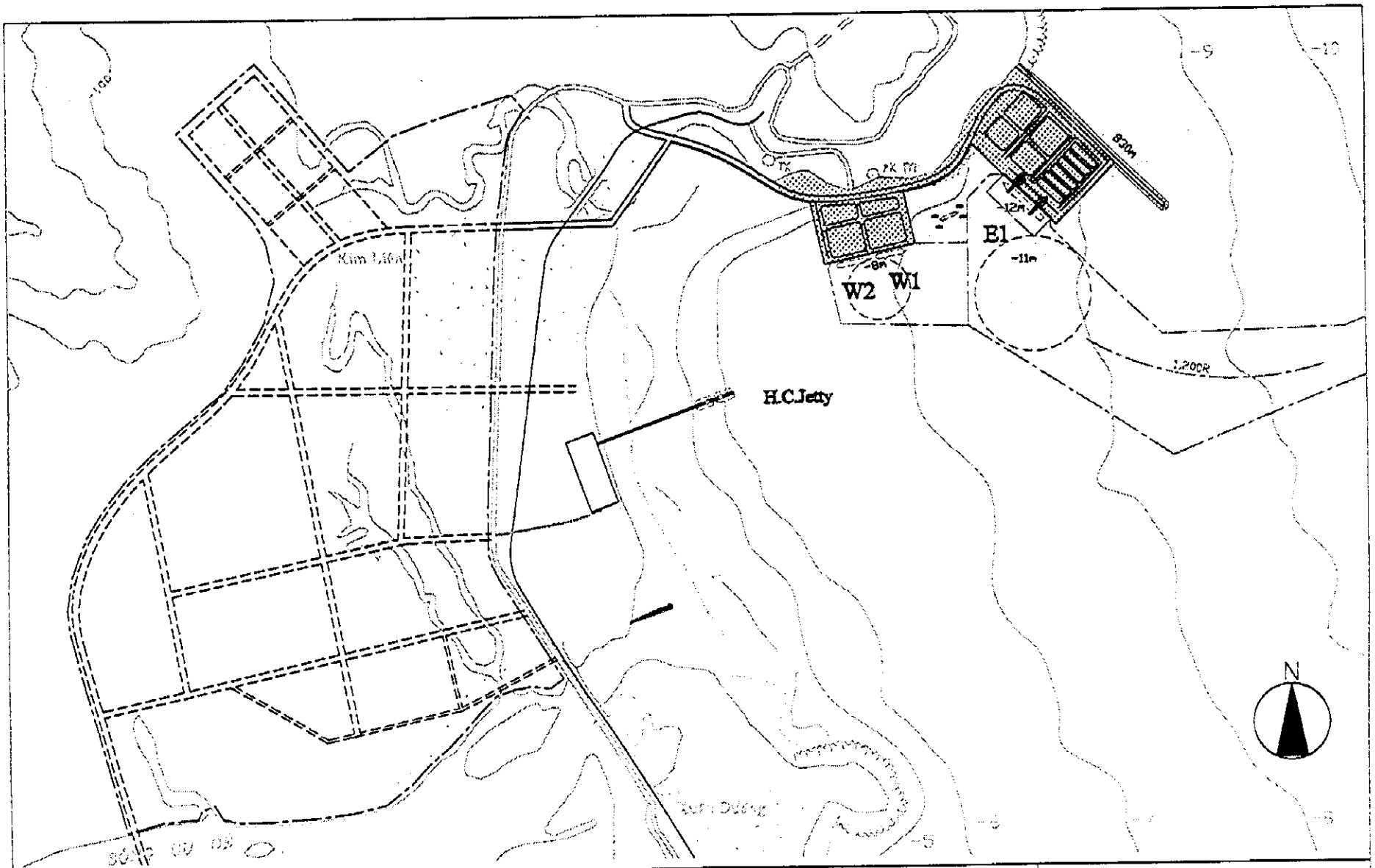
Scenario 2: Tien Sa will remain with five berths, in which No.1-4 will be rehabilitated and No.5 will be completed by the end of 1998. Lien Chieu will be developed to meet the demand exceeding the capacity of Tien Sa Port. Under this scenario, it will become necessary to develop Lien Chieu E1 berth by 2004 in the high growth case and by 2007 in the low growth case. (see Figure 8.4 and 8.5) .

Scenario 3: No investment will be made in Tien Sa Port and access road/bridge and efforts are made to develop Lien Chieu area. This scenario will have a difficulty in coping with cargo demand in the near future.

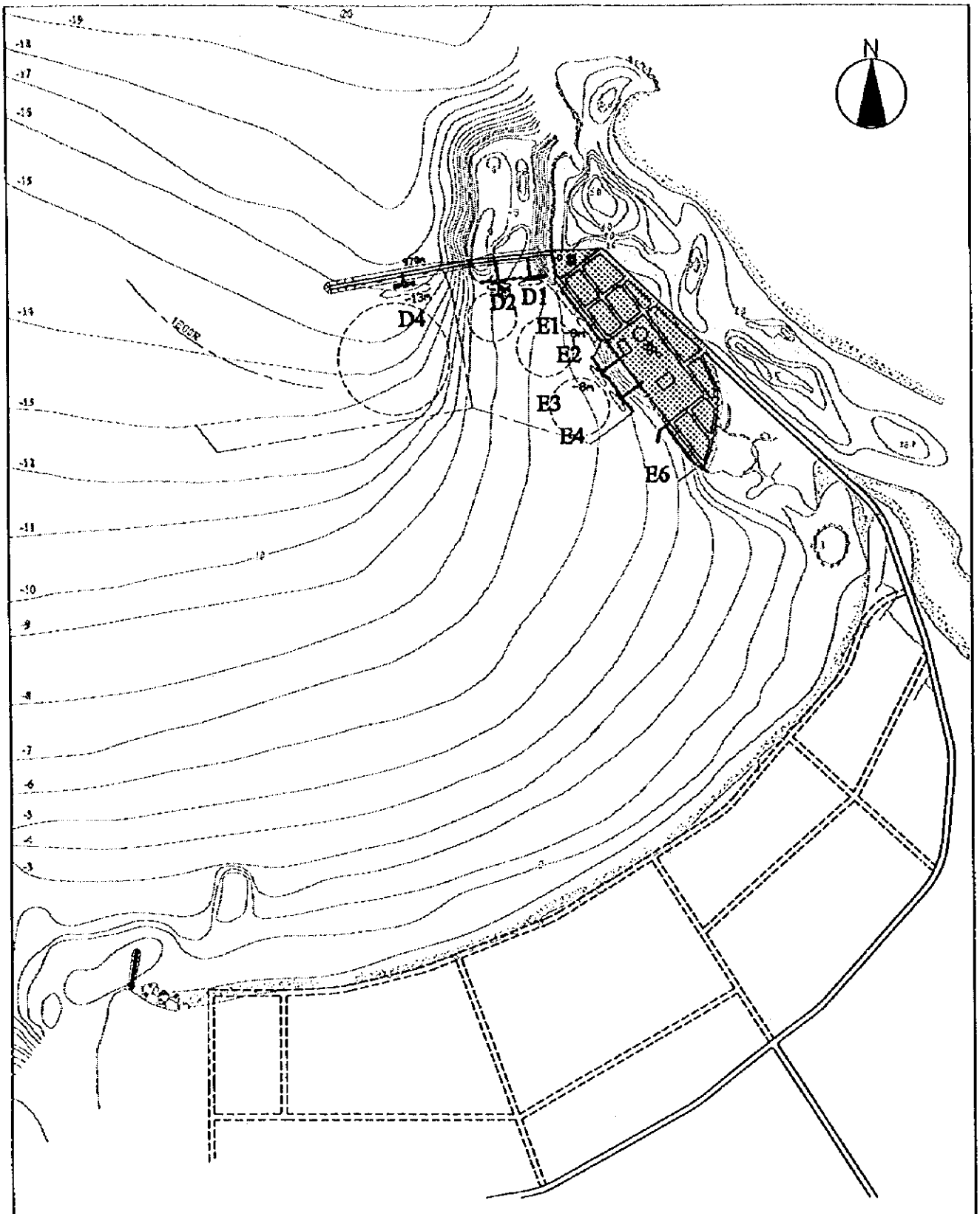
In the scenarios 1 & 2, it will be necessary to rehabilitate the existing No.1-4 berths and upgrade a 11 km access road and Nguyen Van Troi Bridge. Lien Chieu has an advantage in land transportation and future port development. The development of Tien Sa area should meet the urgent demand and be reasonably minimized. The scenario 2 is therefore recommended to expand the capacity of Danang port and the scenario 1 is given second priority. (the case in which economic turmoil in Asian countries affects economic development of Vietnam severely thereby deferring development of the Lien Chieu area). However, since this study did not cover the detailed development plan of Tien Sa area due to another on-going study, more detailed study on the improvement of Tien Sa area may be helpful to clarify the development strategy.



JICA Port Development Study in Central Region	Figure 8.1
Chan May Port Initial Stage Development Plan	0 200 400 600 800 1,000 m
Final Report 1998	FILE CM-ISP-A4



JICA Port Development Study in Central Region	Figure 8.2	Final Report 1998
Lien Chieu Port Initial Stage Development Plan	0 200 400 600 800 1,000m	FILE LC-ISP-A4



JICA Port Development Study in Central Region	Figure 8.3
Dung Quat Port Initial Stage Development Plan	0 200 400 600 800 1,000 m
Final Report 1998	FILE DQ-ISP-A4

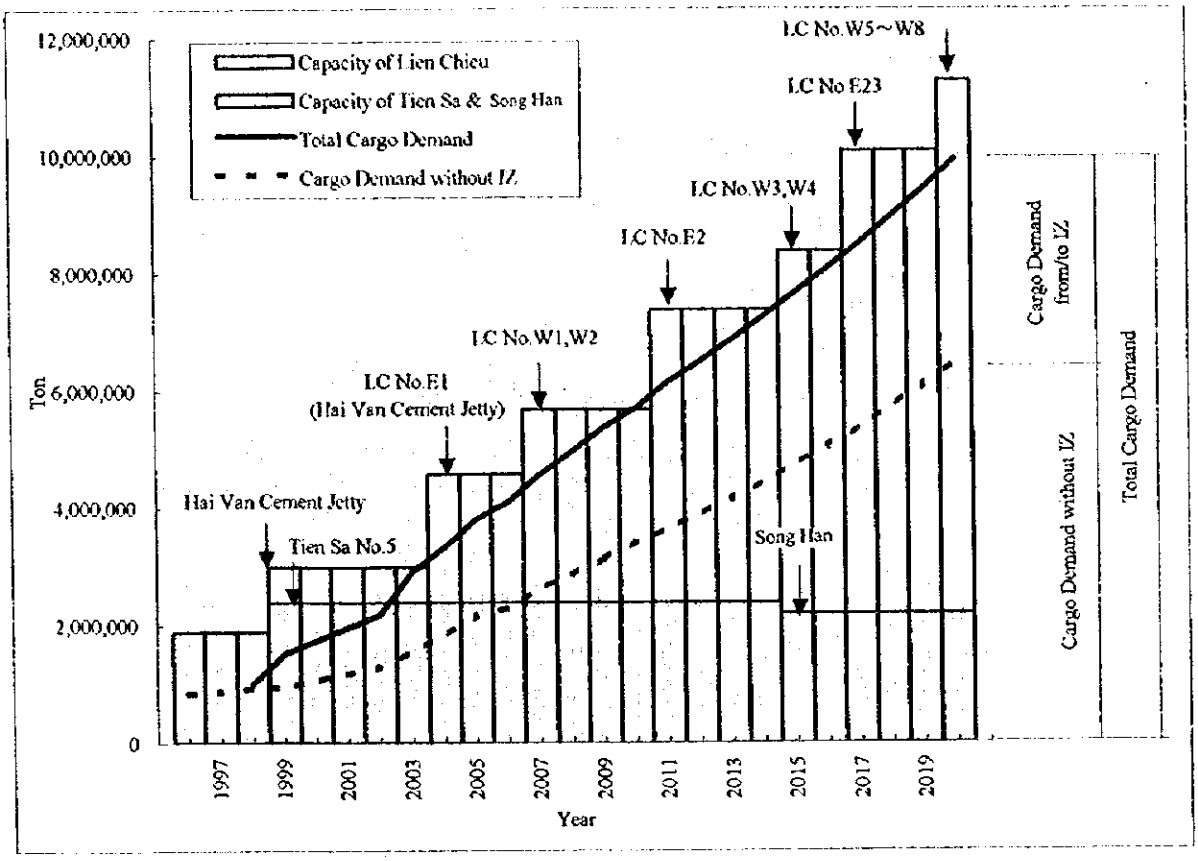


Figure 8.4 Implementation Plan (High Growth Case)

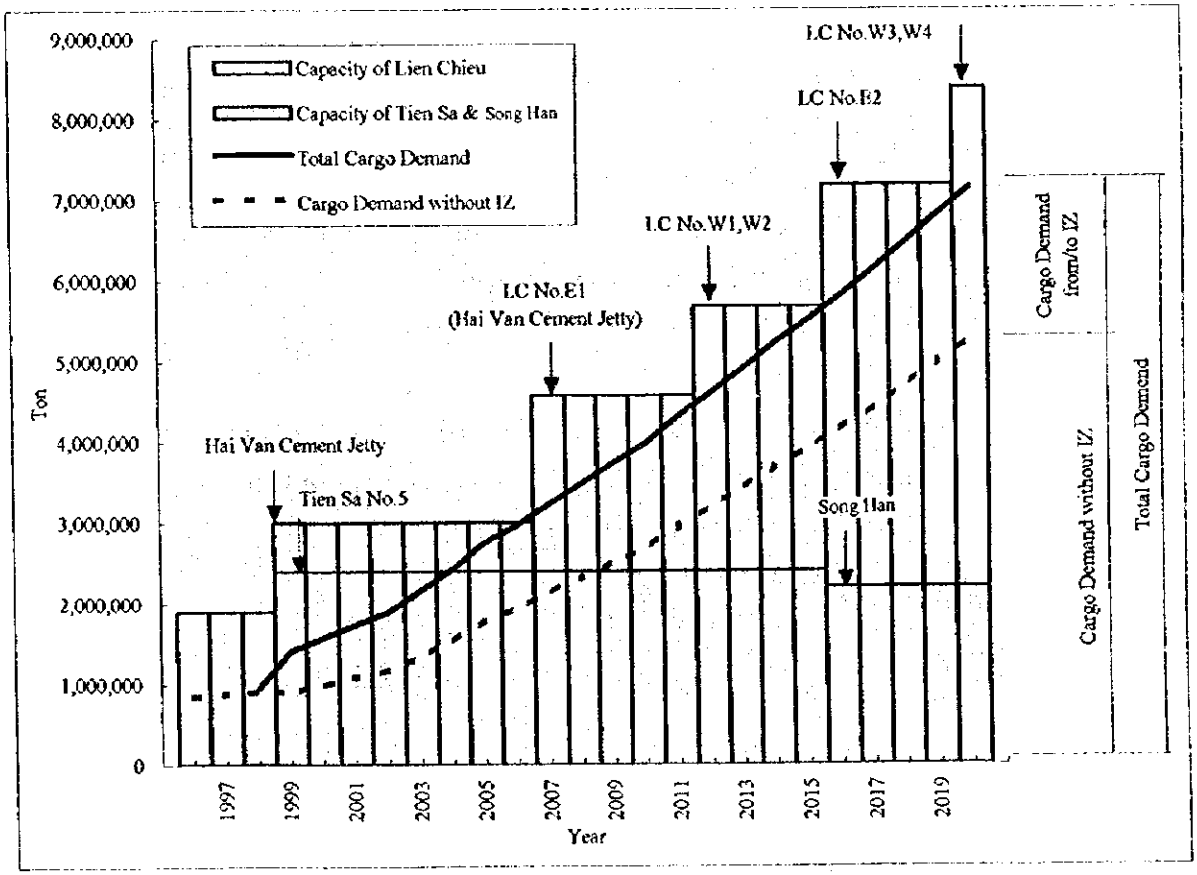


Figure 8.5 Implementation Plan (Low Growth Case)

9. Preliminary Port Facilities Design

In order to assure technical feasibility and to make cost estimates of the Initial Stage Development Plan of the new ports of Chan May, Lien Chieu and Dung Quat, preliminary design work have been carried out for such main port facilities as breakwater, seawall, quaywall, revetment, groin, bridge etc.

The design conditions are set mainly based on the results of surveys done by JICA Study Team /POWECO and Japanese Technical Standards of Port and Harbor Facilities and by using the related computer programs.

The features of the location where the breakwaters will be constructed in Chan May and Dung Quat are deep waters with high waves of -13.5m and -16.0m, respectively. In Lien Chieu also the present depth of the planned breakwater is -8.5m where the design significant wave height(H1/3) is 5.9m. In addition to these high waves, there prevail rather soft soil layers in Chan May and Lien Chieu. Then it became necessary to introduce a particular type of structure being able to resist very large wave pressure but also to stand on the soft foundation safely.

Comparing with various types of structure from several technical view points, the composite gravity-type with hybrid caisson is selected as the most suitable structure for the breakwater. In Chan May and Lien Chieu, the soil improvement method is decided to be the replacement soft soils by sand. An example of design is shown in Figure 9.1 which is proposed breakwater at Lien Chieu. Figure 9.2 and Figure 9.3 show also proposed breakwaters at Chan May and Dung Quat respectively.

As for mooring facilities hybrid caissons adopted for the quaywalls over -12.0m in depth at the two ports(cf. Figure 9.4, Figure 9.5) after comparison with open-type pier with retaining wall, which is popular in Vietnam, and RC(reinforced concrete) caisson-type of quaywall. In Dung Quat for oil handling berths, dolphin-type with RC caisson is selected. Depending on the design depth of the quaywalls RC caisson (cf.Figure9.6) , L-shaped concrete block and rectangular concrete block structures are adopted. The facilities proposed for the Initial Stage Development plans are summarized in the Table 9.1(1)~(3).

These studies are not aimed at the ultimate design work because of now

preliminary design stage. It needs, therefore to make more precise design works toward the most reasonable and economical structures. However basic and fundamental items have been fully examined in this Study. Then, there might be no room to choose any other particular structural types in detail design stage.

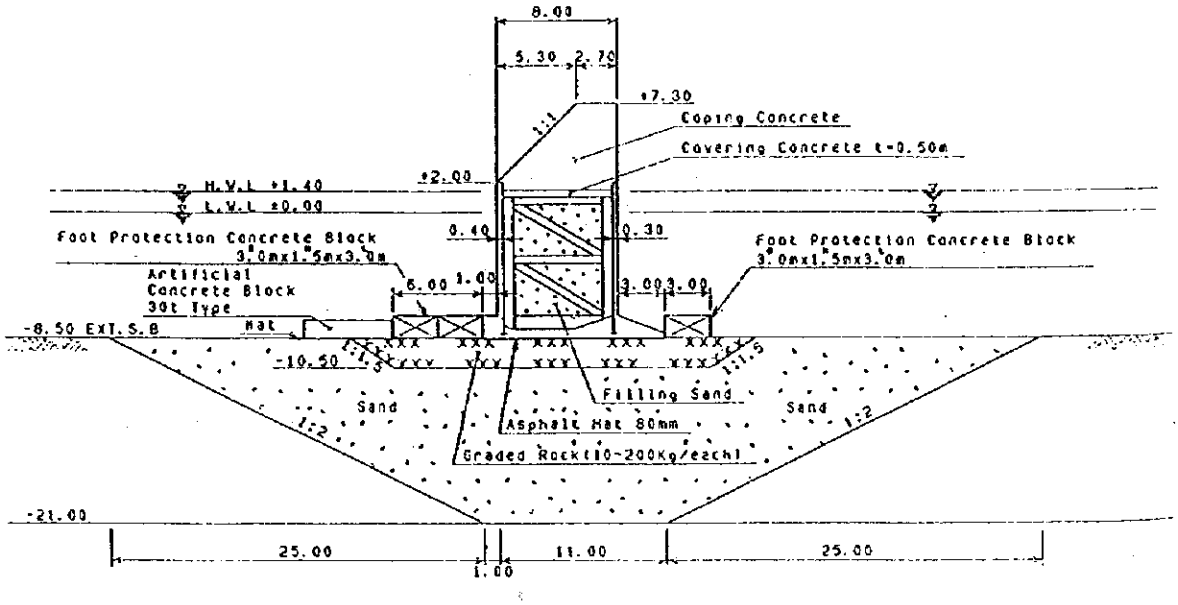


Figure 9.1 Typical Cross Section of Breakwater in Lien Chieu(Hybrid Caisson)

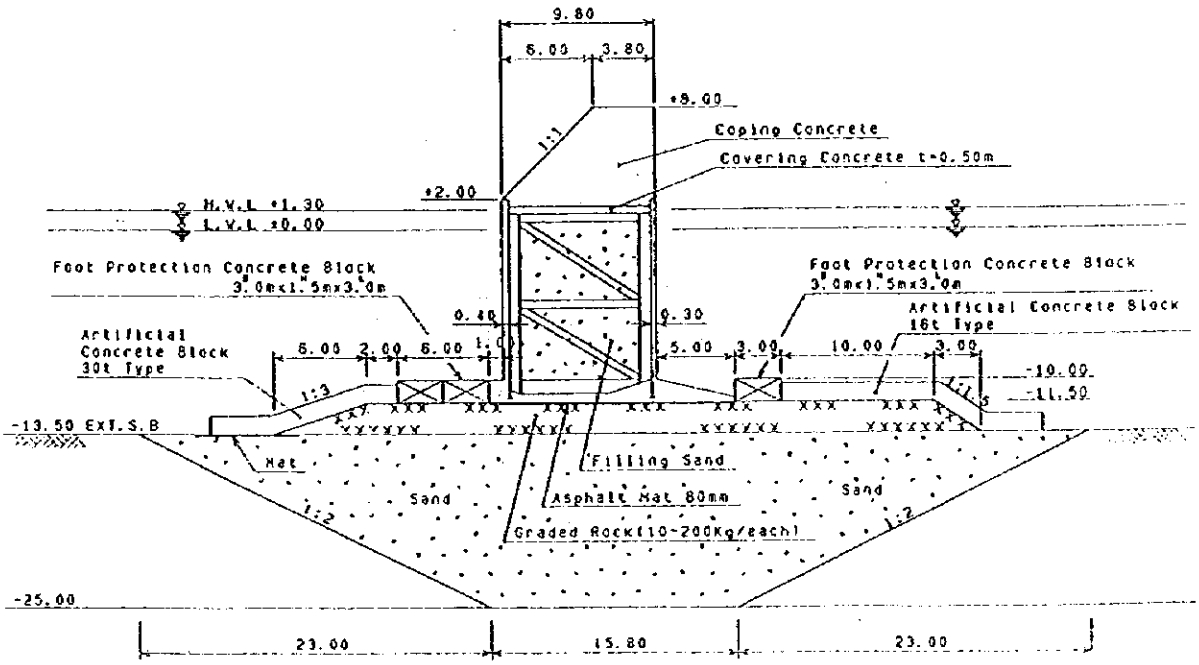


Figure 9.2 Typical Cross Section of Breakwater in Chan May(Hybrid Caisson)

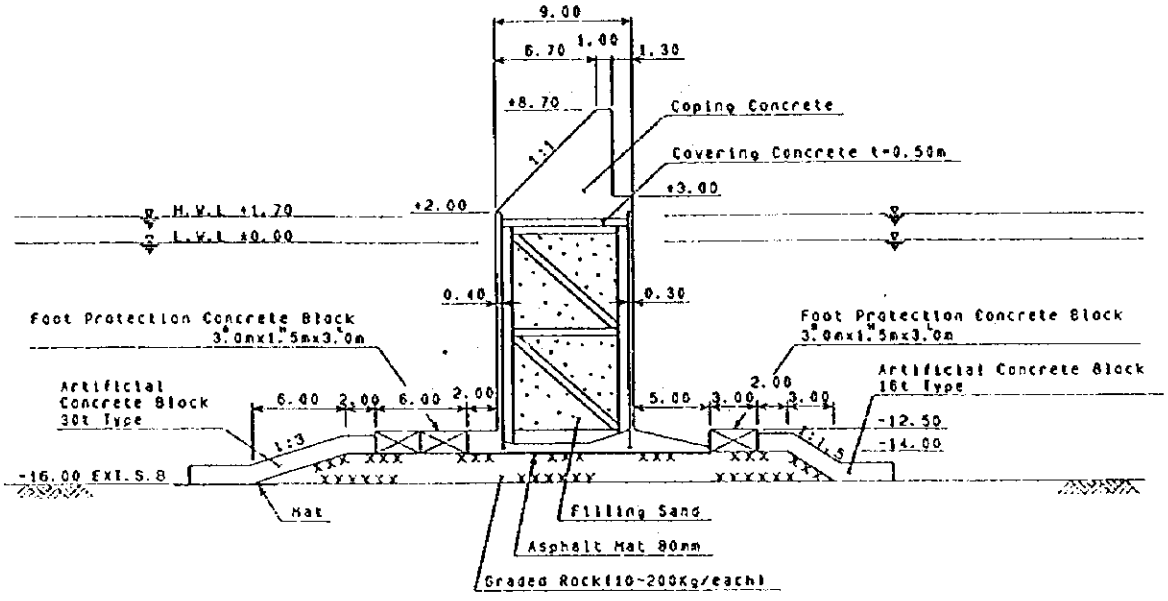


Figure 9.3 Typical Cross Section of Breakwater in Dung Quat(Hybrid Caisson)

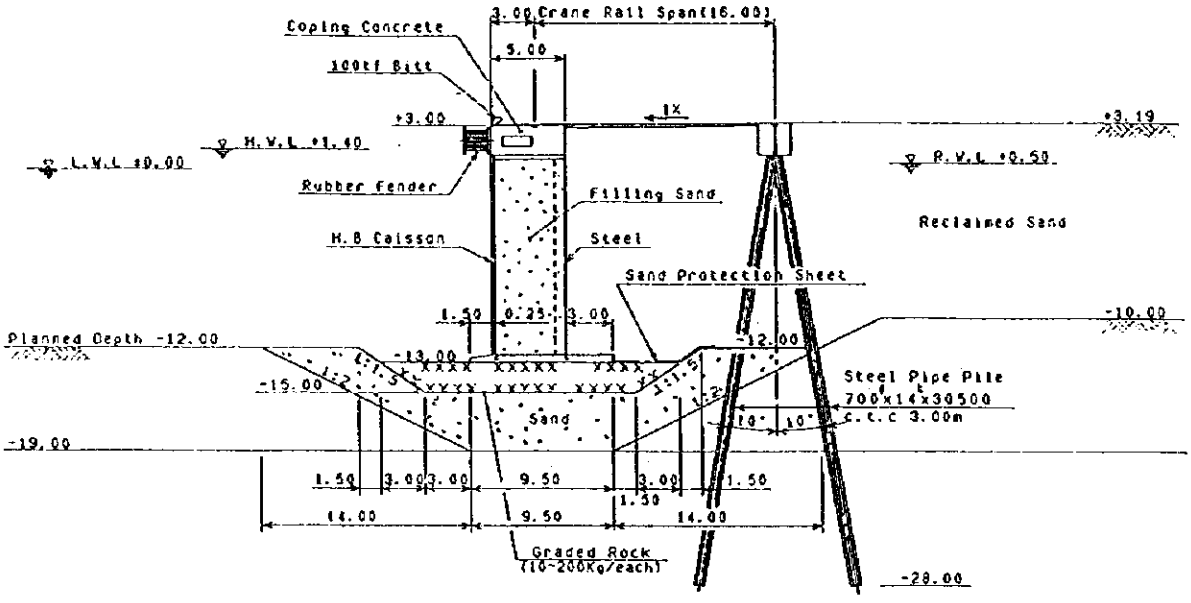


Figure 9.4 Typical Cross Section of Quaywall E1 in Lien Chieu(Hybrid Caisson)

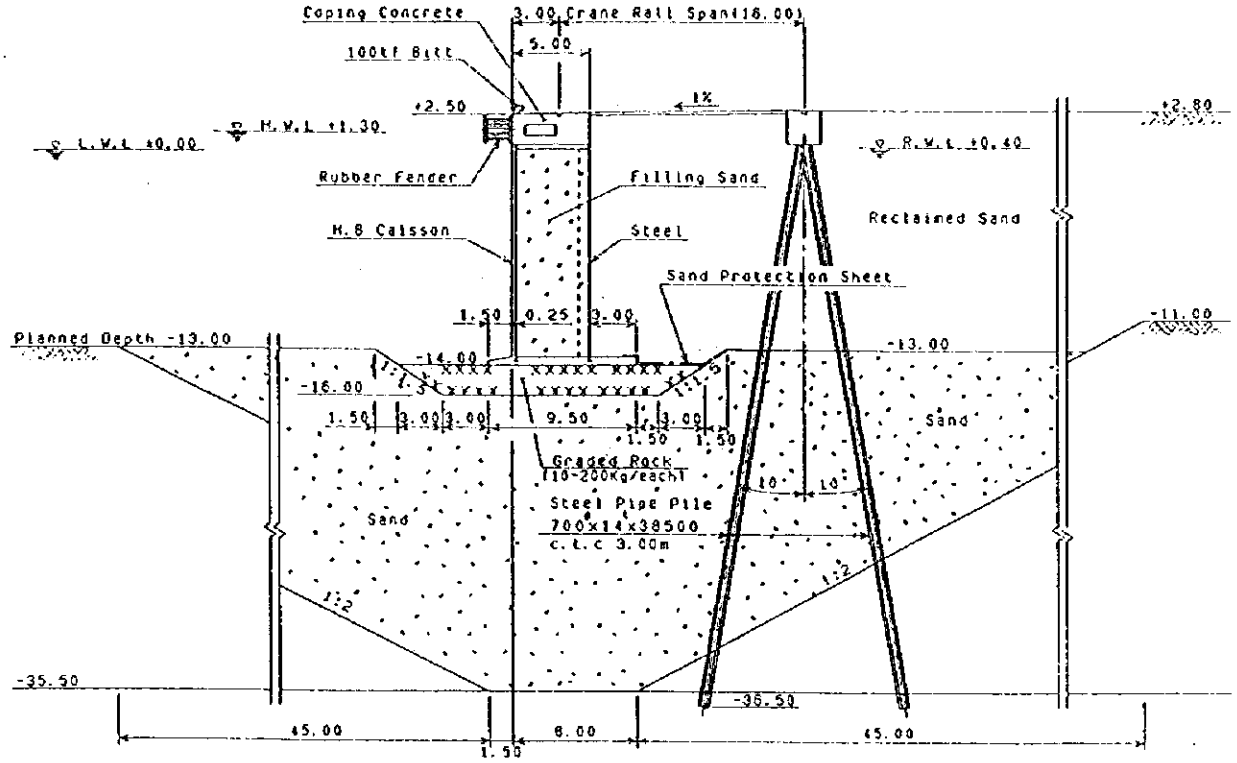


Figure 9.5 Typical Cross Section of Quaywall W2 in Chan May(Hybrid Caisson)

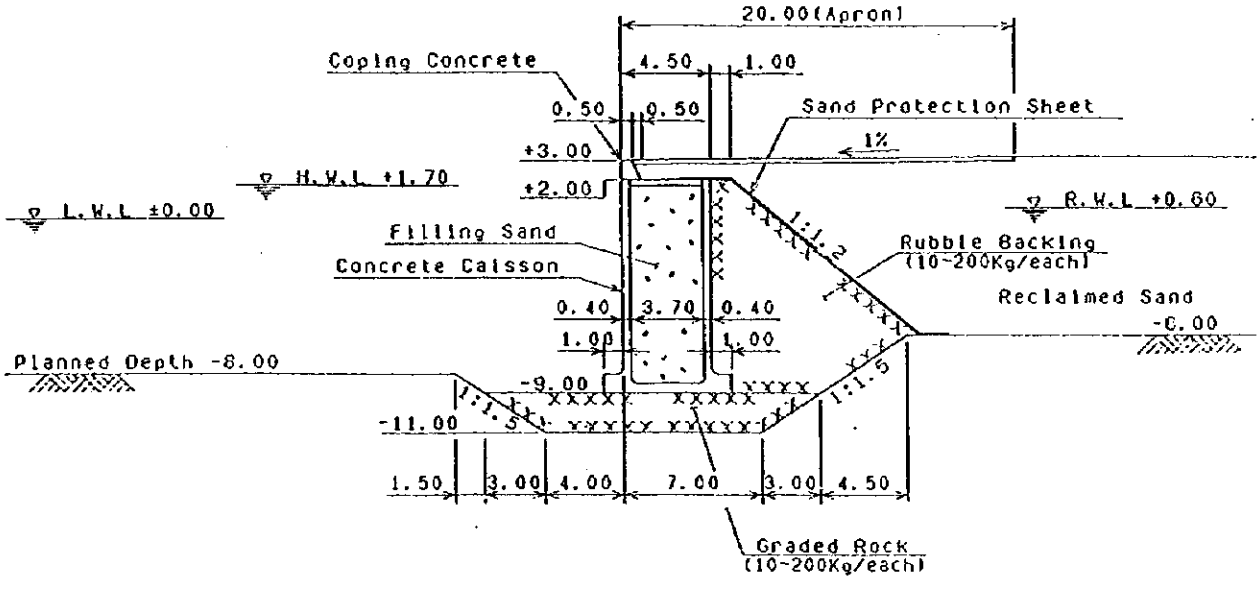


Figure 9.6 Typical Cross Section of Quaywall E1,E2 in Dung Quat(RC Caisson)

Table 9.1(1) List of Proposed Structure in Chan May

Facility	Structural Type	Depth(m)		Crown Height(m)	Planned Quantity(m)	Main Report Figure No.
		Existing	Design			
Protective Fa.						
Breakwater	HB Caisson	-13.5	-13.5	+8.0	630	Fig.A9.5.1(2)
Seawall	HB Caisson	-13.0～-10.0	-12.0	+7.5	300	Fig.A9.5.2(2)
Revetment 1	RC Caisson	-13.5～-11.0	-12.5	+2.5	370	Fig.A9.5.3(1)
Revetment 2	Rubble Mound	-3.0～- 2.0	-2.5	+2.5	150	Fig.A9.5.3(2)
Revet. For Road	Rubble Mound	-2.0～- 1.0	-1.0	+2.5	730	Fig.A9.5.3(3)
Groin	Rubble Mound	-2.0～- 1.0	-1.0	+2.5	150	Fig.A9.5.4
Mooring Fa.						
Quaywall W2	HB Caisson	-11.0～-7.0	-13.0	+2.5	330	Fig.A9.5.5(2)
Quaywall W1	RC Caisson	-6.5～- 4.5	-8.0	+2.5	150	Fig.A9.5.5(3)
Quaywall E1	RC Caisson	-4.0～- 3.0	-8.0	+2.5	150	Fig.A9.5.5(3)
Quaywall	Con. Block	-4.5～- 3.5	-4.0	+2.5	280	Fig.A9.5.5(4)

Table 9.1(2) List of Proposed Structure in Lien Chieu

Facility	Structural Type	Depth(m)		Crown Height (m)	Planned Quantity (m)	Main Report Figure No.
		Existing	Design			
Protective Fa.						
Breakwater	HB Caisson	-8.5	-8.5	+7.3	265	Fig.A9.5.1(2)
Seawall	HB Caisson	-8.5～ -7.5	-8.0	+7.5	565	Fig.A9.5.2(2)
Revetment R1	L-Shaped Co. Block	-7.5～ -5.0	-6.0	+3.0	130	Fig.A9.5.3(1)
Revetment R2	RC Caisson	-8.5 ～ -7.5	-8.0	+3.0	350	Fig.A9.5.3(2)
Revetment R3	L-Shaped Co. Block	-7.5 ～ -5.0	-6.0	+3.0	220	Fig.A9.5.3(1)
Revetment R4	L-Shaped Co. Block	-7.5 ～ -5.0	-6.0	+3.0	370	Fig.A9.5.3(1)
Revetment for Road	Concrete Block	-5.0～ 0.0	-2.5	+3.0	665	Fig.A9.5.3(3)
Training Wall	Rubble Mound with Dissipating Co.Block	-1.0～ 0.0	-0.5	+3.0	200	Fig.A9.5.4
Mooring Fa.						
Quaywall E1	HB Caisson	-8.0～ -7.0	-12.0	+3.0	270	Fig.A9.5.5(3)
Quaywall W1	RC Caisson	-6.5～ -4.5	-9.0	+3.0	160	Fig.A9.5.5(3)
Quaywall W2	RC Caisson	-4.0～ -3.0	-9.0	+3.0	160	Fig.A9.5.5(3)
Bridge	From the scale and popularity, Steel Pile with P.C Girder is selected.	-3.0～ 0.0	3 span	+4.8	75	Fig.A9.5.6

Table 9.1(3) List of Proposed Structure in Dung Quat

Facility	Structural Type	Depth(m)		Crown Height	Planned Quantity	Main Report Figure No.
		Existing	Design	(m)	(m)	
Protective Fa.						
Breakwater 1	HB Caisson	-16.5～-15.0	-16.0	+8.5	300	Fig.A9.5.1(2)
Breakwater 2	HB Caisson	-15.0～-9.0	-15.0	+7.0	300	Fig.A9.5.1(4)
Breakwater 3	Concrete	0.0	0.0	+6.0	100	--
Breakwater 4	RC Caisson	-9.0～-5.0	-8.0	+6.5	270	Fig.A9.5.1(6)
Revetment	Concrete. Block	-5.0～-4.5	-4.5	+3.0	420	Fig.A9.5.2
In.Breakwater	Con. Block	-4.0	-4.0	+3.0	100	Fig.A9.5.3
Training Wall	Rubble Mound	-1.0～0.0	-0.5	+2.0	150	Fig.A9.5.4
Mooring Fa.						
Dolphin D4	RC Caisson	-16.5～-15.0	-13.0	+3.0	355	Fig.A9.5.6(1)
Dolphin D1, D2	RC Caisson	-14.0～-7.0	-8.0	+3.0	313	Fig.A9.5.6(2)
Quaywall E1,E2	RC Caisson	-7.0～-5.5	-8.0	+3.0	300	Fig.A9.5.5(2)
Dolphin E3, E4	RC Caisson	-5.5～-3.5	-8.0	+3.0	313	Fig.A9.5.6(1)
Quaywall	Con. Block	-3.5～-1.0	-4.0	+3.0	200	Fig.A9.5.5(3)
Bridge	From the scale and popularity, Steel Pile with P.C Girder is selected	-3.0～0.0	3 span	+4.8	200	Fig.A9.5.7

10. Construction Plan

One of the characteristics of port construction works is that not only they involve earth works, but also they rely upon heavy equipment and large-size work vessels including dredgers, floating cranes, pile driving barges, etc. Taking into consideration the characteristics and based on the Master Plans and the Initial Stage Development Plans; the natural conditions; and the preliminary designs of the port facilities; at Chan May, Lien Chieu and Dung Quat, construction plans and methods are discussed to enable cost estimates at these three new ports.

The production and procurement of construction materials are, as far as the earth works are concerned, available in the nearby hinterlands of the project sites. The largest quantity required is stones of various sizes, which are obtained from quarries located in acceptable distances from each site. The steel materials are, in principle, should be imported from abroad except reinforcing iron bars. Steel plates can mostly be procured in Vietnam.

Majority of the large-capacity work vessels will have to be brought in from abroad. It will probably be necessary to employ F/Cs, capable of lifting 1,000 tons or more, although F/C up to 600 tons capacity are available in Vietnam. Dredgers of cutter suction-type, drag suction-type and grab-type will be required to dredge the approach channels and basins as well as foundation of upper structures.

Construction bases are necessary for provision of ample space for construction of project facilities; storage and supply of construction materials; fabrication of concrete blocks and caissons; and mooring of work vessels. Required area for the yard in the base will be 200 m along shoreline and 100 m landward, or about 2 ha. There are two candidate places: one is in Danang Bay and the other at Ky Ha.

The expected volumes of dredging are estimated as 2.5, 3.7 and 0.8 million m^3 for ISP at Chan May, Lien Chieu and Dung Quat, respectively. Disposal of the dredged soft seabed materials should be more or less dumped at the offshore sea of the three sites. Drag suction hopper dredgers can bring the spoils from channels and basins by themselves to the dumping site. For a grab dredger, hopper barges will accompany for ocean dumping. In the case of Lien Chieu, the dumping site could be selected at a place of about 15 km apart from the port, taking account of environmental conservation.

In consideration of the above construction plans and methods as well as the required completion time from the port planning side, construction time schedules were prepared for the three sites. The time schedules proposed here can comply with the requirement of the target years of the ISPs and Master Plans of the three new ports, although those for ISP are rather tight.

11. Cost Estimates

Based on the above construction plans, preliminary cost estimates were carried out at the three ports. The following preconditions were adopted.

a. The estimates are made using the prices and exchange rate in December 1997,
b. The inflation factor is excluded from the estimates,
c. The exchange rate employed is: US$1.00 = JP ¥ 130 = VND 12,280,
d. The cost of foreign portion includes the following:
    1) Foreign currency portion of operations includes depreciation cost and products cost for imported equipment,
    2) Cost for imported equipments,
    3) Impoted materials and products,
e. Turnover and profit taxes are taken into account, reflecting the tax system in December 1997, as 6 % of the contract price,
f. Physical contingency is considered as 8 % for civil works and 3 % for equipment, and
g. Costs for engineering services are estimated based on necessary items.

The results of the preliminary cost estimates are shown in Table 11.1 for the Master Plans and Table 11.3 for ISPs at the three new ports. For example, in the case of Lien Chieu, the total construction cost is assessed to be about US$ 150 million for ISP, among which the costs of constructing the protective facilities and dredging, which have a highly public nature different from equipment, amount to US$ 57 million, or 38 % of the total construction costs. The total project cost including indirect costs is estimated to be about US$ 158 million for ISP of Lien Chieu.

It is noted that, in the implementation stage of the project, detailed cost estimates will be necessary to reflect the results of detailed design including the the inflation rate and exact tax levy.

Table 11.1 Preliminary Cost Estimates of Master Plans (Unit : Million US$)

Description	Chan May	Lien Chieu	Dung Quat
1. Protective Facility	66.8	64.4	87.4
2. Dredging	19.8	40.8	25.3
3. Bridge	NA	1.9	5.0
4. Berthing Facility	57.0	51.3	53.4
5. Yard	34.5	67.3	95.9
6. Access Road	2.6	4.4	2.7
7. Building and Utilities	5.3	10.6	NA
8. Oil Treatment Pond and Pipe Line	NA	NA	9.7
9. Sub-total (1)	186.0	240.7	279.4
10. Cargo Handling Equipment	12.8	44.6	NA
11. Loading Arm	NA	NA	6.4
12. Navigation Aids	4.3	4.4	4.6
13. Sub-total (2)	17.1	49.0	11.0
14. Total ((Sub-total(1) + Sub-total(2))	203.1	289.7	290.4
15. Physical Contingency (8%x9.+3%x13.)	15.4	20.7	22.7
16. Engineering Services	27.0	30.8	22.8
17. Total Construction Cost (14. to16.)	245.5	341.2	335.9
18. Tax (6%)	12.2	17.4	17.4
19. Resettlement and Compensation Costs	ST	0.1	ST
20. Total Project Cost (17. to 19.)	258	359	353

Notes: Based on costs in December 1997.
Exchange rate: US$1.00=JPN¥130=VND12,280
Excludes price contingency.
NA: Not applicable. ST: To be studied in the next stage

The scale of development of each master plan is different from each other, which resulted in the above mentioned cost. Planned port facilities and cargo throughput are summarized in the table below.

Table 11.2 Scale of Development of Master Plans

	Chan May	Lien Chieu	Dung Quat
Projected cargo throughput:	5.400,000 tons	8,500,000 tons	30,600,000 tons
Planned port facilities			
Deep sea berths:	2 (660 m)	3 (930 m)	4 (600 m & 2 dolphins)
Medium size berths:	5 (700 m)	8 (1,020 m)	9 (1,200 m & 6 dolphins)

Table 11.3 Preliminary Cost Estimates of Initial Stage Plans (Unit : Million US$)

Description	Chan May	Lien Chieu	Dung Quat
1. Protective Facility	51.6	42.2	33.5
2. Dredging	6.5	14.8	3.9
3. Bridge	NA	1.9	5.0
4. Berthing Facility	29.1	18.4	20.0
5. Yard	21.0	20.1	15.8
6. Access Road	2.6	4.4	2.7
7. Building and Utilities	5.3	5.3	NA
8. Oil Treatment Pond and Pipe Line	NA	NA	5.7
9. Sub-total (1)	116.1	107.1	86.6
10. Cargo Handling Equipment	0.5	14.1	NA
11. Loading Arm	NA	NA	4.1
12. Navigation Aids	4.2	4.4	4.2
13. Sub-total (2)	4.7	18.5	8.3
14. Total ((Sub-total(1) + Sub-total(2))	120.8	125.6	94.9
15. Physical Contingency (8%x9.+3%x13.)	9.4	9.1	7.2
16. Engineering Services	13.5	15.4	11.4
17. Total Construction Cost (14. to16.)	143.7	150.1	113.5
18. Tax (6%)	7.2	7.5	5.7
19. Resettlement and Compensation Costs	ST	0.1	ST
20. Total Project Cost (17. to 19.)	151	158	119

Notes: Based on costs in December 1997.
Exchange rate: US$1.00=JPN¥130=VND12,280
Excludes price contingency.
NA: Not applicable. ST: To be studied in the next stage

Table 11.4 Scale of Development of ISP

	Chan May	Lien Chieu	Dung Quat
Projected cargo throughput:	2,655,000 tons	4,020,000 tons	13,300,000 tons
Planned port facilities			
Deep sea berths:	1 (330 m)	1 (270 m)	1 (1 dolphins)
Medium size berths:	2 (300 m)	2 (320 m)	6 (600 m & 4 dolphins)

12. Economic Analysis

12.1 Methodology

The purpose of the economic analysis is to appraise the economic feasibility of the development plan for the new port and show whether the project is justifiable from the view point of the contribution to the national economy.

A cost-benefit analysis is estimated on difference between the "With" and "Without" case. The economic internal rate of return (EIRR) based on a cost-benefit analysis is used to appraise the feasibility of the project.

The prerequisites of economic analysis are as listed below.

(1) Base Year: 1997

(2) Project Life: Period for construction and 30 years.

(3) Foreign Exchange Rate: US$ 1.00 = 130 ¥ = 12,280 VND

(4)"Without" Case

1) No investment is made for construction of new port and new industrial area.
2) "When the cargo from/to the study hinterland exceeds the handling capacity of the existing port, the cargo which can not be handled in the existing port is assumed to be handled in the other port near site and transported by land.

12.2 Benefits and Costs of Project

(1) Benefits of Project

The following five items are identified as benefits of project. In this study, the monetary benefits of items 1), 2) and 3) are calculated.

1) Savings in land transportation costs
2) Value added by new industrial development
3) Saving in sea transportation costs by international transit cargo
4) Promotion of regional economic development
5) Increase in employment opportunities and incomes

(2) Costs of the Project

The items of the costs of project are construction, Re-investment, Maintenance and Operation.

12.3 Economic Viability

Results of the Economic Internal Rate of Return (EIRR) calculation of initial stage development plans are shown in Table 12.1. Costs of the project are estimated based on economic prices. Here, sensitivity analysis is made in which costs increase by 10% and benefits decrease by 10%.

Table 12.1 Economic Internal Rate of Return (ISP)

Name of Port	Scenario	EIRR	(Sensitivity)
Chan May	High growth	17.2%	14.7%
LienChieu	High growth	19.4%	16.3%
	Low growth	18.4%	15.5%
Dung Quat	High growth	20.8%	18.2%

On the assumption that discount rate is 8%, 12% and 16%, the Net Present Value (NPV) and the Benefit Cost ratio (BCR) of initial stage development plans is summarized in Table 12.2, 12.3.

Table 12.2 Net Present Value (ISP) Unit: ThousUS$

Name of Port	Scenario	8%	12%	16%
Chan May	High growth	166,523	61,188	9,794
LienChieu	High growth	203,707	86,744	28,134
	Low growth	187,634	74,071	19,174
Dung Quat	High growth	243,435	110,996	42,997

Table 12.3 Benefit Cost Ratio (ISP)

Name of Port	Scenario	8%	12%	16%
Chan May	High growth	2.30	1.55	1.10
LienChieu	High growth	2.35	1.68	1.25
	Low growth	2.28	1.60	1.18
Dung Quat	High growth	3.17	2.09	1.46

12.4 Evaluation

There are various views concerning the critical percentage of EIRR to judge whether a project is feasible or not. In general, a project is deemed feasible if the EIRR exceeds 15%.

As for three study projects, even though the economic calculation only takes into account the benefit items which are easily quantified, the EIRR exceeds 17%. Therefore, the three initial stage development plans are viable from the viewpoint of the national economy.

13 Port Management and Operations Plan

13.1 Port Administration

As has been the case in major ports in Vietnam, nationally developed ports shall be administered by the public sector which is an appropriate organ to administer national property. Port management body shall be set up in VINAMARINE and be responsible for administering ports and harbors.

In order to raise the capacity of the port management body to its highest level, it is necessary to keep the essential principles of autonomy, financial independence, principle of competition and unitary management strictly.

13.2 Port Development, Management and Operations Plan

Possible patterns of port development, management and operations for the new port are shown in Table 13.1.

Table 13.1 Patterns of Port Development, Management and Operations

Pattern		A	B	C	D	E	F
Master Plan		○					
Construction	Channels	○		○		○	○
	Breakwater						
	Infrastructure					●	●
	Superstructure			○	●		
Ownership	Land	○		○	○	○	●
	Terminal facilities			●*1	●*1	●*1	
Terminal Operations		○	●	●	●	●	●
Tug & Pilotage		○ or ●					

Note1: ○: Public, ●: Private, (*1 : Land lease system)

Note2: [ ] Recommended patterns

Based on the analysis above, recommendations on the new system of port development, management and operations for Masterplan are as follows:

1) Master plan for the New Port must be authorized by public sector, and construction of infrastructure such as the breakwater, dredging and so on must also be performed by the public sector.

2) For the above purpose, construction of infrastructure such as the breakwater, dredging and land reclamation must also be performed by the public sector and ownership of the land should be retained by the public sector.

3) Construction of the terminals including the superstructures, and its operation is recommended to be performed by the private sector in order to encourage efficient cargo handling.

13.3 Methods to Support Efficient Management and Operations

(1) Port Promotion and Statistics System

Port promotion activities are one of the most important factors to attract port users and to secure an adequate level of revenue. In order to accomplish this aim, action programs such as port sales by a port management body are necessary. Also, it is necessary to introduce a statistics system to support formulation of the port plan, port strategy and promotion of the port.

(2) Tariff

In Vietnam, fees for vessels for overseas and coastal services are charged differently. However, the current level of difference in Vietnam is way to large. The difference should be corrected.

Also, navigational maintenance dues is particularly high among the various tariffs. Each port management body should adopt a self-supporting accounting system in which it collect tariffs including tonnage and clearance fees and maintains maritime routes.

(3) Training System

The port management body should send several staffs and operators to foreign ports or invite foreign specialists to acquire the latest knowledge or skill, since field training is very useful for skill acquisition.

In addition, the port management body needs to develop its own training courses in order to make up for the lack of expertise in the new port and to improve container handling productivity.

14. Financial Analysis

(1) Purpose and Methodology

The purpose of the financial analysis is to appraise the financial feasibility of the proposed port development scheme in Lien Chieu. The analysis focuses on the financial viability of the project itself from the view point of the port management body and the influence by implementation of the project on the financial soundness of the port management body.

The viability of the project is analyzed using the Discount Cash Flow Method and appraised by FIRR (financial internal rate of return). The influence on the financial soundness of the port management body is appraised based on projected financial statements regarding the project (Income Statements, Cash Flow Statements and Balance Sheets).

(2) Prerequisites

Prerequisites are shown in Table 14.1 and Table 14.2. Based on the examination of the cargo handling forecast, two cargo handling volume cases are defined as follows:

<High Growth Case> Cargo handling volume in case of High Growth.
<Low Growth Case> Cargo handling volume in case of Low Growth.

Table 14.1 Prerequisites of Financial Analysis

Construction/Management Body		Public sector (Lien Chieu Port)
Facilities	Infrastructure	Breakwater, Channel and Basin, Quaywall, Land fill Revetment, Inner roads
	Superstructure	Yard pavement, Cargo handling equipment, Building
Project Life		30 years : after construction
Revenue		Tonnage, Pilotage, Navigational maintenance dues Berthage, Cargo handling and Storage charge, Service charge
Expenditure		Initial investment and reinvestment costs Personnel and Administration cost Maintenance and repair cost (including dredging cost) Depreciation cost Turnover and Income tax

Table 14.2 Fund Raising for Project

Type	Long-term Loans		Short-term Loans
Source	Foreign Countries	Domestic Bank	Domestic Bank
Covered Range	85% of the initial investment costs of the projects	15 % of the initial investment costs of the projects	only in case of cash shortage
Repayment Term	30 years (including a grace period of 10 years)	15 years (with no grace period)	1 year (with no grace period)
Interest Rate	1.8% per annum	9.0% per annum	8.5% per annum
Repayment Pattern	Fixed amount repayment of the principal	Fixed amount repayment of the principal	Fixed amount repayment of the principal

(3) Appraisal of the Project

The results of the FIRR calculation including sensitivity analysis are shown in Table 14.3. Sensitivity Analysis is conducted to examine the impact of unexpected future changes.

TABLE 14.3 Results of FIRR Calculation for the Short Term Plan

	Original Case	Sensitivity 1 reve.10% down	Sensitivity 2 cost 10% up	Sensitivity 3 reve.10% down cost 10% up
High Growth Case	5.7%	4.5%	4.6%	3.3%
Low Growth Case	5.1%	4.0%	4.1%	3.0%

Weighted average interest rate of the funds is 2.9% in this study. In all cases of Scenario 1 and 2, FIRR exceeds this rate. Therefore, this project is deemed to be financially feasible.

In both cases, the indicators which show "Profitability", "Loan Repayment Capacity" and "Operational Efficiency" of the port management body (Lien Chieu Port) are all at appropriate levels. Therefore, it can be judged that the port management body will be financially sound in this project.

However, FIRR shows a lower level in the low growth case, so port management body should make continuous efforts to secure forecast cargo volume, to improve cargo handling efficiency and to reduce operating expenses. Also, port management body should consider public benefit and methods/conditions when inviting the private sector to participate in port services such as cargo handling, storage and other activities.

15. IEE and Preliminary EIA

15.1 Natural Environment

Natural environmental survey was carried out by JICA Study Team / TTC (Tropical Technology Center in HCMC) once in April / May 1997 for IEE at the three Study Areas, and three times in December 1997 / January 1998 in Lien Chieu for preliminary EIA. The survey items are fauna, flora, marine life, water quality and sediment.

In Chan May, fauna is classified into feeding (domestic) fauna and natural wildlife fauna. The former includes cow, buffalo, pig and other poultry. The latter is both poor in number and species. Flora at the beach area is composed of coastal pine mixed with *Eucalyptus*, *Pandanus* and *Caotus*, with a ground cover of *Iponoea aquatica* and *Poaceae* species, which are common plants in Vietnam. Marine life of Chan May Bay is considerably greater, consisting of more than 140 taxa, including hard corals and coral fish. The coral reefs already show some significant deterioration in condition. The water quality of marine and river waters was monitored at 10 sites and all the samples comply with the Vietnamese water quality standards in terms of pH, DO, SS, and COD/BOD (coastal water: TCVN 5943-1995 and surface water: TCVN 5942-1995).

In Lien Chieu, ordinary domestic faunas and only common wild life faunas are found. The flora is generally poor and of low economic value, although there are small areas of natural medium crown forest remaining at the foothills of the Hai Van range in the Cu de river catchment area. With regard to marine life, of particular note is the presence of about 100 ha of coral reefs in Danang Bay, including Nam O Cape and Ham So Mot Cape. However, the coral condition is in much greater deterioration compared to Chan May and Dung Quat, which may reflect the effect of urbanization of the hinterland.. The water quality was examined at 10 sites in Danang Bay and the Song Han, Cu De and Cu Nhi rivers. Coastal water quality complies with TCVN for users other than bathing, recreation and aquatic cultivation, due to higher concentration of SS of more than 50 mg/l . The river water samples comply with TCVN for purposes other than domestic water supply. The sediment samples taken at three sites in Kim Lien Bay were analyzed in terms of organic matter, ignition loss, ammonia, sulfide and eight heavy metals, i.e. Cu, Cd, Cr, Pb, Ni, Zn, Hg and As. The concentrations of the chemical characteristics of sediment are found very low. Relatively high level concentrations were found in Cu and As. However, the contents of heavy metals, in general, are lower than that of the reference stations in Vietnam and Malaysia Coastal Zone. Therefore, it

is concluded that the sediment is relatively clean.

In Dung Quat, the project area does not contain any fauna species or habitats of particular or notable value with the possible exception of the Nam Tran mountain. With regard to flora, there are mangrove species, *Rhizophora apiculata* and *Bruguiera sexanguila* in Tuyet Diem village, which is worthy of note. The marine life around Dung Quat Bay is similar to Chan May with a marginally greater abundance of some of the more common seaweeds. Attention should be paid to the existence of coral and other benthic communes around the cape. Water quality at 10 sites in Dung Quat Bay, Tra Bong River and Moi River all comply with the TCVNs.

15.2 Social Environment

Social environmental survey was carried out by JICA Study Team / TTC in April / May 1997 for IEE at the three Study Areas, and in December 1997 / January 1998 in Lien Chieu for preliminary EIA. The site surveys are focused on the fields of socio-economy, historical heritages and communication among local communities.

(Overall Project Area Related to Port Development)

Social environmental survey of the overall project area related to port development inclusive of industrial development area revealed the following.

In Chan May, there are two villages that can be affected by the development of Chan May Centralized Industrial Zone and the planned new port, i.e. Loc Vinh and Loc Tien. Loc Vinh is located behind the Chan May Beach and will be directly influenced by the port development. The population of these villages is about 12,000 and the number of households is about 2,500. Main profession of the inhabitants is agriculture and fishery (87 %). The land is mostly sandy and arid, and therefore agricultural output is low. Average income per capita is very small compared with urban citizens. Currently, stone exploitation is the major industry. Tourism is the most expected sector to be developed with a potential of beautiful beaches. With regard to resettlement of the residents due to industrial and port development, more than 92 % of the households are willing to relocate. Most of the people hope to move with other households in the village with sufficient compensation. With regard to historical heritages, there are about 30 noted places, which could be moved, if necessary in the interest of the public.

In Lien Chieu, the survey was carried out at the coastal Area consisting of three Sub-areas of P, Q and O as shown in Figure 15.2.1 below. The population is about 12,500 in the whole Area. It is 3,500 in the Sub-area P that is between the planned port area and the National Railway. Employment rate is 72%. Job structure among working population is trade and services (47%), industry (22%), fishery (14%), farming (9%) and government (8%). Average income per capita is higher than that in rural areas,

but still not high. With regard to resettlement, all the inhabitants interviewed agreed to move subject to enough compensation. Some of them expressed hopes to maintain the present job (14%) and re-training (8%). With regard to historical heritages, there are 36 places of interest in the Area. But, there is only one in Sub-area P, i.e. the Whale Mausoleum that is not affected by the Master Plan of the new port.

In Dung Quat, the commune directly related to the port development is Binh Thuan Commune, including villages of Tuyet Dien, Thuan Phuoc, Dong Lo, etc. As far as the oil refinery project is concerned, there are other communes to be involved. The population of Binh Thuan is about 6,500. The economic structure of Binh Thuan is agriculture (50%), Fishery (48%) and others (2%). The land of this area is generally not very suitable for agriculture. The average income per household is among the lowest. Fishery is the occupation attracting most of the households. With regard to resettlement, a very high percentage of households expressed consent, subject to sufficient aids and compensation. With regard to historical heritages, there are 11 historical buildings in Binh Thuan, some of which are newly built after 1975. It is to be noted that there are signs of some relics of Champa people in the area.

(Port Development Area)

In Lien Chieu, the only direct impact to the social environment from the port development project is the relocation of inhabitants. In Sub-area P and Q as shown in Figure 15.1, the actual number of houses to be moved is 21 on the access roads planned in the Master Plan. Therefore, no serious problem is anticipated related to movement. However, various welfare policies are expected to be taken by the organizations concerned.

Figure 15.1 Study Area of Social Environment in Lien Chieu