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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

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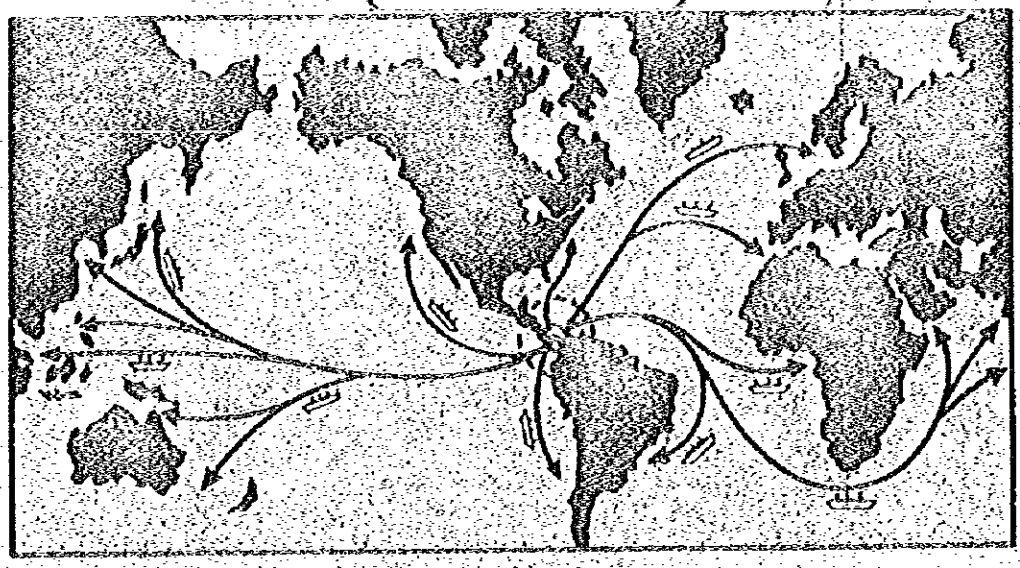
NATIONAL PORT AUTHORITY
THE REPUBLIC OF PANAMA

THE STUDY ON THE DEVELOPMENT PLAN OF THE PORT OF BALBOA IN THE REPUBLIC OF PANAMA

FINAL REPORT

PART II MASTER PLAN



JUNE 1997

THE OVERSEAS COASTAL AREA DEVELOPMENT INSTITUTE OF JAPAN (OCDI)
PACIFIC CONSULTANTS INTERNATIONAL (PCI)

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PREFACE

In response to a request of the Government of the Republic of Panama, the Government of Japan took pleasure in conducting a study on the development of the port of Balboa and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Panama a study team headed by Mr. Takao HIROTA, President of the Overseas Coastal Area Development Institute of Japan (OCDI), and composed of members from this institute and another company, Pacific Consultants International (PCI), three times between May 1996 and March 1997.

The team held discussions with the officials concerned of the Government of Panama, 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 the officials concerned of the Government of the Republic of Panama for the close cooperation they extended to the team.

June 1997

Kimio FUJITA
President
Japan International Cooperation Agency

LETTER OF TRANSMITTAL

June 1997

Mr. Kimio FUJITA
President
Japan International Cooperation Agency

Dear Sir,

I have the honor to submit herewith the Final Report for the Study on the Development Plan of the Port of Balboa in the Republic of Panama.

This report is the outcome of works between March 1996 and June 1997 which included three field surveys. The work was undertaken by the Overseas Coastal Area Development Institute of Japan (OCDI) and Pacific Consultants International (PCI) as per the contract with the Japan International Cooperation Agency (JICA).

Based on the findings of these surveys and utilizing data and information collected, and along the line of the scope of work which was agreed upon by both governments, the report is formulated to cover the following subjects;
(1) To formulate a master plan for the existing port and new terminals for container cargoes, etc., up to the year 2015
(2) To conduct a feasibility study on a short-term plan up to the year 2005 based on the master plan.

The study shows the importance of the overall development of the Port of Balboa and its proper administration, management and operation. I earnestly hope that necessary measures will be taken to implement the projects and recommendations.

I would like to note that the completion of the study is greatly owed to the collaboration with APN (Autoridad Portuaria Nacional) and other related ministries, government agencies, authorities, shipping lines and agents.

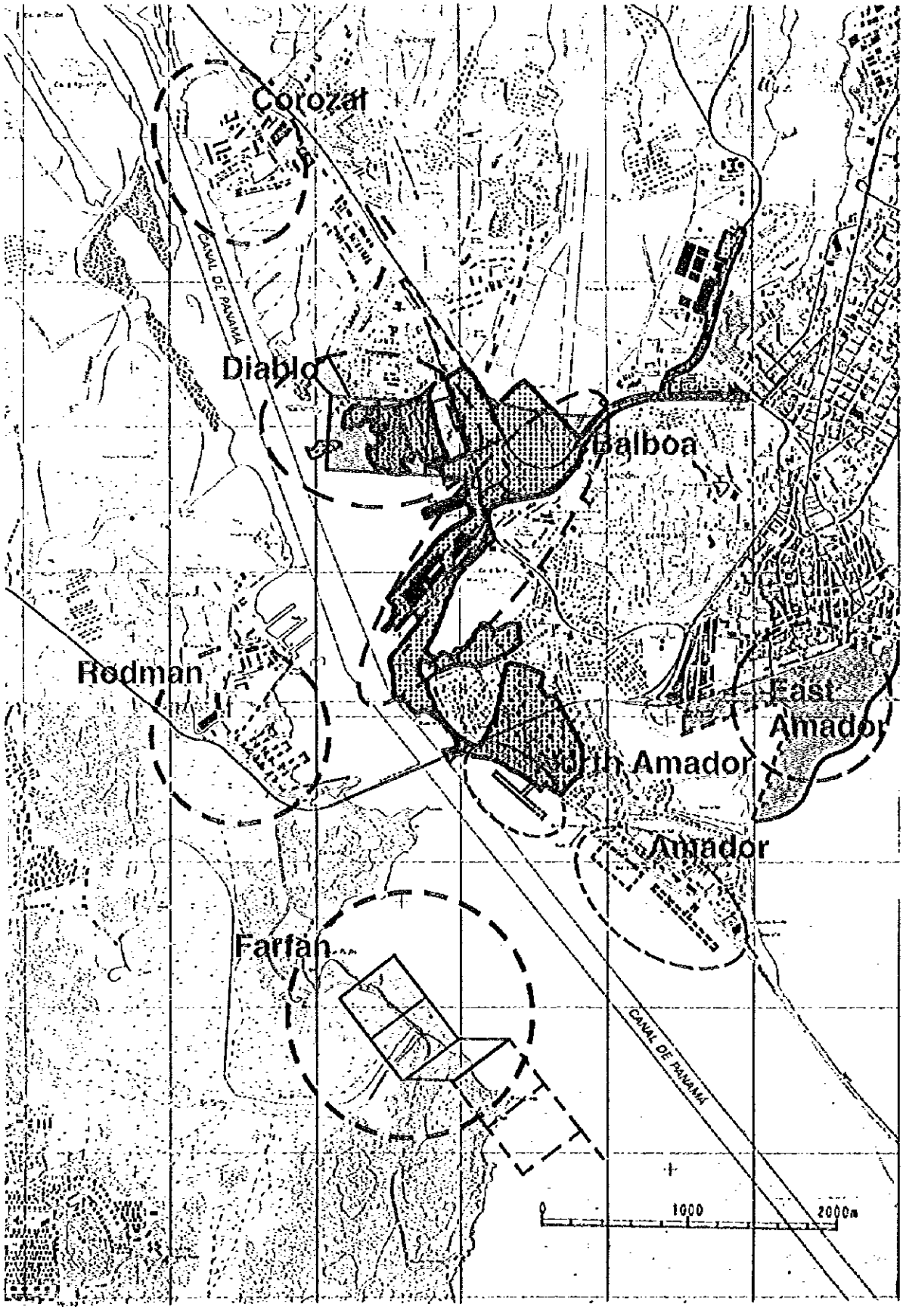
I am also greatly indebted to JICA, the Ministry of Foreign Affairs, the Ministry of Transport and the Embassy of Japan in Panama for giving us valuable advice and assistance at every step throughout the course of the study.

Yours sincerely,

Takao Hirota

Takao HIROTA
Team Leader for the Study
on the Development Plan of the Port of Balboa

PROJECTS OF THE STUDY



CURRENT PORT AREA

SHORT TERM PLAN (2005)

OTHER PROJECTS

MASTER PLAN (2015)

POST MASTER PLAN

ABBREVIATION LIST

A	APN	National Port Authority
	APSA	Atlantic-Pacific, S.A.
	ARI	Interoceanic Regional Authority
B	B/L	Bill of Lading
	BNP	Panama National Bank
	BOD	Biochemical Oxygen Demand
	BOT	Build, Operate and Transfer
C	CCT	Colon Container Terminal
	CFC	Conversion Factor for Consumption
	CFS	Container Freight Station
	CIF	Cost, Insurance and Freight
	CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
	COD	Chemical Oxygen Demand
	COFRISA	Consortium for the Development of Folk River, S.A.
	CPC	Centerport Concept
D	DO	Dissolved Oxygen
	DWT	Dead Weight Tonnage
E	EIA	Environmental Impact Assessment
	EIRR	Economic Internal Rate of Return
	EIS	Environmental Impact Study
	EPZ	Export Processing Zone
F	FCL	Full Container Load
	FEU	Forty-foot Equivalent Unit
	FIO	Free In and Out
	FOB	Free on Board
G	GCO	Office of General Comptroller
	GDP	Gross Domestic Products
	GT	Gross Tonnage
H	HHW	Highest High Water
	HIT	Hongkong International Terminals
I	IDB	Inter-American Development Bank
	IEE	Initial Environmental Examination
	IMF	International Monetary Fand
	IMO	International Maritime Organization

	INRENARE	National Institute for the Renewable Natural Resources
L	LAQ	Lease a Quay
	LCL	Less than Container Load
	LLW	Lowest Low Water
	LPG	Liquid Propane Gas
	LUP	License to Use a Port
M	MARPOL Protocol of 1978	Prevention of Pollution of the Sea from Ships 1973 and the
	M/O or O/M	Maintenance and Operation, or Operation and Maintenance
	MHW	Mean High Water
	MIPPE	Ministry of Planning and Economic Policy
	MIT	Manzanillo International Terminal
	MLB	Mini Land Bridge
	MLW	Mean Low Water
	MLWS	Mean Low Water Spring
	MSL	Mean Sea Level
N	NPV	Net Present Value
O	ODA	Official Development Assistance
P	PCC	Panama Canal Commission
	PLD	Precise Level Datum
	PPC	Panama Ports Company, S. A.
	PTP	Petroterminal de Panama, S.A.
R	Ro-Ro	Roll-on Roll-off
S	SCF	Standard Conversion Factor
	SPM	Suspended Particulate Matter
	SS	Suspended Solid
T	TEU	Twenty-foot Equivalent Unit
	T-N	Total Nitrogen
	T-P	Total Phosphorus
U	UN	United Nations
	UNCTAD	United Nations Conference on Trade and Development
	US	United States of America
Z	ZLC	Colon Free Zone

TABLE OF CONTENTS

LIST OF TABLES

PART II MASTER PLAN

LIST OF FIGURES

PART II MASTER PLAN

I BASIC POLICY FOR PORT PLANNING

1.1 Expected Function for the Port

1. The potential traffic demand through the port of Balboa has been evaluated based on its strategic location at the Pacific entrance to the Canal and its proximity to the population center of Panama.

2. The master plan with the target year of 2015 and the short term plan for 2005 including alternatives have been prepared in accordance with the resulting traffic projections.

3. Full scale container terminals are to be developed as soon as possible, in order that the port may realize its potential transshipment demand. Transshipment will form an important link in the chain of the marketing strategy of the port of Balboa.

4. Based on the above, the possible future functions and services expected at the port of Balboa can be identified as follows:

1.1.1 Principal Port for Cargo Handling

(1) Principal Port for Import and Export Cargoes

1) Gateway port for import cargoes for domestic consumption, and export cargoes of domestic production in Panama

5. Because of its close proximity to Panama city, which has the largest population in the country with a high density of economic activities, it would be more economical to handle most imported consumer goods at the port of Balboa rather than handling them at the ports of Cristobal, Manzanillo, Coco Solo Norte and Bahia Las Minas on the Atlantic side (hereinafter referred to as " the ports of Cristobal").

2) Complementary terminal services to the ports of Cristobal for containers and general cargoes to and from the Colon Free Zone

6. The ports of Cristobal will maintain their important position as a gateway port of the Free Zone. The port of Balboa will also support the activities of the Free Zone concerning the cargoes such as those imported from the Far East

and the U.S. west coast.

3) Main and complementary terminal services for containers and general cargoes to and from the Export Processing Zones

7. The port of Balboa will be the main terminal for the Export Processing Zones planned at the Pacific Side. It will also support the activities of the Export Processing Zones located at the Atlantic Side regarding the cargoes mainly imported from or exported to the Far East and the U.S. west coast. The ports of Cristobal will have a similar relationship with the respective Export Processing Zones.

(2) Principal port for the main and feeder line services for transshipment cargoes to / from major ports at the Pacific side of Central and South America

8. For the time being, these services would be rather limited in handling transshipment containers to / from those ports at west coast of Central and South America from / to the Far East and the U.S. west coast.

9. Transshipment services for the cargoes among the Far East, U.S. west coast, U.S. east coast, east and west coast of Central and South America east coast, and Europe via transit of the present Canal by Panamax vessel or land bridge of the Isthmus in cooperation with the ports of Cristobal will gradually be expanded in the future.

10. Transshipment services for the similar cargoes by post-Panamax type vessel and sea or land bridge of the Isthmus in cooperation with the ports of Cristobal, will take place by the completion of the third set of locks just after the target year 2015 of this Study (see Figure 1-1-1).

11. Regarding container transshipment services at the port of Balboa, a more economical and efficient way of operation should be adopted to secure the strong competitive position of the port. The potential advantage of the port will be enlarged through the completion of deep water berths equipped with high capacity gantry cranes for post-Panamax type vessels.

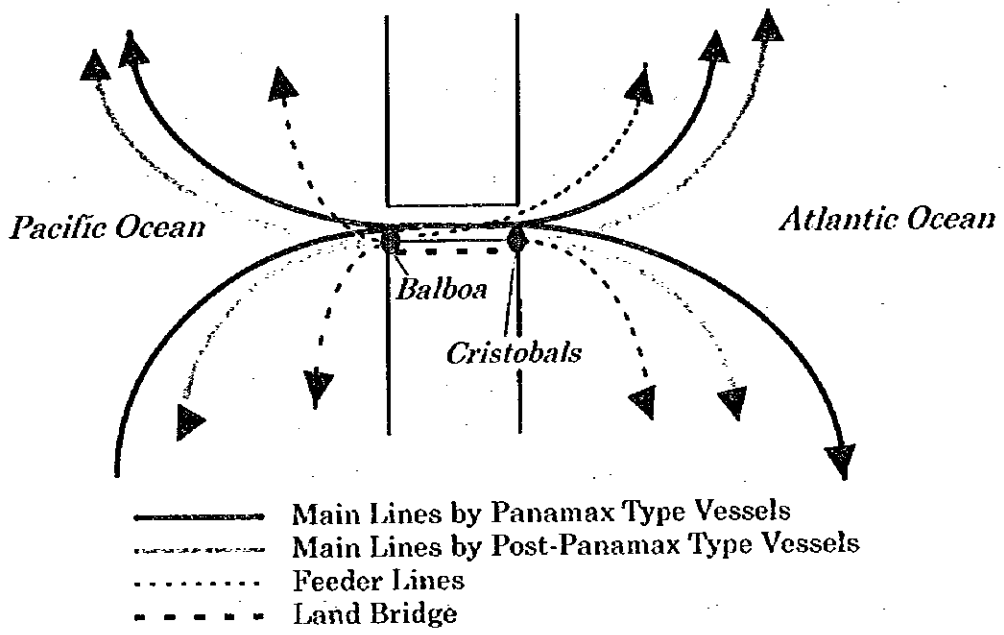


Figure 1-1-1 Conceptual Flow of Transshipment Services between Main lines and Main lines / Feeder lines by Panamax type vessels and / or post-Panamax type vessels

1.1.2 Ship Repair and Bunkering Center

(1) Ship Repair and Maintenance Center

12. Ship repair and maintenance center for the vessels will be another potential function expected at the port of Balboa, in addition to cargo handling.

(2) Bunkering Service Center

13. Bunkering service center for the vessels passing the Canal or calling the port of Balboa will be also expected as one of the value-added functions of the port (the port will be able to take advantage of the Petroleum Free Zone). More active and diversified bunkering services including fuel, water, and other ship supplies will be required to support the increased cargo handling activities of the port.

1.1.3 Other Major Functions

(1) Calling Port for Cruising Passenger Boats

14. In view of tourist industry promotion, construction and/or improvement of a new cruise ship terminal is necessary.

(2) Land Use Related to the Port Activities

15. The reverted area around the port of Balboa should be utilized to support various port activities and buildings such as warehousing and distribution, exhibition center, convention center, maritime training center and so on.

1.2 Planning Stage and Development Scenarios for the Port

16. The planning stage shall be divided basically into three stages, namely, urgent stage which will be implemented immediately, short term stage with the target year of 2005, and long term stage for the year of 2015.

(1) Urgent Stage

17. At the urgent stage, which has already been started, the existing facilities at Balboa will be rehabilitated so that the terminal can cater to Panamax container vessels. Basic assumptions in this stage are;

① The basic pattern of cargo flow will be more or less the same as the present one.
② The port will start to serve the vessels operated on main lines with the feeder transport for Central and South American west coast after the improvement of the existing berths (as the tentative container terminal).
③ Cargoes for consumption in Panama city will continue to be imported mostly through the port.
④ The existing piers will begin to magnify the general services including ship repair works, bunkering and miscellaneous supplies. The existing facilities related to the Rodman naval base will be utilized as an oil terminal.

(2) Short term Plan Stage

18. The Short Term Plan Stage (- 2005) includes not only a development plan to meet the demand of the year 2005 but also includes the improvement plan in port operation, management and its facilities as well. Basic assumptions of this stage are;

① A new container terminal along the north shore of the pier 18 (Diablo) will be operated fully and exclusively with concession.
② The transshipment containers including those shifting from the competing ports on the Pacific side of Central and South America will be handled at the new container terminal.
③ The port will start to establish its position as a principal port for transshipment operation for the Central and South American west coast, together with the ports of Cristobal and the connecting road. It will also be able to receive the post Panamax type of vessels, which can't pass the existing Canal.
④ The port with the new container terminal will serve the increasing container traffic for the Free Zone and the developing Export Processing Zones.
⑤ At the existing piers, general cargo and bulk cargo other than containerized cargo will be handled.

(3) Master Plan Stage

19. The Master Plan stage is to formulate the basic development policy for long term planning of the project up to the year 2015. This stage is essential as the basis of the short term planning and hence this stage shall be carried out in advance of the detailed feasibility study in actual planning works. Throughout the process of formulating the Master Plan of the project, the possible future expansion of the project shall always be kept in mind. Basic assumptions of this stage are;

① The development of a new container terminal may be extended beyond the present port area.
② The port will assure its position as a major principal port for transshipment operation for the lines from / to the ports on the Pacific side of Central and South America.
③ The expansion project of the Free Zone and the construction of the Export Processing Zones will mostly be completed. The cargo flow to / from these areas through those container terminals at the port will increase

/

accordingly.

④ Construction of the third set of locks with a new canal alignment must be initiated.

(4) Post Master Plan Stage

20. As a result of the appropriate expansion of the Canal, post Panamax type vessels will be in service via the Canal with increased number of transits. The full scale services for transshipment operation between main lines and feeder lines will be realized at both the port of Balboa and the ports of Cristobal.

21. The general scenario just explained above will be employed as a basic case for the calculation of the project feasibility in this Study.

22. However, events may not develop precisely in the order described above. Other parties could be interested simultaneously in the new terminal development, thus port development would take place in a competitive environment. In this regard, the master plan becomes a practical " Menu " of various projects for the private developers as well as for the port administrator. The details will be discussed later.

1.3 Development Sites for Container Terminal

23. The basin to which the port planning area belongs is more or less separated into the east area and the west area by the Canal as shown in Figure 1-3-1. These two areas are connected by only one bridge called the American Bridge. The existing facilities of the port gather together on the east side. This side has been also well developed with Panama city. On the west side, there are the US Naval Base of Rodman and a huge dump site of flat space, both of which are supposed to be reverted to Panama by 2000.

24. The coast line of the east area is divided into several areas according to natural and social conditions. The viability of each area as a construction site for a new port, especially for a new full container terminal, is evaluated here, because it will have a great influence on the other functions of the port. The characteristics of each area from north to south are summarized as follows:

Corozal: The north land area is occupied by the US military facilities, which will be reverted to Panama by 2000. In the south area, several

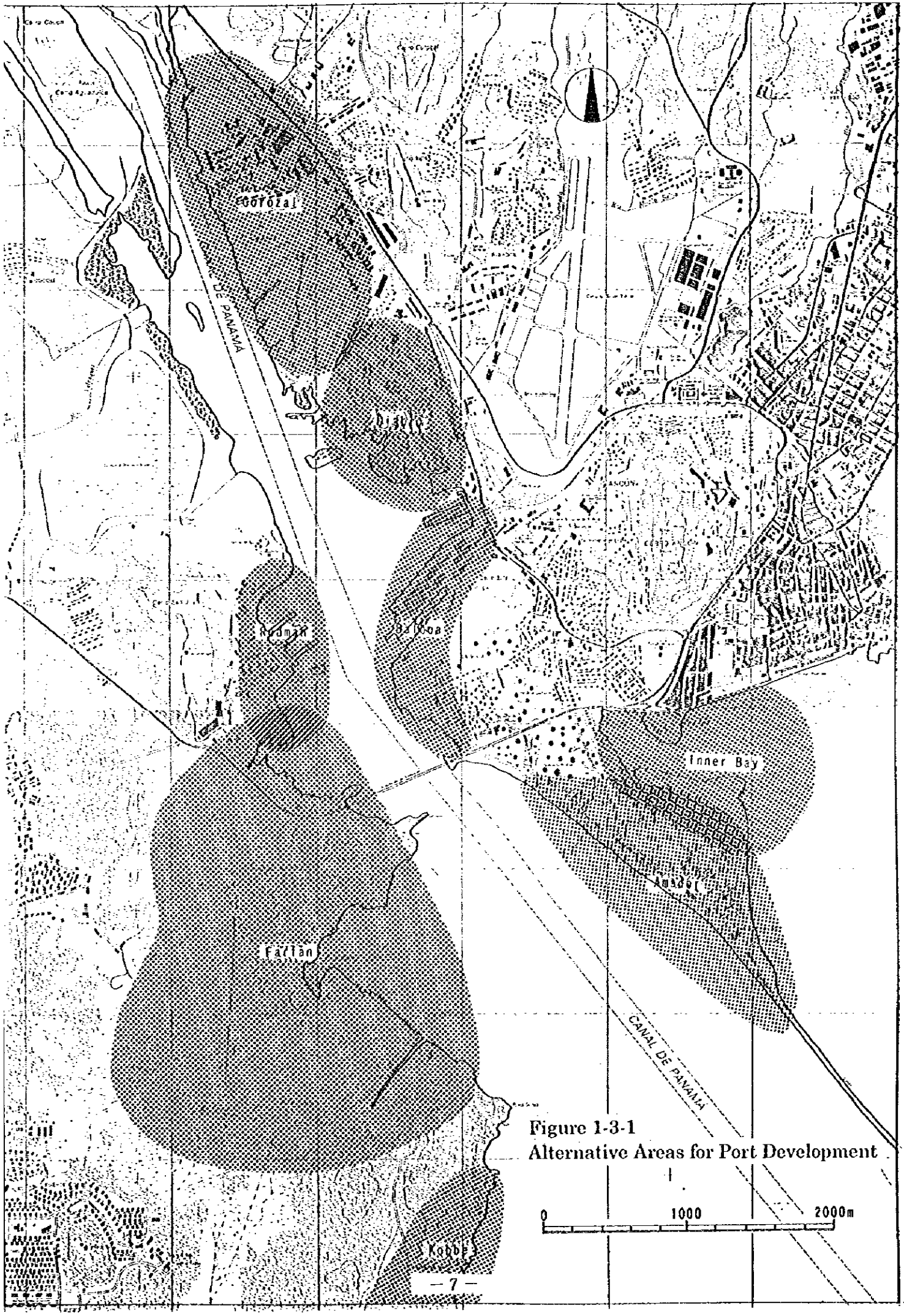


Figure 1-3-1
Alternative Areas for Port Development

antennas of PCC are located in the field. These areas could be available for the port activities if well coordinated. However, there is no sufficient room for the large vessels on the water side.

Diablo: The north land area has been used mainly for the residential quarter where many PCC workers used to live. On the water side, there is no sufficient space for the large vessels. However, a turning basin can be secured in the south water area for Panamax type vessels. Around the tidal swamp area near the south land, mangroves are grown on a small scale. These areas are in close proximity to the existing port facilities and have good access to the transport facilities. In particular, the south area is favorable for a new port construction. Space for at least two continuous full container berths can be easily secured by reclamation utilizing the existing road.

Balboa: Basically, the area just behind the existing piers is narrow. In addition, there will be no flexibility for the land use with the existing port facilities. For example, the dry dock with immovable heavy equipment, will continue to work as one of the important functions of the port as aforementioned.

Amador: This area is being developed as the strategic center for tourism by ARI. This project includes a cruise ship pier, a recreational marina, waterfront promenades and so on.

Inner Bay: This area is located in the back side of Amador. The water depth around the area is shallow for a full container terminal. In addition, it might be affected directly by the current or sediment.

25. Concerning the coast line of the west area, the characteristics of each divided area are also evaluated and summarized as follows:

Rodman: The existing facilities of the US naval base are utilized for fuel supply and operation. The related oil tank farm a few kilometers away from the base was transferred to Panama in 1996. These facilities are expected to support the port activities. However, it must be noted that these facilities will require modification to accommodate the new Canal alignment by 2020. There is some space for a container terminal just on the north land side of existing port facilities of the base. However, sufficient room is not secured for the large vessels on the water side in front of the Canal. In addition, if

container terminals are constructed in this area, their facilities are to be temporary and will be removed upon the new Canal construction.

Farfan: This area has been used for a dump site of the Canal construction and maintenance, and has become almost flat. This area will be suitable not only for a new full container terminal but also the future expansion of other port activities including the industrial complex. A turning basin can be secured in the water area for Panamax type vessels even when the new Canal is constructed by 2020. However, it should be noted that this water area was supposed to be one of the working areas for the new Canal construction. The access road between the east area and the west area separated by the Canal must be strengthened. The existing American Bridge cannot be expected to serve the general traffic demand after the year of 2000 even if the approaches to it are widened from two lanes to four lanes. The completion of the Arraijan-Panama superhighway with a new bridge near the Miraflores locks and/ or the replacement of the American Bridge is necessary.

Kobbe: This area faces the open sea of the Pacific Ocean. It might be affected directly by the current or sediment, and require a large amount of additional investment to be suitable for the port development. (Note: The neighboring Amador Causeway was constructed mainly to protect the Canal from the current or sediment.)

26. On the basis of above situation, Site-Diablo and Farfan are chosen as principal sites for a new port construction. Area Balboa is a supplementary site utilizing the existing facilities.

27. However, the priority can be changed if the basic conditions change. Priority can be also influenced by the criteria of the first consideration. Some examples of criteria to influence the priority of container berth construction can be given as follows:

① Site-Diablo is more convenient than Site-Balboa to develop the full container terminal from various points of view. A concessionaire could choose to invest in Site-Diablo from the beginning, instead of developing Site-Balboa and Site-Diablo one after another. It would be a more efficient and strategic way to create and meet the future demand all through the short term up to the year of 2005. It would also result in large cost savings.

② The same concessionaire of Site-Diablo or another would get interested in Site-Farfan sooner or later because this site has more capacity and flexibility for the development of the full container terminal than Site-Diablo, under favorable conditions such as the early arrangement of access infrastructure. At the same time, it could also meet the unforeseen future demand more easily. (In this case, it is desirable not to let the former concessionaire develop Site-Farfan in order that the port administrator can avoid a monopoly and maintain a competitive environment.)

28. In this sense, we can call Table 1-3-1 the "Menu" of the Development Plan for concessionaires prepared on the basis of the Master Plan with the target year of 2015. The details of the table will be explained in the following chapters.

1.4 Restoration of the old Albrook airport and the New Canal Alignment

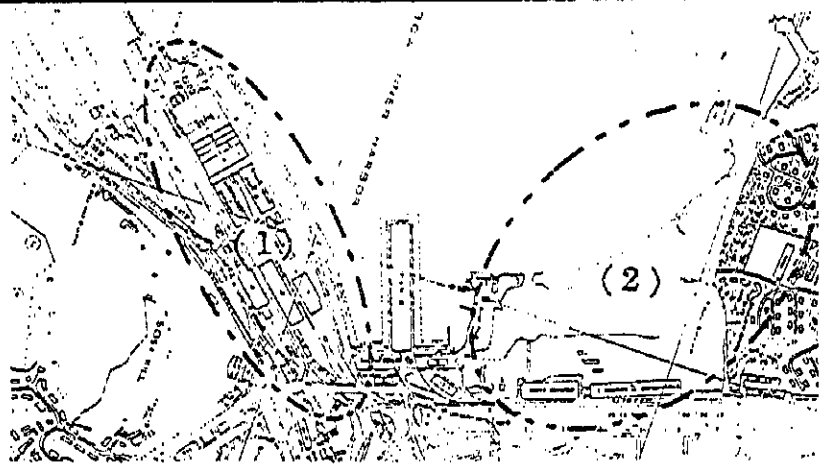
4.4.1 Effect of Restoration of the Old Albrook Airport

29. The government made an internal decision recently that the Paitilla airport would be relocated to the old Albrook airport neighboring the port. The existing airport has a 1,500 meter runway. The old Albrook airport has a 2,000 meter runway. If the regulations on airspace of the airport are strictly applied, the height of port facilities such as gantry cranes and vessels with high masts around the airport could be restricted.

30. The airport is already surrounded by several mountains and hills with an altitude of more than 50 meters, which exceeds the height limit of horizontal surface. Therefore, the height restriction of Balboa need not be strictly applied. In case that the Albrook airport is used as the airport, APN has to coordinate with the authorities concerned to ensure flexible application of the regulations.

Alternatives of Development Plan of Container Terminal and their Evaluations

Evaluation of Alternative Sites for Container Terminals as *Menu* for Investment Priority

	Alternatives		
	(1) Improvement of the Existing Area (2) Full Sized Yard along the north shore of Pier No.18 (Diablo)		(3) The West Bank of the Canal Entrance (Farfan)
Plan			
Evaluation			
Land Area Plan	C	A	A
Water Area Plan	B	B	B
Accessibility	A	A	C
Effect on Existing Function	C	A	A
Future Expansion	C	B	A
Construction Cost	A	B	C
Envirn. Impact	A	B	B
Other Remarks	(Effected by Airport Relocation to Albrook)	(Effected by Airport Relocation to Albrook)	(Effected by New Canal Construction)
Overall Evaluation			

note 1: the number of container termin Atlantic side - Cristobal 1(+1?), Manzanillo 2(+2), Coco Solo Norte (+2); Pasific side - Balboa 0 (+2~)
note 2: the implementation program analized in this Study: Alternative (1)→(2)→(3)
note 3: In case that the new airport is relocated to Albrook, not only Alternative (A) or (B) but also the vessels transitting the Canal will be seriously affected by the clearance

Table 1-3-1 The Summary of the Evaluation of Site Balboa, Diablo and Farfan for the Container Terminal

4.4.2 Coordination with the New Canal Construction

31. It should be borne in mind that the area near Site-Farfan is planned to be used for the working area for the new Canal construction. A camp is supposed to be located on the south side of the current dump site of the Canal, at the foot of the south hill. A temporary jetty will be constructed on the south coast of the hill, at the entrance of the Canal. And a placing area is planned along the approaching waterway of the new Canal.

32. As the new Canal is supposed to be operated by the year of 2020, the area will be very active during the construction of the new Canal around the target year 2015 of the master plan of this Study. Careful coordination could be required between the new Canal construction and the projects of this Study.

II DEMAND FORECAST OF PORT TRAFFIC

2.1 Future Projection of Socio-economic Indices

2.1.1 Population

1. A census has been taken every ten years since 1911. According to the result of the census, the population of Panama has been increasing steadily.

2. The General Control Office of Panama has a projection of population in the long term. The population in 2005 and 2015 is assumed according to the projection and is summarized in Table 2-1-1.

Table 2-1-1 Projection of Population

Year	1995	2005	2015
Population	2,631,000	3,067,000	3,451,000
Annual Growth Rate	1.4 % (1995 - 2015)	1.5 % (1995 - 2005)	1.2 % (2005 - 2015)

Source: GCO

2.1.2 Gross Domestic Products (GDP)

3. There is no authorized projection of the GDP in Panama. Therefore, the future GDP is estimated by a linear regression analysis using the time trend of the last five years (as high case) and the last ten years (as low case). The annual growth rates of the low case and high case are 2.4% and 5.0%, respectively. The projection of the GDP is shown in Table 2-1-2.

Table 2-1-2 Projection of GDP at 1982's Constant Price

Year	1995 (Actual)	2005	2015
GDP at 1982 Price (million US$)	5,670	7,188 (Low) 9,236 (High)	9,112 (Low) 15,045 (High)
Annual Growth Rate		2.4 % (Low) 5.0 % (High)	2.4 % (Low) 5.0 % (High)

2.2 Forecast of Domestic Cargo

2.2.1 Macro Forecast

4. Macro forecast of domestic cargo is carried out by a linear regression analysis with the GDP in Panama.

5. The past records of the GDP and domestic cargo are shown in Table 2-2-1. Figure 2-2-1 shows the linear regression analysis between the domestic cargo and the GDP. In the equation of the figure, x represents the GDP in 1982's constant price, y is the domestic cargo, and R is the corresponding correlation coefficient. The correlation is very strong because the coefficient is very high (R=0.949).

6. Once the regression analysis is carried out, the domestic cargo can be estimated using the equation with the GDP. The forecast of the domestic cargo is summarized in Table 2-2-2.

Table 2-2-1 Past Records of GDP and Domestic Cargo

Year	GDP in 1982 (Mil. $)	Domestic Cargo (ton)
1986	4,667.1	334,329
1987	4,808.2	313,830
1988	4,175.9	251,317
1989	4,143.8	276,753
1990	4,451.1	313,122
1991	4,803.2	386,642
1992	5,149.9	454,213
1993	5,363.0	499,577
1994	5,562.1	659,500
1995	5,670.3	674,243

Source: Autoridad Portuaria Nacional (APN)

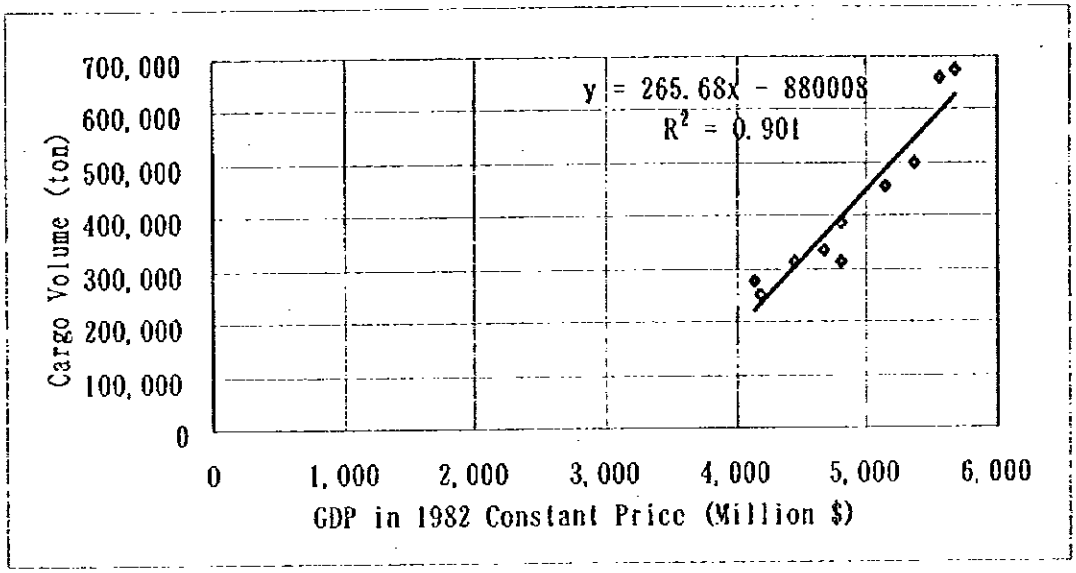


Figure 2-2-1 Regression Analysis between Domestic Cargo and GDP

Table 2-2-2 Forecast of Domestic Cargo

Year	1995 (Actual)	2005		2015	
		Low Case	High Case	Low Case	High Case
Domestic Cargo (ton)	674,243	1,030,000	1,574,000	1,541,000	3,117,000
Annual Growth Rate		4.3% (1995-2005)	8.9% (1995-2005)	4.1% (2005-2015)	7.1% (2005-2015)

2.2.2 Micro Forecast

7. Micro forecast of domestic cargo is carried out by types of cargoes, namely, bulk cargo (solid and liquid) and general cargo (container and break bulk).

(1) Bulk Cargo

8. Bulk cargo consists of solid bulk and liquid bulk. According to the past records of the bulk cargo in 1995, the ratio of export cargo to the total bulk cargo is only 1%, and the ratio of solid bulk cargo to the total is 85%. Therefore, it is assumed that the export cargo is omitted (all bulk cargo is imported), and the ratio of solid bulk and liquid bulk is 85% and 15%, respectively.

9. The past records of the GDP and the domestic bulk cargo are shown in Table 2-2-3. Figure 2-2-2 shows the linear regression analysis between the domestic bulk cargo and the GDP. This correlation is very strong because the coefficient is very high (R=0.920). Forecast of the domestic bulk cargo is summarized in Table 2-2-4.

Table 2-2-3 Past Records of GDP and Domestic Bulk Cargo

Year	GDP in 1982 (Mil. $)	Domestic Bulk Cargo (ton)
1986	4,667.1	174,288
1987	4,808.2	187,616
1988	4,175.9	181,514
1989	4,143.8	184,122
1990	4,451.1	230,896
1991	4,803.2	268,845
1992	5,149.9	325,797
1993	5,363.0	353,322
1994	5,562.1	404,087
1995	5,670.3	442,504

Source: Autoridad Portuaria Nacional (APN)

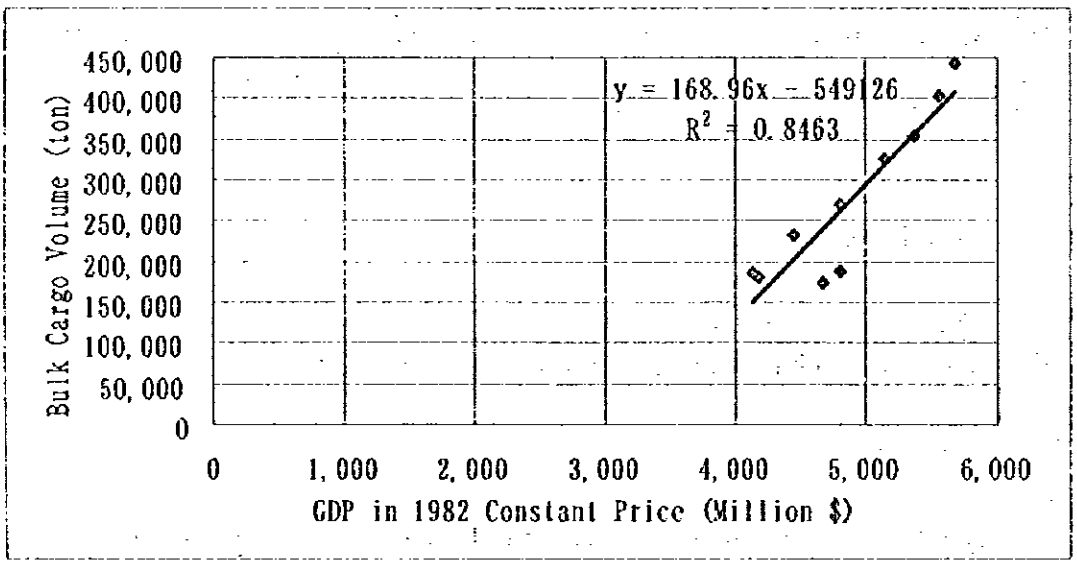


Figure 2-2-2 Linear Regression between Domestic Bulk Cargo and GDP

Table 2-2-4 Forecast of Domestic Bulk Cargo

Year	1995 (Actual)	2005		2015	
		Low Case	High Case	Low Case	High Case
Bulk Cargo (ton)	442,504	666,000	1,012,000	991,000	1,993,000
Annual Growth Rate		4.2% (1995-2005)	8.6% (1995-2005)	4.1% (2005-2015)	7.0% (2005-2015)
Solid Bulk (ton)	376,128	566,000	860,000	842,000	1,694,000
Liquid Bulk (ton)	66,376	100,000	152,000	149,000	299,000

(2) General Cargo

10. General cargo consists of container and break bulk cargoes. The general cargo is forecast based on origins and destinations of cargo, namely, local, the Colon Free Zone, and EPZ around Balboa. The container and break bulk cargoes are estimated using containerization ratio which is the ratio of containerizable cargo to the total general cargo.

1) General Cargo to/from Local

11. The general cargo to/from local is forecast by import and export cargoes. The past records of the import cargo and the export cargo are shown in Table 2-2-5.

12. The import cargo is forecast by a linear regression analysis with the GDP. Figure 2-2-3 shows the regression analysis (R=0.966) and Table 2-2-6 summarizes the forecast of the import general cargo to the local.

13. According to the past records of the export general cargo from the local, the export cargo volume has been very small and has no relationship with time or the GDP. Therefore, the export cargo is assumed to be constant and 20,000 tons in 2005 and 2015.

Table 2-2-5 Past Records of General Cargo to/from Local

Year	GDP in 1982 (Mil. $)	Import General (ton)	Export General (ton)
1986	4, 667. 1	80, 124	22, 610
1987	4, 808. 2	65, 949	15, 555
1988	4, 175. 9	32, 051	18, 280
1989	4, 143. 8	38, 394	15, 350
1990	4, 451. 1	44, 887	14, 386
1991	4, 803. 2	63, 343	21, 172
1992	5, 149. 9	85, 816	13, 534
1993	5, 363. 0	93, 737	12, 856
1994	5, 562. 1	120, 881	16, 545
1995	5, 670. 3	117, 890	15, 043

Source: Autoridad Portuaria Nacional (APN)

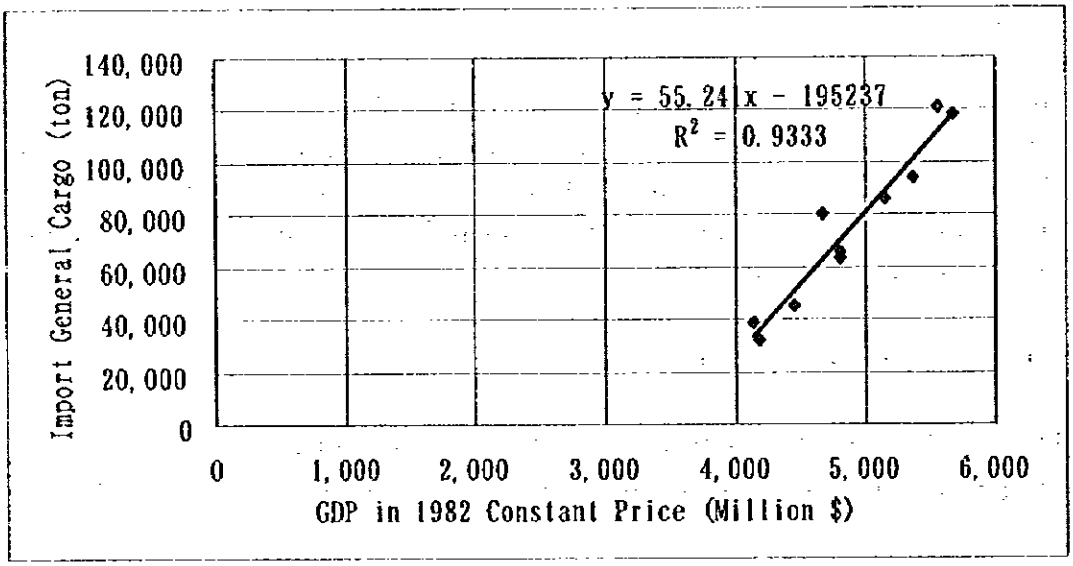


Figure 2-2-3 Regression Analysis of Import General Cargo to Local

Table 2-2-6 Forecast of Import General Cargo to Local

Year	1995 (Actual)	2005		2015	
		Low Case	High Case	Low Case	High Case
Import General (ton)	117,890	202,000	315,000	308,000	636,000
Annual Growth Rate		5.5% (1995-2005)	10.3% (1995-2005)	4.3% (2005-2015)	7.3% (2005-2015)

2) General Cargo to/from Colon Free Zone

14. The general cargo of the Colon Free Zone is imported mainly through ports and re-exported to countries in Central and South America. It is indicated that the general cargo to/from the Colon Free Zone is independent of the social and economic conditions of Panama. Accordingly, forecast of the cargo is carried out based on the productivity of the Free Zone.

15. Productivity is identified as the cargo volume handled per unit area (ton/hectare). Table 2-2-7 shows the actual productivity of the Free Zone in 1995. In 2005 and 2015, it is assumed that the productivity of the import and export cargoes is 420 (ton/ha) and 150 (ton/ha), respectively.

16. Future area of the Free Zone is assumed as follows. In 2005, it is assumed that the areas of Casco Viejo, COFRISA, France Field, and Nuevo de Enero are already developed and the total area is 260 hectares. In 2015, it is assumed that the area of Coco Solito is also developed and the total area is 370 hectares.

17. Once the productivity and the future area in the zone are set, the general cargo of the zone can be estimated. Table 2-2-8 summarizes the forecast of the general cargo in the zone.

Table 2-2-7 Productivity of Colon Free Zone (1995)

	Cargo Volume (ton)	Area of Free Zone (hectare)	Productivity (ton/hectare)
Import Cargo	72,659	174.9	415.4
Export Cargo	26,097	174.9	149.2

Source: Administration of Colon Free Zone

Table 2-2-8 Forecast of General Cargo to/from Colon Free Zone

	Import			Export		
Year	General Cargo (ton)	Area (ha)	Productivity (ton/ha)	General Cargo (ton)	Area (ha)	Productivity (ton/ha)
1995	72,659	174.9	415.4	26,097	174.9	149.2
2005	109,200	260.0	420.0	39,000	260.0	150.0
2015	155,400	370.0	420.0	55,500	370.0	150.0

3) General Cargo to/from EPZ

18. It is possible that a EPZ (Export Processing Zone) like Fort Davis EPZ will be developed around the port of Balboa in the future. Therefore, general cargo to/from the EPZ around Balboa is included in the micro forecast of the domestic general cargo.

19. The productivity of the EPZ is estimated according to the actual data of the Barranquilla EPZ in Colombia. Table 2-2-9 shows the actual productivity of the Barranquilla EPZ in 1995. In 2005 and 2015, it is assumed that the productivity is 2,000 (ton/ha) for import cargo and 2,500 (ton/ha) for export cargo.

20. It is expected that the EPZ will start to be developed in the near future and will be completed by 2015. Therefore, the future area of the EPZ is assumed to be 30 (ha) in 2005 and 100 (ha) in 2015.

21. Once the productivity and the future area in the EPZ are set, the general cargo in the EPZ can be estimated. However, it is necessary to assume what percentage of the total cargo will come from the port of Balboa and what percentage of the total will go to the port.

22. According to the recent data of the cargo flow in the Colon Free Zone, about 90% of the import cargo came from nearby ports and about 60% of the export cargo went to nearby ports. Therefore, it is assumed in 2005 and 2015 that 90% of the import cargo will come from the port of Balboa and 60% of the export cargo will go to the port. Table 2-2-10 summarizes the forecast of the general cargo in the EPZ.

Table 2-2-9 Productivity of Barranquilla EPZ in 1995

	Cargo Volume (ton)	Area of Free Zone (hectare)	Productivity (ton/hectare)
Import Cargo	200,000	100	2,000
Export Cargo	250,000	100	2,500

Source: Administration of Barranquilla EPZ

Table 2-2-10 Forecast of General Cargo to/from EPZ

Year		1996	2005	2015
Area of EPZ (ha)		0	30	100
Productivity of EPZ				
	Import (ton/ha)	0	2,000	2,000
	Export (ton/ha)	0	2,500	2,500
Cargo Volume of EPZ				
	Import (ton)	0	60,000	200,000
	Export (ton)	0	75,000	250,000
	Sub Total (ton)	0	135,000	450,000
Cargo Volume at Balboa				
	Import (ton)	0	54,000	180,000
	Export (ton)	0	45,000	150,000
	Sub Total (ton)	0	99,000	330,000

4) Container and Break Bulk Cargo

23. According to the forecast of the domestic general cargo obtained above, the general cargo, which is also referred to as containerizable cargo, is summarized in Table 2-2-11.

24. Containerization ratio is identified as the ratio of container cargo volume to the containerizable cargo. Table 2-2-12 shows the past records of containerization ratio. According to the table, the ratios of import and export cargoes are very high and are expected to remain so in the future. Therefore, it is assumed that the ratios are 80% for the import and 90% for the export.

25. The average cargo volume in 1995 is 7.7 (ton/TEU) for import and 7.4 (ton/TEU) for export. These values are adopted to calculate the number of laden containers if composition of commodities handled remains unchanged in the future.

26. The ratio of laden containers to the total containers in 1995 is 96% for import cargo and 33% for export cargo. Because the ratios have been stable in recent years, it is assumed that they will remain unchanged in the future.

27. Table 2-2-13 summarizes the forecast of container cargo by laden and empty containers, and Table 2-2-14 shows the forecast of break bulk cargo.

Table 2-2-11 Forecast of Domestic General Cargo

Unit: Metric Ton

Year		1995	2005		2015	
		(Actual)	Low Case	High Case	Low Case	High Case
General Cargo to/from Local						
	Import	117,890	202,000	315,000	308,000	636,000
	Export	15,043	20,000	20,000	20,000	20,000
	Sub Total	132,933	222,000	335,000	328,000	656,000
General Cargo to/from Colon Free Zone						
	Import	72,659	109,000	109,000	155,000	155,000
	Export	26,097	39,000	39,000	56,000	56,000
	Sub Total	98,756	148,000	148,000	211,000	211,000
General Cargo to/from EPZ						
	Import	0	54,000	54,000	180,000	180,000
	Export	0	45,000	45,000	150,000	150,000
	Sub Total	0	99,000	99,000	330,000	330,000
Total General Cargo						
	Import	190,549	365,000	478,000	643,000	971,000
	Export	41,140	104,000	104,000	226,000	226,000
	Sub Total	231,689	469,000	582,000	869,000	1,197,000

Table 2-2-12 Past Records of Containerization Ratio

Unit: Metric Ton

	Import				Export			
Year	Container	Break Bulk	General Cargo	Imp. Ratio	Container	Break Bulk	General Cargo	Exp. Ratio
1986	142,802	38,607	181,409	78.7%	67,341	4,766	72,107	93.4%
1987	74,150	33,464	107,614	68.9%	16,378	9,369	25,747	63.6%
1988	37,632	10,213	47,845	78.7%	14,804	10,325	25,129	58.9%
1989	63,050	10,573	73,623	85.6%	19,836	2,947	22,783	87.1%
1990	35,430	24,548	59,978	59.1%	19,908	5,070	24,978	79.7%
1991	46,857	31,958	78,815	59.5%	27,179	15,954	43,133	63.0%
1992	72,479	41,086	113,565	63.8%	46,233	6,837	53,070	87.1%
1993	84,824	43,166	127,990	66.3%	40,722	6,049	46,771	87.1%
1994	167,901	60,696	228,597	73.4%	40,913	4,539	45,452	90.0%
1995	158,086	50,095	208,181	75.9%	55,683	2,331	58,014	96.0%

Source: Autoridad Portuaria Nacional (APN)

Table 2-2-13 Forecast of Container Cargo

Year		1995	2005		2015	
		(Actual)	Low Case	High Case	Low Case	High Case
Container Cargo (Metric Ton)						
	Import	140,536	292,000	382,000	514,000	777,000
	Export	38,847	94,000	94,000	203,000	203,000
	Sub Total	179,383	386,000	476,000	717,000	980,000
Laden Container Cargo (TEU)						
	Import	20,625	38,000	50,000	67,000	101,000
	Export	7,566	13,000	13,000	27,000	27,000
	Sub Total	28,191	51,000	63,000	94,000	128,000
Empty Container Cargo (TEU)						
	Import	904	2,000	2,000	3,000	4,000
	Export	15,173	26,000	26,000	56,000	56,000
	Sub Total	16,077	28,000	28,000	59,000	60,000
Total Container Cargo (TEU)						
	Import	21,529	40,000	52,000	70,000	105,000
	Export	22,739	39,000	39,000	83,000	83,000
	Sub Total	44,268	79,000	91,000	153,000	188,000

Table 2-2-14 Forecast of Break Bulk Cargo

Unit: Metric Ton

Year		1995	2005		2015	
		(Actual)	Low Case	High Case	Low Case	High Case
	Import	50,013	73,000	96,000	129,000	194,000
	Export	2,293	10,000	10,000	23,000	23,000
	Sub Total	52,306	83,000	106,000	152,000	217,000

2.3 Forecast of Transshipment Container Cargo

28. The transshipment container cargo at the port of Balboa is very limited at present even though the port possesses a geographical advantage in the container transportation of the Panama Canal. Low efficiency of container cargo handling and lack of port facilities mainly cause this situation and make shipping operators reluctant to use the port as a hub port for transshipment feeder services to Central and South America on the Pacific side.

29. The port of Balboa has great potential to play an important role as a hub port to Pacific Latin America. Therefore, the transshipment container cargo at Balboa will dramatically increase if the current situation is improved to a high level.

2.3.1 Method of Forecast

30. In general, forecast of transshipment container cargo is complicated because the transshipment cargo is affected by many conditions regarding origins and destinations of the cargo.

31. In the forecast of transshipment container at Balboa, the potential container cargo for Balboa is identified as the total container traffic in Pacific Latin America. In order to forecast the potential container traffic in the region, a linear regression analysis is carried out with the total GDP in the area.

32. To forecast the transshipment container cargo at Balboa, it is assumed that a part of the potential container will be transshipped at Balboa and the transshipment cargo volume will depend on how the port will be improved in the future.

2.3.2 Forecast of Container Cargo in Pacific Latin America

(1) Container Cargo in Pacific Latin America

33. The container cargo in Pacific Latin America is calculated as the sum of container cargoes at major ports in the region.

34. The following thirteen ports including Balboa were selected for calculating the total container cargo in the region.

Lazaro Cardenas, Manzanillo, Salina Cruz (Mexico)
Acajutla (El Salvador)
Balboa (Panama)
Buenaventura (Colombia)
Guayaquil (Ecuador)
Callao (Peru)
Valparaiso, San Antonio, Iquique, Arica, Antofagasta (Chile)

35. The past records of the total container cargo in the region are shown in Table 2-3-1.

Table 2-3-1 Past Records of Container Cargo in Pacific Latin America

Year	Container Cargo ('000TEU)	Growth Rate
1984	343.1	
1985	311.0	-9.4%
1986	349.2	12.3%
1987	386.8	10.8%
1988	381.9	-1.3%
1989	449.0	17.6%
1990	535.5	19.3%
1991	624.2	16.6%
1992	859.5	37.7%
1993	1,026.2	19.4%
1994	1,177.3	14.7%

Source: Ocean Shipping Consultants

(2) Gross Domestic Product in Pacific Latin America

36. The past records of the Gross Domestic Product in the corresponding seven countries (Mexico, El Salvador, Panama, Colombia, Equador, Peru, and Chile) are shown in Table 2-3-2.

37. The forecast of the regional GDP is carried out using a linear regression analysis with time. Figure 2-3-1 shows the regression analysis giving a strong correlation (R=0.982). The forecast of the regional GDP is summarized in Table 2-3-3.

Table 2-3-2 Past Records of GDP in Pacific Latin America

Year	GDP (Mil of 1987 US$)	Growth Rate
1984	229,801	
1985	237,104	3.2%
1986	237,300	0.1%
1987	245,226	3.3%
1988	247,747	1.0%
1989	253,178	2.2%
1990	261,680	3.4%
1991	271,615	3.8%
1992	281,632	3.7%
1993	288,749	2.5%

Source: World Tables 1995, World Bank

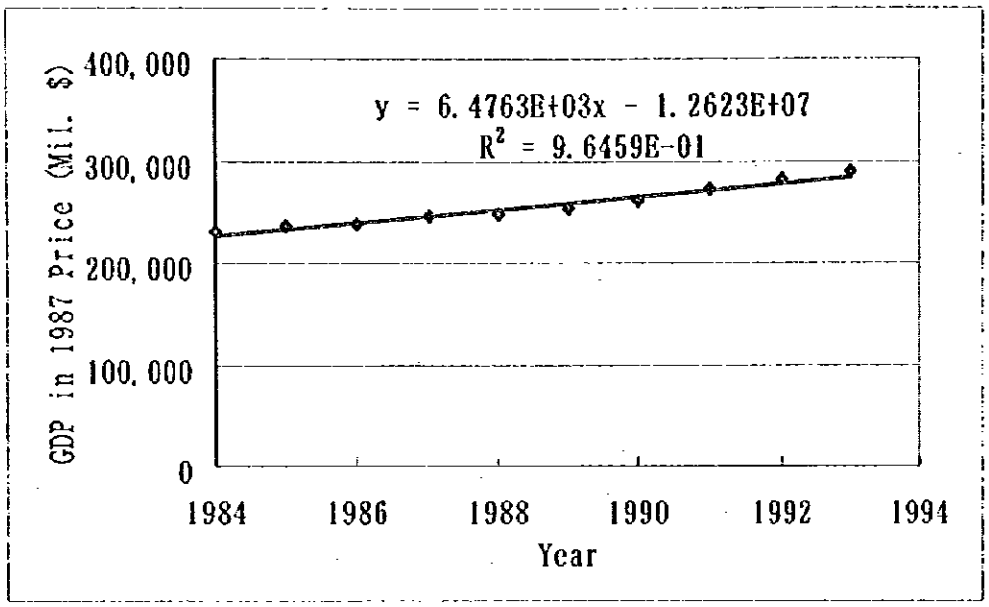


Figure 2-3-1 Regression Analysis of GDP in Pacific Latin America

Table 2-3-3 Forecast of GDP in Pacific Latin America

Unit: Millions of 1987 Constant US$

Year	1993 (Actual)	2005	2015
Regional GDP	288,749	361,982	426,745
Annual Growth Rate	1.8 % (1993 - 2015)	1.9 % (1993 - 2005)	1.7 % (2005 - 2015)

(3) Forecast of Container Cargo in Pacific Latin America

38. The forecast of the container cargo in Pacific Latin America is carried out using a linear regression analysis with the GDP in the corresponding region. Figure 2-3-2 shows the regression analysis with the strong correlation (R=0.955). The forecast of the regional container cargo is summarized in Table 2-3-4.

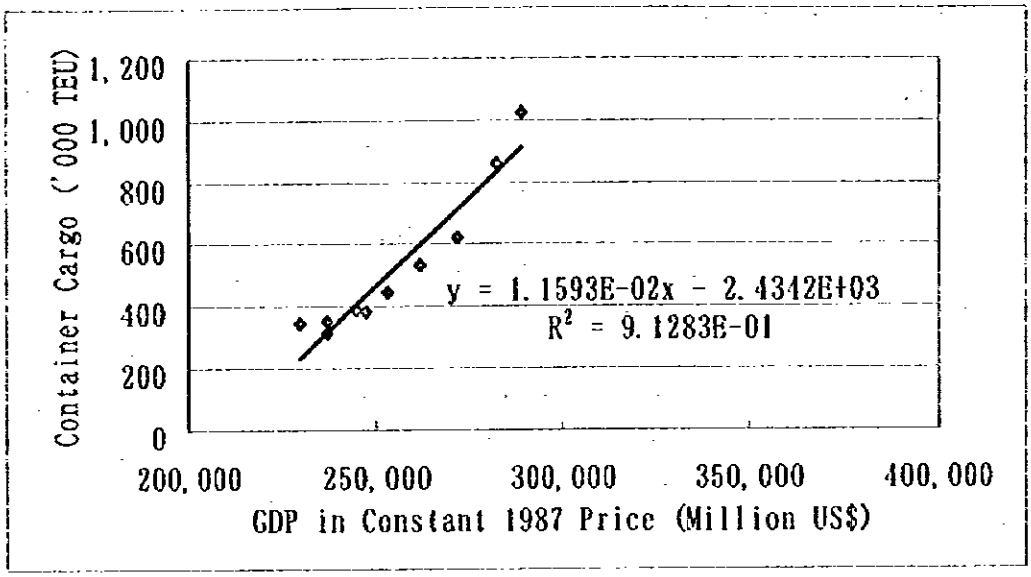


Figure 2-3-2 Regression Analysis of Container Cargo in Pacific Latin America

Table 2-3-4 Forecast of Container Cargo in Pacific Latin America

Year	1993 (Actual)	2005	2015
Container Cargo ('000 TEU)	1,026	1,762	2,513
Annual Growth Rate	4.2 % (1993 - 2015)	4.6 % (1993 - 2005)	3.6 % (2005 - 2015)

2.3.3 Forecast of Transshipment Container Cargo at Balboa

39. According to the past records at Balboa, transshipment container cargo has been very small in comparison to the container cargo in Pacific Latin America.

40. If it is profitable for shipping lines to use Balboa port as a transshipment hub instead of direct calls to the Pacific Latin American ports, the transshipment container volume at Balboa will increase significantly. Such potential transshipment is closely related to the facilities and services offered at Balboa.

41. In each target year, three cases (low, medium, and high cases) are considered. The medium case is assumed so that 10% of the container cargo in Pacific Latin America will be transshipped at Balboa in 2005, and 15% of the

regional container cargo will be transshipped in 2015.

42. The high case is assumed so that 20% of the cargo in the corresponding medium case will be gained if container terminal at Balboa is efficient enough to recover the container cargo diverted to MIT at Manzanillo and attract further container traffic. By contrast, the low cases are assumed so that 20% of the cargo in the corresponding medium case will be lost if ports competing with Balboa are efficient enough to attract further container traffic.

43. The average container cargo volume at Balboa is 7.6 (ton/TEU) and the average ratio of laden containers is 64% in 1995. Because these figures have been stable in recent years, it is assumed that they will remain unchanged in the future.

44. Under the above assumptions and findings, the forecast of the transshipment container cargo at Balboa is carried out and summarized in Table 2-3-5.

Table 2-3-5 Forecast of Transshipment Container Cargo at Balboa

Year	1995	2005			2015		
	(Actual)	Low	Medium	High	Low	Medium	High
Container Transshipment Cargo							
(TEU)	6,477	282,000	352,000	423,000	603,000	754,000	905,000
Laden Container							
(TEU)	4,145	180,000	225,000	271,000	386,000	483,000	579,000
(ton)	34,386	1,368,000	1,710,000	2,059,600	2,933,600	3,670,800	4,400,400
Empty Container							
(TEU)	2,332	102,000	127,000	152,000	217,000	271,000	326,000

2.4 Summary of Micro Forecast

45. The results of the forecast from Section 2.2 and Section 2.3 are summarized in Table 2-4-1, Table 2-4-2, and Figure 2-4-1. Table 2-4-1 summarizes the forecast for all kinds of cargo in metric tons. Table 2-4-2 summarizes the forecast of container cargo in tons and TEU. According to Table 2-4-2, ratio of transshipment, which is the ratio of transshipment container to the total container, is about 80% in 2005 and 2015.

Table 2-4-1 Summary of Cargo Forecast at Balboa

Unit: Metric Ton

Year	1995	2005			2015		
	(Actual)	Low Case	Medium	High Case	Low Case	Medium	High Case
Import Cargo							
Bulk Cargo							
Solid Bulk	376,128	566,000	713,000	860,000	812,000	1,268,000	1,691,000
Liquid Bulk	66,376	100,000	126,000	152,000	149,000	224,000	299,000
Sub Total	412,504	666,000	839,000	1,012,000	991,000	1,492,000	1,993,000
General Cargo							
Container	140,536	292,000	337,000	382,000	514,000	646,000	777,000
Break Bulk	50,013	73,000	85,000	96,000	129,000	162,000	194,000
Sub Total	190,549	365,000	422,000	478,000	643,000	807,000	971,000
Total Import Cargo	633,053	1,031,000	1,261,000	1,490,000	1,634,000	2,299,000	2,964,000
Export Cargo							
General Cargo							
Container	38,847	94,000	94,000	94,000	203,000	203,000	203,000
Break Bulk	2,293	10,000	10,000	10,000	23,000	23,000	23,000
Total Export Cargo	41,140	104,000	104,000	104,000	226,000	226,000	226,000
Import & Export Cargo	674,193	1,135,000	1,365,000	1,594,000	1,860,000	2,525,000	3,190,000
Container Transshipment	34,386	1,368,000	1,710,000	2,060,000	2,934,000	3,671,000	4,400,000
Grand Total	708,579	2,503,000	3,075,000	3,654,000	4,794,000	6,196,000	7,590,000

Table 2-4-2 Summary of Forecast for Container Cargo at Balboa

Year	1995	2005			2015		
	(Actual)	Low Case	Medium	High Case	Low Case	Medium	High Case
Import Cargo							
Laden Container							
(Metric Ton)	140,536	292,000	337,000	382,000	514,000	646,000	777,000
(TEU)	20,625	38,000	44,000	50,000	67,000	84,000	101,000
Empty Container							
(TEU)	904	2,000	2,000	2,000	3,000	4,000	4,000
Total Import							
(Metric Ton)	140,536	292,000	337,000	382,000	514,000	646,000	777,000
(TEU)	21,529	40,000	46,000	52,000	70,000	88,000	105,000
Export Cargo							
Laden Container							
(Metric Ton)	38,847	94,000	94,000	94,000	203,000	203,000	203,000
(TEU)	7,566	13,000	13,000	13,000	27,000	27,000	27,000
Empty Container							
(TEU)	15,173	26,000	26,000	26,000	56,000	56,000	56,000
Total Export							
(Metric Ton)	38,847	94,000	94,000	94,000	203,000	203,000	203,000
(TEU)	22,739	39,000	39,000	39,000	83,000	83,000	83,000
Import & Export							
(Metric Ton)	179,383	386,000	431,000	476,000	717,000	849,000	980,000
(TEU)	37,791	79,000	85,000	91,000	153,000	171,000	188,000
Transshipment							
(Metric Ton)	34,386	1,368,000	1,710,000	2,060,000	2,934,000	3,671,000	4,400,000
(TEU)	6,477	282,000	352,000	423,000	603,000	754,000	905,000
Grand Total							
(Metric Ton)	213,769	1,754,000	2,141,000	2,536,000	3,651,000	4,520,000	5,380,000
(TEU)	44,268	361,000	437,000	514,000	756,000	925,000	1,093,000

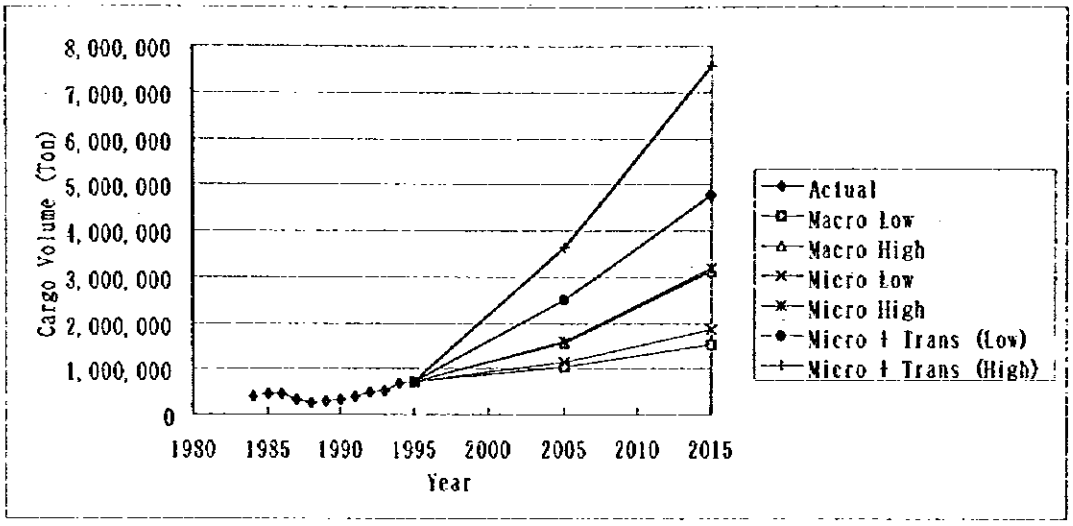


Figure 2-4-1 Summary of Cargo Forecast at Balboa

2.5 Forecast of Ship Size and Ship Calls

2.5.1 Current Trends of Ship Size

46. Table 2-5-1 shows the past records of the Panama Canal transits. According to the table, the number of transits for oceangoing vessels has been stable in recent years except for the year 1995 when the number peaked (13,631 transits).

47. On the other hand, the average loaded cargo of the oceangoing vessels per transit has slightly increased with the average annual growth rate of 2%. This means that the ship size of the oceangoing vessels through the Canal has become larger.

48. Table 2-5-2 shows international trend of full container ships. According to the table, the average gross tonnage per vessel has increased with the annual growth rate of 2.4%, and the average number of TEU per vessel has increased with the annual growth rate of 3.6%.

49. Taking the above findings into account, it is expected that the container ships calling at the port of Balboa will become larger and the capacity of container cargo will also increase in the future because of larger ship size.

Table 2-5-1 Past Records of Panama Canal Transits

Fiscal Year	Number of Transits		Oceangoing / Total
	Total	Oceangoing	
1986	13,278	12,023	91%
1987	13,444	12,313	92%
1988	13,441	12,318	92%
1989	13,389	12,075	90%
1990	13,325	12,052	90%
1991	14,108	12,763	90%
1992	14,148	12,636	89%
1993	13,720	12,257	89%
1994	14,029	12,478	89%
1995	15,136	13,631	90%

Source: Annual Report in 1995, PCC

Table 2-5-2 International Trend of Full Container Ships

Year	No. of Vessel	Gross Ton	Growth Rate	Cargo (TEU)	Growth Rate	GRT/VSL	Growth Rate	TEU/VSL	Growth Rate
1985	809	18,337,449		1,111,450		22,667		1,374	
1986	805	18,698,711	2.0%	1,135,070	2.1%	23,228	2.5%	1,410	2.6%
1987	840	19,985,548	6.9%	1,219,895	7.5%	23,792	2.4%	1,452	3.0%
1988	881	22,019,955	10.2%	1,352,181	10.8%	24,994	5.1%	1,535	5.7%
1989	918	23,276,467	5.7%	1,442,424	6.7%	25,356	1.4%	1,571	2.4%
1990	952	24,356,118	4.6%	1,527,112	5.9%	25,584	0.9%	1,604	2.1%
1991	970	25,857,384	6.2%	1,641,621	7.7%	26,657	4.2%	1,695	5.7%
1992	1,028	27,812,516	7.6%	1,812,350	10.2%	27,055	1.5%	1,763	4.0%
1993	1,046	29,135,438	4.8%	1,931,282	6.6%	27,854	3.0%	1,846	4.7%
1994	1,147	32,277,179	10.8%	2,158,616	11.8%	28,141	1.0%	1,882	1.9%
Average			6.5%		7.7%		2.4%		3.6%

Source: Lloyd's Maritime information Service Ltd.

2.5.2 Forecast of Ship Size

50. According to the past records in recent years, the average ship size by ship type is shown in Table 2-5-3.

51. It is assumed that ship sizes for mix type, solid and liquid bulk carriers, oil tanker, and cruiser are adopted from the above average ship sizes.

52. As for container ships, the recent worldwide trend of full container ships is applied. Therefore, it is assumed that the container ship size will increase with the annual growth rate of 2.4%, and the cargo capacity will increase with the

annual growth rate of 3.6%. According to the interview with major shipping lines serving feeder services to Pacific Latin America, the average ship size is about 20,000 DWT and the average cargo capacity is about 1,000 TEU.

53. Taking the above assumptions and findings into consideration, the average ship size and average cargo capacity of container ships is summarized in Table 2-5-4.

Table 2-5-3 Past Records of Average Ship Size and Average Cargo at Balboa

Type of Ship	Average Gross Ton	Average Cargo Volume
Container Ship	15,000	250 (TEU)
Solid Bulk Carrier	9,000	11,000 (ton)
Liquid Bulk Carrier	6,000	1,400 (ton)
Mix Type Ship	6,000	1,800 (ton)
Ro-Ro Ship	27,000	300 (ton)
Oil Tanker	11,000	9,100 (barrels)
Passenger Ship	24,000	950 (person)

Source: National Port Authority (APN)

Table 2-5-4 Forecast of Container Ship Size

Year	1995	2005	2015
Dead Weight Tonnage	20,000	25,000 (2.4 %)*	32,000 (2.4 %)*
Cargo Capacity (TEU)	1,000	1,400 (3.6 %)*	2,000 (3.6 %)*

* Annual growth rate

2.5.3 Forecast of Ship Calls

54. In the micro forecast of Section 2.2.2, there are four types of cargo (solid bulk, liquid bulk, container, and break bulk). It is assumed that break bulk cargo is handled by only mix type ships.

55. Once cargo volume and average cargo per vessel are forecast, number of ship calls can be calculated. The forecast of ship calls by ship type is summarized in Table 2-5-5.

Table 2-5-5 Forecast of Ship Calls

Type of Ship	Year 2005		Year 2015	
	Cargo Volume	Ship Calls	Cargo Volume	Ship Calls
Container	437,000 TEU	312	925,000 TEU	463
Solid Bulk	713,000 ton	65	1,268,000 ton	115
Mix Type	95,000 ton	53	185,000 ton	103
Liquid Bulk	126,000 ton	90	224,000 ton	160

2.6 Forecast of Passenger Traffic

2.6.1 Current Situation

56. According to the information from IPAT (Instituto Panameno de Turismo), 27,516 passengers entered the port of Balboa by ship in 1995. The number of the passengers entering the port has been very small in recent years. One of the major reasons for the small number is the lack of tourist attractions.

57. International cruise lines use the Panama Canal continually to get from one destination to another in the Atlantic and Pacific Oceans. They are looking for new ports to call at along the Pacific Coast of Central America during the low season in the Caribbean.

58. ARI (Interoceanic Region Authority) has a master plan at Amador. The master plan includes a professional golf course, cruise ship terminal, yacht club and marina, luxury hotels, and tourist village. If this tourism project is developed successfully, the number of passengers entering Balboa will increase significantly in the future.

2.6.2 Forecast of Passenger Traffic

59. Looking at cruise ships calling at the port of Balboa, most cruise ships connect between Pacific ports and Atlantic ports through the Panama Canal. According to the annual report of PCC, the number of transits for cruise ships is 307 in 1995.

60. With reference to the master plan at Amador by ARI, the number of transits for the cruise ships through the Canal is assumed to increase with the annual growth rate of 3.4% up to 2015. In this forecast, the number of transits

will increase with the same annual growth rate.

61. According to the past records of APN in 1995, the number of cruise ship calls at Balboa is 33 which is only 11% of the Canal transits for cruise ships. If the Amador tourism project by ARI is developed successfully, the number of cruise ships calling at Balboa will increase significantly in the future. Therefore, it is assumed that 20% of the Canal cruise ships will call at Balboa in 2005 and 30% of the Canal cruise ships will call at in 2015.

62. The Amador master plan by ARI expects the number of passenger per cruise ship to be 1,100 persons in 2005 and 1,300 persons in 2015.

63. Taking the above findings and assumptions into consideration, the forecast of cruise ships and passengers at Balboa is carried out and summarized in Table 2-6-1.

Table 2-6-1 Forecast of Cruise Ships and Passengers at Balboa

Year	1995	2005	2015
Canal Transit of Cruiser	307	430 (3.4%)*	600 (3.4%)*
Cruise Ship Calls	33	86	180
Passenger / Cruiser	945	1,100	1,300
Annual Passenger	31,185	94,600	234,000

* Annual growth rate

2.7 Forecast of Bunkering Service and Ship Repair

2.7.1 Forecast of Bunkering Service

64. The port of Balboa has the advantage of supplying fuel and water to the ships transiting the Panama Canal because of its geographic location.

65. Under the concession with APN, APSA (Atlantic-Pacific, S.A.) is responsible for the administration of fuel oil supply between the supplier's tanks and piers. Fuel oil to APSA is supplied from Texaco Refinery or directly imported.

66. According to the interviews with major oil suppliers, marine fuel supply has a much larger share on the Pacific side than that on the Atlantic side because of sea calmness.

67. According to the statistics of PCC and APSA, the ratio of ship calls for bunkering at Balboa to the Canal transits has increased from 6% to 11% for the last ten years as shown in Table 2-7-1. It is assumed that the ratio of ship calls to the Canal transits will increase to 15% in 2005 and 20% in 2015.

68. Regarding the widening project of Gaillard Cut in the Canal, the project will be completed by 2005 and the maximum number of the Canal transits will increase from 14,000 to 17,000. Therefore, it is assumed that the number of the Canal transits is 17,000 in 2005 and 2015.

69. According to the past records of APSA, the average oil volume is 9,100 barrels per ship in 1995. It is assumed that the average oil volume is 10,000 barrels per ship.

70. Taking the findings and assumptions mentioned above, forecast of bunkering is conducted and summarized in Table 2-7-2.

Table 2-7-1 Past Records of Canal Transit and Bunkering Service at Balboa

Fisical Year	Canal Transit	Ship Call of Oil Supply	Oil Supply / Canal Transit
1986	13,278	825	6%
1987	13,444	959	7%
1988	13,411	682	5%
1989	13,389	742	6%
1990	13,325	1,074	8%
1991	14,108	1,146	8%
1992	14,148	1,241	9%
1993	13,720	1,206	9%
1994	14,029	1,397	10%
1995	15,136	1,612	11%

Source: PCC and APSA

Table 2-7-2 Forecast of Bunkering Service

Year	1995	2005	2015
Canal Transits	15,136	17,000	17,000
Ship Call of Bunkering	1,612 (11%)	2,550 (15%)	3,400 (20%)
Cargo Volume (Barrel)	14,713,814	25,500,000	34,000,000

2.7.2 Forecast of Ship Repair Service

71. Astilleros Braswell International S.A. contracted a concession with APN in 1992 for the management of ship yards including three dry docks.

72. According to the interview with the ship repair company, they worked on 74 ships in 1995, in which 25 ships were Panamax tankers, and 15 ships were Panamax bulk carriers. This means more than 50% were Panamax type ships.

73. The ship repair company expects to reach their maximum capacity of 105 ships per year by 1998. However, there is no plan to expand their capacity of business at Balboa. On the other hand, it is possible to expand their business on the Atlantic side. Therefore, it is expected that the ship calls for ship repair will reach the maximum capacity of 105 in 2005 and remain unchanged in 2015 as shown in Table 2-7-3.

Table 2-7-3 Forecast of Ship Repair Service

Year	1995 (Actual)	2005	2015
Ship Calls	73	105	105

III DEVELOPMENT PLAN FOR THE TARGET YEAR OF 2015

3.1 New Container Terminal

3.1.1 Necessary Number of Container Terminals for Port Development

1. The number of berths is decided on the basis of productivity of each berth. From the viewpoint of competition with neighboring ports, the productivity for each berth should be at least 300,000 - 400,000 TEUs per annum with proper backup facilities and sufficient space. More than 70 % of containers handled at the port are expected to be for transshipment.

2. The projected container volume, including empty container, the number of ships at the port and the necessary number of the berths in the year 2005 and 2015 are summarized as shown in Table 3-1-1.

Table 3-1-1 Container Volume Handled and Number of Ship Calls in the Target Years

Target Year	2005	2015
Container Volume Handled (TEU)	361,000 (low case)	756,000 (low case)
	437,000 (medium case)	925,000 (medium case)
	514,000 (high case)	1,093000 (high case)
Number of Ship Calls (/year)	312 (medium case)	463 (medium case)
Number of Required Berths	2	4

3. The port of Balboa will need two berths by the year 2005 of the short term plan stage, and four berths by the year 2015 of the master plan stage, so as to meet the rapidly increasing demand for transshipment and imports / exports.

4. The berth occupancy ratio will be estimated at around 0.4 - 0.7 in the target year (medium case), on the simple assumption that the container vessels are supposed to be assigned to the port periodically, and that the average staying time is 1.4 - 1.6 days. (The berth occupancy ratio of 0.4 will take place just after

the fourth berth starts to operate at Farfan in 2015 as part of the consecutive berths, which is also one of the major marketing strategies to attract users.)

5. As to the area for the container terminal development, the current area allotted to Balboa port is limited. Improvement of the existing berths is suitable only at the initial stage of development as a full scale container terminal. For further development, full sized yard will be placed along the north shore of the pier 18. After this area becomes fully occupied, the west bank of the canal entrance will be suitable for the future terminal area..

6. The area is now used as a military communication antenna yard. Its vast space with flat land will be suitable not only for a large scale container terminal but also for an industry complex.

3.1.2 Design Ship Size and Berth Dimension

7. The maximum draft of the vessel which can transit the Canal is limited to less than 39.5 ft (12.04 m), and waterways and basins are generally designed as 42 ft (12.73 m) deep in consideration of the extent of oscillatory motion of the ship due to the natural conditions such as waves, winds and tidal currents, and the trim. Consequently, it is appropriate that the water depth of the new berths for the short term is kept at least 13 m.

8. Besides, we should also take into consideration the transshipment services for the cargoes by post-Panamax type vessel, as described in Chapter I. According to the latest information, 6,000 TEU class vessels have a draft of 13 to 14 meters, while 5,000 TEU class vessels have a draft of 11.2 - 12.7 meters (see Table 3-1-2 and 3-1-3). In addition, if the Panama Canal is expanded and Over Panamax type vessels become able to transit the Canal, deeper berths will be required sooner or later in this port.

9. Table 3-1-4 shows the recent development of new container terminals concerning the ports of Cristobal, Singapore and Hong Kong. Concerning container traffic through the port, Singapore and Hong Kong reached 12 million TEUs and 12.7 million TEUs in 1995 respectively.

10. According to this table, the ports serving as container transshipment centers are equipping berths with depths of more than 14 meters. The new terminal of the port of Balboa for the short term, therefore, shall be designed in a manner that will allow the berth depth to be increased to 14 meters.

11. The necessary berth length is usually estimated as 350 meters for the berths of a depth of 14 - 15 meters. Even a 6,000 TEU class vessel, with a length of about 300 meters and a depth of 13-14 meters, could moor at this berth one way or another; for example, utilizing this berth combined with the neighboring consecutive berth, or the supplemental structure in length; and adjusting the cargo volume in calling the port or waiting for the appropriate high tides in depth.

12. In this regard, vessels that require a depth of 14 meters can use port facilities of 13 meters depth during the time when the tides come up beyond the level of + 1.0 meter. The difference between MHW (Mean High Water) + 4.462 m and MLW (Mean Low Water) +0.626 m at the port is 3.836 meters. Assuming the daily tide consists of two simple cycles between MHW and MLW, the tides of more than + 1.0 m take place for about 9 and a half hours during half a day. (On the other hand, this could not be applied to the ports of Cristobal, where the difference between MHW and MLW is only 0.349 meters.)

Table 3-1-2 Dimensions of 6,000 TEU Class Container Vessels

Operator	Loa (meter)	B (meter)	Draft (meter)	TEU	Remarks
MAERSK	318	42	14	6,000	REGINA MAERSK
NYK	299.9	40	13	5,700	To be delivered in 1997
P&O	300	42.8	-	6,674	To be delivered in 1998

Table 3-1-3 Dimensions of 5,000 TEU Class Container Vessels

Operator	Loa (meter)	B (meter)	Draft (meter)	GRT	TEU	Remarks
1	300	37.1	11.2	47,300	4,812	
2	276	40	12.0	49,600	4,960	
3	279	37.8	12.5	51,150	4,400	
4	285	40	12.7	63,130	4,900	

Table 3-1-4 Outline of the New Container Terminal Development

Terminal	Panama			Singapore		Hong Kong	
	Cristobal (JICA study)	Manzanillo Phase I	Coco Solo North Phase I	Pasir Panjang Phase I	Pasir Panjang Phase II	Tsing Yi CT9	Lantawu Port CT10-13
Number of Berths (1)	3	2	2	8	18	4	17
Berth Depth (m)	-13-14	-13	-14	-15	-15-16		
Berth Length (m)	900	600	612			1280	
Terminal Area (ha) (2)	31.5	25	25	127	222.6	60	
Construction Schedule	-2009	1994-1995	1996-1998	1993-2000	1995-2009	1996-1999	1996-2003
(2)/(1) (ha/berth)	10.5	12.5	12.5	15.9	12.4	15.0	

Source: Port of Singapore Authority, The Second Review of Port Development Strategy
The Second Review of Port Development Strategy (Port Development Board of Hong Kong; Oct. 1997)
Autoridad Portuaria Nacional (APN)

3.1.3 Terminal Area

13. According to Table 3-1-4, in the same way, the terminal area to be needed for one berth is estimated as at least 12 ha. This means that the width of terminal yard space will be at least 350 meters under the condition that the length of each berth is 350 meters. In planning a full scale container terminal, the maximum size (or minimum size with future expansion area) shall be secured in the area

3.2 Arrangement Plan for Each Port Function

3.2.1 Development of Container Terminal

14. Basic policies for the container handling are as follows:

① Urgent Stage

The piers No.14, 15 and 16 will be used for the container terminal. Container yard will be expanded on the land side of the piers No.15 and 16 and at the Pier No.7. Cargo handling equipment will be replaced or newly deployed in order to improve cargo throughput totally.

② Short Term Plan Stage (- 2005)

Site-Diablo is developed as the first full container terminal. Higher priority is laid on the effective operation and swift cargo handling. Site-Balboa will decrease total volume of container cargo handled. The new container terminal will accommodate large sized full container vessels with maximum efficiency. This makes the port attractive, thus increasing its competitiveness with competing ports in the area.

③ Long Term Plan Stage (- 2015)

Site-Farfan is also developed as the second full container terminal. Transshipment container cargo will increase greatly, and cargo traffic between the container terminals will also increase. It will be necessary to strengthen the port highway connecting container terminals and the cities.

④ Post Master Plan Stage

The container terminal of Site-Farfan will be expanded to make it more attractive.

3.2.2 Arrangement of Other Functions

15. The dry dock complex will play a more important role in the future. The port facilities neighboring the existing dry dock will be utilized gradually to strengthen this function. The dry dock will assist in coping with the increasing demand of ship repair and maintenance. Pier 7 and 14 will be allotted to the expansion of the dry dock at first. In the further future, a dry dock capable of accommodating post-Panamax type vessels should be considered around Site-Farfan.

16. The bunkering function will be also one of the most important services of the port. In order to avoid possible fire hazard, however, this function should be separated from the other port services as soon as possible. As a short-term measure, Pier 6 (and 7) should concentrate its function in bunkering in order to cope with the increasing bunker demand. Other types of cargo handling will be shifted totally to other existing piers. Fortunately, the U.S. Naval Base of Rodman with plenty of storage tanks started to be available at the opposite side across the Canal in January of 1997. Site-north Amador in front of the Balboa tank farm should be developed as soon as possible. Chemical products should be treated in a similar manner.

17. Piers 6, 14, 15 and 16 are used for automobile and grain, together with container, dry dock and bunker just mentioned above. After the new container terminal at Site-Diablo begins operations, these cargoes will be concentrated at Pier 15 and 16. The storage yard for automobile will be expanded to the vicinity of the new airport. The size of the automobiles is within the height limit of approach surface and horizontal surface of the airport. Space for silos can also be assured behind the piers at need of users.

18. Pier 17 and 18 are located nearest to the main gate of the port. The former is used mainly for the small passenger boats such as liners to the nearby islands and launches, while the latter is allotted for relatively large passenger ships calling the port. The railway line along Pier 18 is expected to be utilized to transport passengers conveniently to the tourist spots such as the Canal, the Summit Park the Colon Free Zone etc. The north side of Pier 18 and Pier 19 to the north will be used exclusively for passengers. They will also complement a cruise ship pier being developed in Amador. Pier 17 will be assigned mainly for port service small ships like launches.

19. The south side of Pier 18 will be utilized for general cargoes. Its shed is

especially useful for the cargoes to be kept out of the rain, precious cargoes and so on.

20. Pier 19 is now used exclusively for PCC small launches (for transportation of line-handling workers). PCC plans to gather this function together with their other scattering functions around the port in the north part of Corozal. The existing US military facilities there are expected to be available and utilized for this purpose.

21. A number of tuna ships calling Pier 18 should be concentrated and shifted to the appropriate place such as the south area of Corozal. Current sand handling at Pier 20 should be also shifted to a similar place.

22. As mentioned above, every function of the port is expected to be clearly separated from each other and arranged in the future. This ideal concept is summarized in Table 3-2-1.

3.3 Tentative Container Terminal

23. Existing berths No. 14, 15 and 16 may be converted to a container terminal for temporary use. With installation of two gantry cranes and creation of some yard space by clearing the existing buildings and railway yard, up to 120,000 TEU annual capacity will be obtained. Improvement of cargo handling system will be discussed in detail in the following chapter.

24. Because the size and the form of the yard is not suitable for efficient container operation and also because of a possible conflict with other types of cargo, this terminal should be used only until the terminal at Diablo comes into operation as a full scale container terminal.

Table 3-2-1 Functional Allotment of the Port at Each Stage of Development

Time Span to be Considered	Major Functions (draft)					
	Container Terminal	Automobile	Grain	General Cargo	Bunker (Import)	Dry Dock
Present	Pier 14, 15, 16	Pier 6, 15, 16	Pier 6, 14	Pier 16, 18	Pier 6, 7	Pier 14
Urgent (Instant Improvement)	Pier 14, 15, 16 (yard expansion and new equipment)	Pier (7,) 14, 15, 16 (yard expansion)	Pier (7,) 14,15 (new equipment)	Pier 16, 18	Pier 6(, 7) and Rodman (partial transfer)	Pier 7(,14)
Short Term 2005 (Feasibility Study)	Diablo (and Farfan) (new terminal)	Pier 15,16 (yard expansion)	Pier 15,16	(Pier 16 and) 18 south	Pier 6 and Rodman (and/or north Amador)	Pier 7, 14
Long Term 2015 (Master Plan)	Diablo and Farfan (new terminal)	Pier 15,16 (and/or Farfan) (new terminal)	Pier 15,16	(Pier 16 and) 18 south	north Amador and south Rodman	Pier 7,14 (and/or Farfan) (expansion)
Post Long Term After 2015	Diablo and Farfan	Pier 15,16 and/or Farfan	Pier 15,16 (and/or Farfan)	(Pier 16 and) 18 south	north Amador and south Rodman	and Farfan

Time Span to be Considered	Major Functions (draft)					
	Passenger Cruiser	Tuna Boat*	Sand Vessel*	Ferry and Launch	PCC Launch	Tugboat
Present	Pier 18	Pier 18	Pier 20	Pier 17	Pier 19	(Pier 14)
Urgent (Instant Improvement)	Pier 18	Pier 18	Pier 20	Pier 17, 19	Pier 19	Pier 18
Short Term 2005 (Feasibility Study)	Pier 18 (north and/or Amador)	north Balboa (new pier)	Diablo (new pier)	Pier 17, 19	north Corozal (new PCC terminal)	Pier 18
Long Term 2015 (Master Plan)	Pier 18 north and Amador	north Balboa (new pier)	Diablo (new pier)	Pier 17, 19	north Corozal (new PCC terminal)	Pier 18
Post Long Term After 2015	Pier 18 north and Amador	north Balboa (new pier)	Diablo (new pier)	Pier 17, 19	north Corozal (new PCC terminal)	Pier 18

Note1: all the canal area, related to the Canal and US military, will be reverted to Panama by 2000.

Note2: the new third lock of the Canal will be constructed by 2020.

Note 3: (*) locations of new pier are based on the economical Alternative Plan-D4 and D-5 and those of the desirable Alternative Plan-D2 and D3 are south Corozal.

(Note)

25. The full annual capacity of existing facilities for container handling is estimated at around 60,000 TEUs, based on simple assumptions and calculations as below;

① Major Premises

(a) Three berths of Pier 14 - 16 are assigned to Container Ships.
(b) Yard area under preparation behind Pier 14 and 7 and 15 (for container and partially for car) totals around 30,000 ㎡ (see section 2.1.3 (5) of Progress Report).
(c) Cargo Handling System is the same as the current one. No new modern equipment such as gantry crane is introduced. However, private yards outside of the port support it in shortening port staying days of container.

② Annual yard capacity

15,000 ㎡ (total yard area for container) ÷ 75 ㎡ (yard area/ TEU : by forklift) × 2 (stacking height) ≒ 400 TEU (yard capacity)
400 TEU (yard capacity) × 365 (day / year) ÷ 2.4 (average port staying day: see section 7.2.5 of Progress Report) ≒ 58,000 TEU (annual yard capacity)

③ Annual berth capacity

3 (number of berths) × 2 (number of gangs) × 4.6 TEU/ hour/ gang (gross productivity: see section 7.2.7 of Progress Report) × 365 (day / year) × 24 (hour / day) × 0.7 (supposed operation rate) ≒ 169,000 TEU (annual berth capacity)

3.4 Berths for Conventional Cargo (Cereal, Automobile and Other Type of Bulk and General Cargo)

26. Berths No.7 and 14 , 15, 16 and 18 will be used for cereal, automobile and other type of bulk / general cargo for the time being. These are the main existing piers with depths of at least 9 meters at the port. After completion of Diablo container terminal, these activities will be concentrated to the berths No. 15, 16 and 18. As to the usage of Pier No. 18, general cargo will be assigned mainly to the

south part of the pier, while passenger cruiser has priority in mooring at the north part of it as explained in the next section.

27. In order to check the cargo handling capacity of the existing piers in the target year 2015 of the master plan, a convenient method, i•e index of wharf utilization was applied to the preliminary evaluation of wharf utilization in 2.2 (9) of PART I (the Progress Report). Generally speaking, it is most suitable when the index has a value of around 1000 ton/m (700 to 1100 ton/m).

28. The result of the analysis is shown in Table 3-4-1. It is carried out for the figures of low case and high case in that year concerning solid bulk, liquid bulk (excluding bunker oil) and break bulk (including automobile), obtained in the previous chapter.

29. In calculating the index, solid bulk, liquid bulk and automobile were assigned to Pier 15 and 16, while break bulk excluding automobile was allotted to the south of Pier 18. The share of automobile in break bulk is assumed as 50 %, taking into consideration the 1995 share(around 40%) and the containerization of others.

30. According to the table, Pier 15, 16 and 18 proves to be sufficient for cargo handling in the target year, since the level of consolidation will be 400 - 1000 ton/m at Pier 15 and 16, and 300 - 500 ton/m at the south of Pier 18. However, improving the productivity of cargo handling by means of expansion of cargo handling yard (for automobile), installation of new equipment or silos (for cereal) should be considered.

31. One quay crane which is to be installed for urgent container handling at Pier 16 shall be left there for the other types of cargo after the other quay cranes are moved to be utilized for container handling at Diablo in the target year of 2005. (This crane has narrow rail gauge and does not fit the new berths anyway.) In this sense, it should be taken into consideration that this quay crane is not exclusively used for container handling, but for multipurpose use.

32. As to automobile, the area around the Albrook airport will be utilized as aforementioned for the time being. Site-Farfan is available for further expansion.

33. In the table, the wharf utilization in the target year 2005 of the short term plan is also evaluated. If the containers are also handled at Pier 15 and 16, in addition to above-mentioned cargoes, the index will increase. We try to evaluate

the index there in the case that Diablo container terminal isn't developed at that time.

Table 3-4-1 Evaluation of Wharf Utilization in the Target Year 2005 and 2015

Target Year		2005		2005		2015		2015	
Case		Low Case		High Case		Low Case		High Case	
Cargo, Mooring Length and Level of Consolidation		total (ton)	converted (ton)	total (ton)	converted (ton)	total (ton)	converted (ton)	total (ton)	converted (ton)
Import Cargo									
Bulk Cargo									
Solid Bulk	(1)	566,000	169,800	860,000	258,000	812,000	252,600	1,691,000	508,200
Liquid Bulk	(2)	100,000	10,000	152,000	15,200	149,000	14,900	299,000	29,900
General Cargo									
Break Bulk		73,000	54,750	96,000	72,000	129,000	96,750	194,000	145,500
Automobile*	(3)	36,500	18,250	48,000	24,000	64,500	32,250	97,000	48,500
Others	(4)	36,500	36,500	48,000	48,000	64,500	64,500	97,000	97,000
Export Cargo									
General Cargo									
Break Bulk	(5)	10,000	10,000	10,000	10,000	23,000	23,000	23,000	23,000
Total Converted Cargo									
Total of (1)-(3)	(6)		198,050		297,200		299,750		586,600
Total of (4)-(5)	(7)		46,500		58,000		87,500		120,000
Total Mooring Length (m)									
Pier 15 and 16	(8)		572		572		572		572
South of Pier 18	(9)		305		305		305		305
Level of Consolidation (ton/m)									
Pier 15 and 16	(6)/(8)		346		520		524		1,026
South of Pier 18	(7)/(9)		152		190		287		393

Note*: The share of automobile in break bulk is assumed as 50 %, taking into consideration that that of 1995 is around 40% and the containerization of others.

34. As container volume, import of 292,000 tons and export of 94,000 tons for low case, or import of 382,000 tons and export of 94,000 tons for low case in 2005, and transshipment of only 34,386 tons, the same as recorded in 1995, shall be employed. This is why the port of Balboa would not be able to dig up the full potential demand of container transshipment if full scale container terminals were not developed.

35. The converting coefficient for container is assumed as 0.5 here. The total level of consolidation will increase drastically to the saturation point, 700 - 1000 ton/m in 2005. That is, the development of Diablo terminal for container will be necessary by 2005 in order that the existing facilities might be relieved from the burden of container handling in order to concentrate on the other activities.

3.5 Berths for Passenger Cruise Ships

36. A jetty type pier for cruise ships will be built at the west side of Amador area by the project of ARI. The jetty type pier is not recommended because there would be a risk of collisions with other vessels entering the canal. It should be changed into a 560 meter long T-type pier. This terminal will relieve congestion of

Balboa basin. The new pier should be parallel to the main navigation channel.

37. In this Study, the north side of Pier No.18 will be also assigned for cruise ships as aforementioned. The berth should be deepened to 10 m at least 280 m from the end of the pier in order to accommodate the passenger ships of the highest class, 30,000 GT.

38. Generally speaking, the number of calling passenger ships fluctuates seasonally. The maximum number was recorded during the dry season from December to April. According to the past records of 1995 as shown in Table 3-5-1, around 25 % of the annual passenger boats called in January and April respectively.

39. The number of cruise ships in 2015 is estimated as around 200. Therefore, a maximum of 50 (200×0.25) ships will arrive at the port in a month during the dry season. The average occupancy ratio of three piers will be estimated at around 0.56 (0.28 - 0.83) in the target year, on the simple assumption that the staying time of cruise ships is 1.0 (0.5 for one day stay - 1.5 for one night stay) days.

Table 3-5-1 Monthly Distribution of Calling Passenger Cruise Ships in 1995

Month	Number of Calling Ships	Share
January	8	24.2%
February	4	12.1%
March	6	18.2%
April	8	24.2%
May	0	0.0%
June	1	3.0%
July	0	0.0%
August	0	0.0%
September	2	6.1%
October	2	6.1%
November	2	6.1%
December	0	0.0%
Total	33	100.0%

3.6 Oil Terminals

40. The piers No. 6 and 7 are used as an oil terminal as well as for other cargoes at present. There haven't been international codes on handling dangerous cargoes at ports. In order to avoid possible fire hazard, however, this terminal should be separated from other purposes as soon as possible.

41. In Japan, the maximum permissible dosage per ship is regulated based on the kind of dangerous cargo and the location of the wharf concerned. For example, a general wharf where a large quantity of bunkering oil is unloaded must be around 500 meters (at least 300 meters) away from the town area.

42. From the viewpoint of utilizing the existing piers, Pier No. 6 is relatively suitable for exclusive unloading of bunkering oil.

43. However, it is pointed out by the pilots of PCC that they must pay considerable attention in maneuvering the vessels near that pier. This is because the pier juts out into the substantial operation area of the Canal, and that there is a relatively fast current caused by the operation of the locks of the Canal.

44. Therefore, its function should be relocated to another suitable place at the first opportunity. The appropriate site for it is found just in front of the existing Balboa Tank farm at Amador. This should be done as soon as possible from the viewpoint of dangerous cargo handling and safe ship maneuvering.

45. In addition, another oil terminal became operational at the existing US navy piers: Pier No.1 and No.2 of the base on the opposite bank of Balboa area. However, the piers at Rodman will have to be removed around 2015 during the construction of the new Canal, because the traffic through the canal will require the new Canal by 2020 and the alignment of the navigation channel will need to be shifted. The oil handling at these piers will also be moved to a new site. The new piers should be constructed to the south of the existing Rodman-site.

46. If the oil movement continues its impressive growth from 1986 to 1995 (see 3.5.1 of PART I), the amount of unloaded oil will increase around 1.6 - 1.7 times more in 2005 and 2.3 - 2.4 times more in 2015, respectively, than that in 1995 (see the previous chapter).

47. A total of 180 oil tankers called the port in 1995, as shown in Table 3-6-1 (excluding oil barges with concession). Excluding the vessels at Pier 14, 15, 16 and

18 which are supposed to have received only supply, repair and so on, the number of vessels calling Pier 6 and 7 to unload oil was 95.

48. Assuming this number will be doubled in 2015 and that the size of tankers will be enlarged, around 200 tankers will call the port at that time. As a tanker needs around two days for unloading at the pier, total of two piers will be necessary. The berth occupancy ratio is around 0.55. At least one berth is necessary at Amador and at Rodman, respectively. In addition, some berths for oil barges will be necessary.

49. Some of the current tanker sizes at the port are over 30000 GT class, as shown in Table 3-6-1. However, they use Pier 6 and 7 with their draft under 10 meters to meet the berth depth of around 10 meters.

50. According to a representative of one of the major users, a 20 % increase in berth depth is required in the future. Therefore, one pier of 12 meters depth will be planned at Amador in place of Pier 6. The water area between the Canal and this pier is cable of maneuvering circles of a diameter of 2L(=370m) for a 30000 DWT tanker, 1.8L for 40000 DWT, and 1.7L for 50000 DWT. The full water depth of the area to be needed is 12 meters, 13 meters, and 14 meters, respectively. The new pier shall be designed in a manner that will allow the berth depth to be increased to 14 meters.

51. Some smaller berths are necessary for oil barges to serve other vessels marine fuel. Two additional berths are planned; one is 100 m long with a depth of 5.5 m for 2000 DWT and the other is 130 m long with a depth of 7.5 m for 5000 DWT. The new tanker pier mentioned above and the existing piers are also available for this purpose if necessary. (See Table 3-6-2 for the existing oil barges.)

52. On the other side of the Canal, the piers No. 1 and 2 (and 3) at Rodman can be utilized for the short term plan. Pier No.1 and 2 are about 12 meters and 11 meters deep, respectively. (The depth of No. 3 is about 9 meters.) These piers are used for oil unloading from the large tankers and for oil loading to the oil barges etc.

53. When the new piers are constructed to the south of the existing Rodman, one of them should have a depth of at least 15 meters to accommodate the large tankers of 60000 DWT, corresponding to the current maximum vessels of 40000 GT class at the port.

Table 3-6-1 Oil Tankers Calling the Port by Pier, Number and Size in 1995

Pier No.	0-5000GT	5000-10000GT	10000-20000GT	20000-30000GT	30000-40000GT	40000-50000GT	Total
6	7	3	9	8	1		28
7	14	2	16	16	18	1	67
Sub Total	21	5	25	24	19	1	95
14	10	1	1				12
15	9	1	1				11
16	5	1	1				7
18	54	1					55
Sub Total	78	4	3	0	0	0	85
Total	99	9	28	24	19	1	180

Table 3-6-2 Existing Oil Barges at the Port of Balboa

Type of Ships (Operator)	Tonnage (ton)	Length (meter)	Breadth (meter)	Draft (meter)	Remarks
Oil Barge					Pier No.6,7,14,15,16,18
(Environmental Protection Service)					
LOS ANGELS	1916	79.2	14.6	2.4	
SEATRADE BAY BREE	1282	73.2	13.2	2.4	
POS II	1409	77.1	12.0	3.7	
POS 32	1832	82.3	15.2	4.6	
POS 42	1291	80.8	15.2	4.3	
(Panama Marine Safety)					
PAMAR II	4037	125.3	16.2	6.1	
PETROPAN I	495	61.0	12.0	3.0	

3.7 Dock Yard

54. Dry docks of three sizes are located between berth Nos. 7 and 14. The ship repair facility of this size, particularly the Panamax size dock, is the only working dock available along the Pacific coast of the American Continent from Mexico to Chile. Those vessels crossing the Pacific Ocean need a reliable repair and maintenance facility.

55. Comparing the magnitude of ship repair business now available at Singapore, this facility may not be sufficient to cater for the traffic in this area. In Singapore, there are more than 10 principal shipyards and ship repair companies. One of the largest companies operates seven dry docks for vessels up to 400000 DWT, 330000 DWT, 150000 DWT etc., and repair berths of more than 4000 m in length.

56. The concessionaire of the dry docks expects to reach the maximum capacity of 105 ships per year in 1997-1998, as mentioned in PART I. Therefore, when the berth No. 14 is relieved from container operation, No. 7 and No. 14

should be converted to the fitting berths attached to the dock yard.

57. In the long term plan, additional dock yard with new Panamax size (same as the third lock size) may be necessary at Farfan.

3.8 Mooring Facilities for Smaller Vessels and Port Service Vessels

(1) Tuna boats

58. The number of tuna boats calling the port is shown in Table 3-8-1. The number increased to 368 in 1995 after having declined for a period of several years. Most of them call the port just before or after transiting the Canal. Based on the data of 1995, more than 90 % of the ships called at the port for supply, repair and so on without cargo handling.

59. The average drafts of ships arriving and leaving has remained fairly constant in the last ten years, between 17 and 18 feet. The average mooring time of tuna boats was around 5 days in 1995. More than 60 % of them moored at Pier No.18. And they moored at the same place doubly on and off, if necessary.

60. The distribution of draft of tuna boats calling the port in 1995 is shown in Table 3-8-2. The share of the draft from 18 feet to 20 feet is 26.6%, and that from 20 feet to almost maximum 22 feet is 33.4%. The distribution of length is also shown in the same table. The accumulated share of the length up to 70 meters is 88.6% and that up to 80 meters is 99.2%. Therefore, the berth for a tuna boat requires a length of 90 meters and a depth of 7.5 m.

61. Based on the simple assumption that the number and the staying time of tuna boats in the future is the same as those of 1995, at least six (6) new berths will be necessary. At that time, the berth occupancy ratio will become 0.84 on average. This figure will decrease if tuna boats are allowed to moor at the same place doubly as they are at present. Utilizing other vacant berths is another effective measure to meet the peak demand. (Around 10 to 15 ships are said to have stayed simultaneously at the peak time at the port.)

62. Concerning tuna boats, the port of Vacamonte has a T-type pier with four (4) berthing places for them. The water depth currently ranges from 6.1 to 9.8 meters. However, the related facilities for ship repair and supply aren't equipped or don't work well because of the lack of maintenance even if equipped. This is the

reason why few tuna boats have called this port in recent years. These kinds of facilities should be improved as soon as possible in case that this port serves tuna boats as the alternate port to the port of Balboa.

Table 3-8-1 Number of Tuna Boat Calls

Year	Number of Calling Ships
1986	466
1987	500
1988	591
1989	483
1990	555
1991	521
1992	433
1993	337
1994	316
1995	368

Table 3-8-2 (a) Distribution of the Draft of Tuna Boats in 1995

Draft (feet)	Number of Calling Ships	Share (%)	Accumulated Share (%)
-2	1	0.3%	0.3%
-4	0	0.0%	0.3%
-6	10	2.7%	3.0%
-8	6	1.6%	4.6%
-10	11	3.0%	7.6%
-12	10	2.7%	10.3%
-14	21	5.7%	16.0%
-16	40	10.9%	26.9%
-18	44	12.0%	38.9%
-20	98	26.6%	65.5%
-22	123	33.4%	98.9%
-24	4	1.1%	100.0%
Total	368	100.0%	

Table 3-8-2 (b) Distribution of the Length of Tuna Boats in 1995

Length (m)	Number of Calling Ships	Share (%)	Accumulated Share (%)
-10	2	0.5%	0.5%
-20	3	0.8%	1.4%
-30	16	4.3%	5.7%
-40	22	6.0%	11.7%
-50	29	7.9%	19.6%
-60	89	24.2%	43.8%
-70	165	44.8%	88.6%
-80	39	10.6%	99.2%
-200	3	0.8%	100.0%
Total	368	100.0%	

(2) Working Vessels (Sand Barge)

63. Sand has been handled at Pier No. 20 by one private company since the 1920's. The pier has a sand storage yard at the back. This sand is used for construction material in the city. The volume handled fluctuates according to the demand of the construction.

64. The function of the pier must be relocated to another appropriate place when a new container terminal is developed near it. At present, the company operates three ships with a length of about 120 feet in rotation for 24 hours. Therefore, at least one berth with a depth of 4.0 m and a length of 60 m will be necessary. Two berths would be desirable.

(3) Ferries for Islands and Other Small Crafts

65. Ferries for islands such as Taboga and other small launches are mooring at Pier No. 17 because of its convenient location. These ships are listed in Table 3-8-3. At least six (6) ferries and nine (9) launches use this pier. This pier is extremely congested because its mooring length is only 92 meters and the use by ferries is concentrated at similar time to get passengers.

66. The minimum required mooring length calculated as follows based on actual vertical mooring:

(a) for the ferries

(Ship Breath 7 m + 3 m) × 6 ≒ 60 m

(b) for the launches

(Ship Breath 5 m + 3 m) × 9 ≒ 70 m

In addition to the above, area for future expansion should be considered.

67. On the other hand, Pier No. 19 is exclusively used by six (6) PCC launches for transportation of line-handling workers. The mooring length is 88 meters. Besides this pier, PCC has two more piers around the port of Balboa: one for four (4) tugboats at Diablo and the other for four (4) pilot launches at Naos island of Amador. The control center of these small crafts is located at the pier of Diablo.

68. PCC plans to relocate and concentrate the function of Pier No. 19 with other facilities around the port of Balboa to the north of Corozal. Therefore, the area around Pier No. 19 is expected to be available for small ships in addition to Pier No.17. In this case, the Pier No.19 and Pier No. 17 are preferable to be assigned for passenger ferries and for the port service launches respectively, taking the neighboring port function into the consideration (ex. the north side of Pier No.18 will be assigned for cruise ships as aforementioned).

Table 3-8-3 The Existing Ferries and Launches at the Port of Balboa

Type of Ships (Operator)	Tonnage (ton)	Length (meter)	Breadth (meter)	Draft (meter)	Capacity (person)	Remarks
Ferry (Tourism)						Pier No.17
(Argo Tours)						
ISLA MORADA	95	29.3	6.0	1.8	200	to Taboga Island
FANTASIA	10	35.7	3.4	1.8	600	for Canal cruising
(Calypso Queen)						
CALYPSO QUEEN	52	19.5	5.7	1.8	160	
CALYPSO PRINCESS (new ship)	44	16.8	5.2	1.8	110	operation in 1997 under consideration
(Maritima de Cabotaje)						
BONA	95	19.8	6.7	1.8	200	
(Hotel Cotadora)						
ISLA CONTADORA	60	16.8	6.7	1.8		
Launch						Pier No.17
(Trans Iberica)						
ANAYANSI	11	16.2	4.4	1.2		
BALBOA	9	12.2	3.4	1.2		
ANCON	11	16.2	6.5	1.2		
(new ship No.1)	17.5	12.8	4.3	1.2		operation in 1997
(new ship No.2)	17.5	12.8	4.3	1.2		- ditto -
(new ship No.3)	17.5	12.8	4.3	1.2		- ditto -
(new ship No.4)	17.5	12.8	4.3	1.2		- ditto -
(new ship No.5)	17.5	12.8	4.3	1.2		- ditto -
(Environmental Protection Service)						
ILKA	27	14.6	4.6	1.2		transferred to the port of Cristobal
SUNDANCE SUNSET	24	12.5	4.0	1.2		- ditto -
(Panama Marine Safety)						
MORENA I	28	14.6	4.6	1.2		for private use

(4) Tug Boats and Supply Ships Other than Oil Barges

69. Two (2) tugboats are operated at the port now. They stay at the south end of Pier 14. This place will be assigned for ship repair as explained earlier in 3.7. They will be relocated to the west side of Pier No. 18 with a mooring length of 59 m. This is one of the most convenient places for tugboat service because it is close to the Canal (northbound and southbound), the existing port, and Diablo container terminal. It also has sufficient space to meet the increase in the number

of tugboats (See Table 3-8-4 for the existing tug boats and supply ships).

70. Listed in Table 3-8-5 are the supply ships other than oil barge, which transport water, lubricating oil, parts and so on. Only three (3) ships are fully in service now. The number would increase sooner or later as in the case of ship repair and fuel supply service explained earlier. They will be assigned to Pier No. 15, 16 and 18 as they are at present while these piers are vacant.

Table 3-8-4 Existing Tug Boats at the Port of Balboa

Type of Ships (Operator)	Tonnage (ton)	Length (meter)	Breadth (meter)	Draft (meter)	Capacity (person)	Remarks
Tugboat						Pier No.14
(Smit Panama)						
HOEKSENBANK	253	33.2	9.1	3.0		
STEENBANK	253	33.2	9.1	3.0		

Table 3-8-5 Existing Supply Ships Other than Oil Barges at the Port of Balboa

Type of Ships (Operator)	Tonnage (ton)	Length (meter)	Breadth (meter)	Draft (meter)	Capacity (person)	Remarks
Supply Ship (Water, Oil, Parts etc.)						Pier No.15.16.18
(Maritima de Cabotaje)						
VIVEROS I	91	31.4	7.3	3.0		
KENOKI	323	37.2	11.0	3.0		
(new larger ship)						operation in 1997
(Panama Marine Safety)						
OMAR I	123	45.7	11.0	3.0		
(new ship)	123	45.7	11.0	3.0		under consideration

(5) Pleasure Boats

71. In the port area, there are a few bases for pleasure activities represented by Diablo Spinning Club and Balboa Yacht Club with a concession. Relocation of these yacht clubs may be necessary.

72. On the other hand, several marina plans are in progress around the port. A recreational marina with 200 boats and 100 boat garage is planned by ARI at Amador. At the waterfront of the Panama bay, a new resort hotel has been constructed with private piers for 30 cruisers. Its capacity will be increased up to 90 in the future. Its neighboring club is also increasing the current capacity of 30 to a total of 120.

73. Therefore, it would not be necessary to plan a new marina at this time.

3.9 Alignment of the New Canal

74. Alignment of the New Canal was recommended by the Commission for the Study of Alternatives to the Panama Canal in 1993. At the completion of the third locks, the maximum size of vessels passing through the channel will become 150,000 DWT and the width of the channel needs to be expanded from 150 m to 320 m. (Some operating area will also be required.)

75. In the early stages after the expansion of the channel, the American Bridge, the main span of which is around 330 m, may be retained for a few more decades after completion of the third locks.

76. Use of Pier No.6 for oil handling may be completely terminated because there will be no distance between the pier and the channel which means that operation at the pier would become more dangerous.

77. With the increase of usage of the new Canal, the western side of the American Bridge and the tip of Rompeolas at Farfan will have to be removed. This means renewal of American Bridge.

78. In the following section, several alternative plans for port development will be studied. In the study, two (2) alignments of the new Canal explained above, one recommended in 1993, and the other shifted parallel to it through the main span of the American Bridge, will be taken into consideration. Each alternative of this Study for port development will satisfy both alignments of the new Canal and contain sufficient operating area.

3.10 Alternative Plans for Port Development

(1) Site - Diablo

1) Alternative Plan - D1 (see Figure 3-10-1)

79. This is the most basic alternative to be studied. Two consecutive container berths are located just adjacent to Pier 20 on the north side and parallel to the existing Diablo road. This kind of plan has been proposed repeatedly by