(3) Domestic Shipping

i) Domestic Transportation Service

171. Since Western Samoa can basically be described as a two island sovereign state, sea transport is, essentially, the infrastructural linkage between the inhabitants of Upolu and Savaii. For this purpose a ferry service has long been established between the ports of Mulifanua in Upolu and Salelologa in Savaii.

172. The Government controls virtually all domestic shipping through the Western Samoa Shipping Corporation. The Corporation was established on 30th December 1974 under New Zealand company law; the Minister of Transport is the Board Chairman.

ii) Western Samoa Shipping Corporation

173. Conscious of the needs of the Western Samoan islands and being fully aware that the development of the largest island Savaii could not possibly be undertaken without the needed shipping facilities, the Government founded Western Samoa Shipping Corporation to meet the requirements of the domestic shipping sector. The corporation which is wholly owned by the central Government operates appropriate ferry vessels for the carriage of passengers and cargoes. The system provides regular service between the larger islands, involving several trips each day. The main features of the service are outlined below.

iii) Passenger and Vehicle Traffic

174. There are no official statistics on the domestic traffic. But according to "The Basic Design Study for the Domestic Transportation Strengthening Project" by Japan International Cooperation Agency, the number of passengers and vehicles transported by ferry has been increasing in recent years (see Fig. 1.2.28). The most recent data is as follows:

Passengers : 243,668 (from 25th March 1986 - 31st December 1986)

Vehicles : 11,857 (")

Table 1.2.14 Cargo Volume of Foreign Trade in Western Samoa

(Unit: tons)

		1974	1976	1978	1979	1980	1981	1982	1983
Inward	Commonwealth	32,448	46,439	79,564	57,534	51,954	63,585	51,687	71,992
	Others	18,095	16,057	28,694	43,242	41,284	33,023	44,203	43,793
	Total	50,543	62,496	108,258	100,776	93,238	96,608	95,890	115,785
	(Annual Increase Rate)	-	1.11	1.32	0.93	0.93	1.04	0.99	1.21
Outward	Commonwealth	20,030	15,699	25,085	21,873	26,840	22,200	26,684	34,910
	Others	3,976	12,341	11,014	15,102	19,999	11,297	17,585	8,542
	Total	24,006	28,040	36,099	36,975	46,839	33,497	44,269	43,452
	(Annual Increase Rate)	-	1.08	1.13	1.02	1.27	0.72	1.32	0.98
Total	Commonwealth	52,478	62,138	104,649	79,407	78,794	85,785	78,371	106,902
	Others	22,071	28,398	39,708	58,344	61,283	44,320	61,788	52,335
	Total	74,549	90,536	144,357	137,751	140,077	130,105	140,159	159,237
	(Annual Increase Rate)	-	1.10	1.26	0.95	1.02	0.93	1.08	1.14

Note: In case of the FCL, the cargo volume is calculated by the container capacity.

Source: "Return of the Trade, Commerce and Shipping of Western Samoa"

Table 1.2.15 Total Cargo Volume at Apia Port

		1981	1982	1983	1984	1985	1986	Annual incr. (1981-1986)
Imports	General Cargo	70,607	89,483	91,516	80,396	102,164	105,694	1.084
	Oil Products	29,125*1	14,392*1	20,985	*2	23,960	23,074	0.954
	Total	99,732	103,875	112,501	-	126,124	128,768	1.052
Exports	General Cargo	33,117	40,148	35,260	45,816	43,970	38,070	1.028
	Coconut Oil	-	8,027	12,188	10,537	12,099	13,801	1.145
	Total	33,117	48,175	47,448	56,353	56,069	51,871	1.094
Total	General Cargo	103,724	129,631	126,776	126,212	146,134	143,764	1.067
	Oil	29,125	22,419	33,173	-	36,059	36,875	1.048
	Total	132,849	152,050	159,949	-	182,193	180,639	1.063
	Annual Increase Rate	-	1.14	1.05	-	1.07	0.99	-

*1: Estimated From Total Volume of Oil Products

*2: Unknown

Source: General Cargo: "Economic Statistics of Shipping" Dept. of Statistics
Western Samoa Shipping Corporation
Oil Products: Customs Dept.
Coconut Oil : Samoa Coconut Products

Table 1.2.16 Main Import Commodities

	1976	1977	1978	1979	1980	1981	1982	1983
Meat (Tons)	2,290	2,948	3,372	3,556	2,867	2,667	3,057	2,289
Vegetables (Tons)	715	765	860	847	610	546	620	531
Cereals (Tons)	9,009	8,111	5,953	6,912	9,462	7,154	7,337	10,276
Preserved Fish (Tons)	5,155	2,075	1,310	2,378	1,966	3,011	1,598	1,150
Sugar (Tons)	6,216	4,415	4,603	5,003	5,905	6,099	10,853	6,889
Salt (Tons)	735	682	1,394	581	792	591	573	499
Cement (Tons)	6,396	7,191	11,664	10,232	*1	10,196	9,232	9.688
Oil Products (kl)	20,694	24,905	30,628	36,344	33,587	41,617	20,787	30,862
Iron (Tons)	3,405	5,662	3,065	4,034	6,110	7,554	7,789	2,458
Vehicles (No.)	290	557	692	-*1	659	392	230	1.169

Source: Customs Dept. "Return of the Trade, Commerce and Shipping of W.S."

*1: Not Available

Table 2.1.17 Oil Products Imported by Tankers

(1) Total

		1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Gals (1,000)	Motor spirit	1,591	2,345	2,370	2,705	2,533	3,106	1,283	2,023	1,844	2,141	2,395
	Kerosine, white spirit	898	978	1,326	1,282	1,439	1,776	752	1,287	-*1	1,340	1,705
	Distillate fuels	1,962	2,983	2,886	3,826	3,272	4,181	2,435	3,393	3,041	3,747	3,037
	Total	4,451	6,306	6,582	7,813	7,264	9,063	4,470	6,703	-	7,228	7,137
	(Annual Increase Rate)	-	1.42	1.04	1.19	0.93	1.25	0.49	1.50	-	1.04	0.99
Tons	Motor spirit	5,250	7,738	7,821	8,928	8,425	10,252	4,233	6,676	6,088	7,066	7,904
	Kerosine white spirit	3,326	3,621	4,913	4,749	5,331	6,579	2,784	4,766	-	4,963	6,315
	Distillate fuels	7,265	11,048	10,689	14,169	12,117	15,485	9,018	12,565	11,262	13,878	11,248
	Total	15,841	22,407	23,423	27,846	25,873	32,316	16,035	24,007	-	25,907	25,467
	(Annual Increase Rate)	-	1.41	1.05	1.19	0.93	1.25	0.50	1.50	-	1.04	0.98

Note: Motor Spirit: 303 Gals=1 Ton, Kerosine, White Spirit & Distillate fuels: 270 Gals=1 Ton. 1 Gals=4.564L

Resource: Customs Dept (1976-1984). Treasury Dept (1985-1986)

*1. unknown

(2) Asau Port

(Unit: tons)

	1983	1984	1985	1986
Motor Spirit	854	867	612	836
Distillate Fuels	2,169	1,953	1,335	1,558
Total	3,023	2,820	1,947	2,394

Source: Customs Dept.

Table 1.2.18 Main Export Commodities

(Unit: tons)

	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985
Copra	12,300	19,400	11,800	17,800	13,800	18,500	25,253	16,066	10,370	4,787	-	2,752
Cocoa	1,816	1,459	1,644	2,173	1,178	1,675	1,556	888	770	2,123	652	581
Banana	1,312	479	1.339	340	370	850	2,095	1,598	1,148	926	-	-
Taro	2,958	649	2,521	1,680	3,728	4,116	2,710	5,414	3,959	3,975	4,468	7,176
Timber (m^3)	8,085	2,865	1,053	3,637	5,185	3,538	4,050	4,036	7,255	2,475	4,069	3,013
Coconut Oil	-		-	-	-	-	-	-	8,037	12,207	10,651	10,926
Copra Meal	-	-	-	-	-	-	-	-	3,963	5,200	4,290	5,926
Veneer (m^3)	-	-	-	-	-	-	-	-	1,038	1,253	-	367

Source: The Budget Statement. (1981, 1983, 1985, 1987)

Note: A banana case contains 56 Lbs net of bananas; a taro case contains 72 Lbs of taro.

Table 1.2.19 Volume of Imports by Area of Origin

(Unit: tons, %)

Origin	1981	1982	1983	1984	1985	1986
Australia	9,250 (13.4)	10,137 (12.2)	12,263 (14.0)	9,606 (13.2)	16,535 (17.5)	14,687 (14.8)
New Zealand	31,735 (45.8)	27,167 (32.7)	38,368 (43.7)	33,199 (45.8)	34,816 (36.9)	44,431 (44.9)
Pacific Islands	7,361 (10.6)	7,782 (9.4)	12,893 (14.7)	7,342 (10.1)	10,400 (11.0)	11,872 (12.0)
Asia	10,289 (14.9)	14,489 (17.4)	11,410 (13.0)	12,293 (16.9)	27,281 (28.9)	12,942 (13.1)
Europe	805 (1.1)	1,201 (1.4)	2,845 (3.3)	4,752 (6.6)	1,973 (2.1)	9,896 (10.0)
North America	9,782 (14.2)	22,416 (26.9)	9,920 (11.3)	5,358 (7.4)	3,237 (3.5)	5,161 (5.2)
Total	69,222 (100)	83,192 (100)	87,699 (100)	72,550 (100)	94,242 (100)	98,989 (100)

Note: Oil Products are excluded due to lack of data

Source: Economic Statistics of Shipping, Dept. of Statistics

Table 1.2.20 Volume of Exports by Area of Destination

(Unit: tons, %)

Destination	1981	1982	1983	1984	1985	1986
Australia	1,593 (5.1)	2,326 (6.2)	3,812 (10.3)	6,845 (14.3)	5,580 (13.5)	2,898 (7.9)
New Zealand	12,446 (40.2)	8,779 (23.4)	9,943 (26.5)	16,349 (34.1)	18,785 (45.3)	9,881 (26.9)
Pacific Islands	4,822 (15.6)	9,641 (25.6)	4,928 (13.1)	7,037 (14.7)	6,546 (15.8)	8,928 (24.3)
Asia	2,081 (6.7)	7,399 (19.7)	2,112 (5.6)	3,308 (6.9)	140 (0.3)	1,561 (4.2)
Europe	7,674 (24.8)	6,488 (17.2)	3,238 (8.6)	6,222 (13.0)	8,000 (19.3)	9,389 (25.6)
North America	2,341 (7.6)	2,981 (7.9)	13,540 (36.0)	8,146 (17.0)	2,393 (5.8)	4,078 (11.1)
Total	30,957 (100)	37,614 (100)	37,573 (100)	47,909 (100)	41,444 (100)	36,736 (100)

Source: Economic Statistics of Shipping, Dept. of Statistics

Table 1.2.21 International Arrivals and Departures by Sea

	Arrivals	Departures	Total
1980	22,343	24,323	46,666
1981	19,277	16,465	35,742
1982	17,139	17,341	34,480
1983	18,448	19,827	38,275
1984	19,498	21,727	41,225

Source: Department of Statistics

Table 1.2.22 Western Samoa Shipping Corporation
Ferry Vessels

Specification	Lady Samoa	Queen Salmasina	Salafai	Puleono
Length (m)	32.3	42.3	27.1	36
Beam (m)	6.3	10.4	7.2	9.6
Depth (m)	1.4	2.1	1.6	1.5
Year Built	1983	1977	1969	1975
Passengers	250	216	60	119
GRT	136	714	121.82	229.64
NRT	65	517	47.02	133.95
Speed (knots)	16.2	11.5	10	9.5
Engine	4 cycle diesel 8 cylinders, 1440 kw	2 diesel gardner	Twin screw V8 diesel	2 diesel Caterpiller
Hull Type	Chrome welded aluminium	Welded steel	Welded steel	Welded steel
Vehicle Capacity	Nil	15	4 Trucks or 8 Cars	11 Trucks or 15 Cars
DWT	40	91	-	-

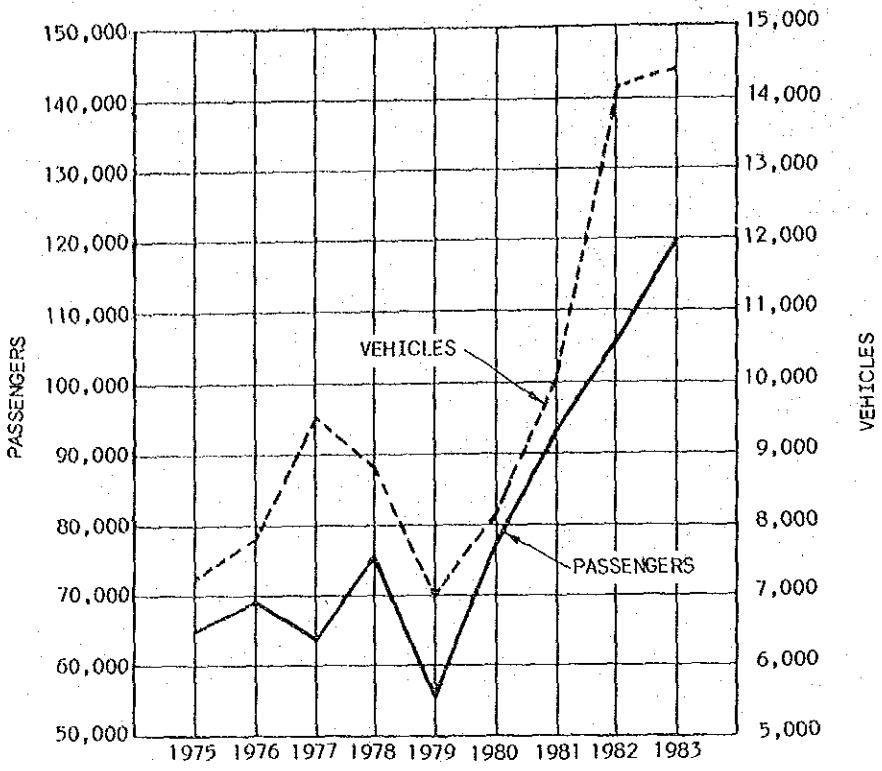


Fig. 1.2.28 Number of Vehicles and Passengers Transported by Ferry (1975 - 1983)

Source: "The Basic Design Study for the Domestic Transportaion Strengthening Project" JICA

iv) Sailing Schedules

175.

MULIFANUA	SALELOLOGA	
0600 hrs	0600 hrs	
0900 "	0900 "	Monday to
1200 "	1200 "	Friday
1500 "	1500 "	
0600 hrs	0600 hrs	
1000 "	1000 "	Saturdays only
1300 "	1500 "	
0800 hrs	1100 hrs	
1400 "	1300 "	Sundays only

(4) Other Transportation Systems

i) Road Transport

(a) Road Network

176. Western Samoa has in general terms an adequate road system and considerable improvement has been made during the past decade. The length of the road system is shown below.

Length of Road System (Kilometers)

Administrative Classification	1970	1980
Apia Town Roads	32	69
Main (Primary) Roads	378	396
Secondary Roads	129	334
Plantation/Village Access Roads	282	1,234
Total	821	2,042

177. The official system of road classification is based on the administrative system. Four classes of roads are recognised as follows:

. Town - Urban roads in the Apia town area and its environs serving residential and commercial areas;

. Main - The primary or trunk roads of the rural network, usually through roads but occasionally (in principle) serving large rural community areas;

. Secondary - The secondary roads of the public rural network, defined as less important roads, generally village access roads or access roads to private planation settlements;

. Plantation - The tertiary or feeder roads of the network, normally constructed using government funds. Access roads are designed and maintained by the people of the areas served. They are considered private rather than public roads.

(b) Main Transport Vehicles

178. In Western Samoa, the main transport vehicles are trucks and pick-ups. To and from port areas trucks are mainly used to transport such commodities as cement, cereals, coconuts and other heavy cargoes. Containers are sometimes transported into the hinterland.

179. All bus and taxi services are owned and operated privately and there is no form of Government subsidy. The 192 buses registered in Western Samoa in 1985 were owned by approximately 50 bus companies and individuals indicating a wide dispersion of ownership and control. On the other hand during 1985 there were 351 registered taxis.

(c) Traffic Volume

180. The traffic volume has been counted by the Public Works Department at

some points in Apia. The latest survey was carried out in 1982. According to this survey, during 13 hours (6:00 - 19:00) there were more than 10,000 vehicles in the center of Apia. And 5,000 - 7,000 vehicles passed in front of Aggie Grey's Hotel.

(d) Road Condition

181. The road condition in Apia is not very good. There are many potholes. And some rotaries cause traffic congestion due to the lack of traffic signals.

ii) Domestic Air Services

182. Polynesian Airlines operates domestic air services on the following routes:

Apia (Fagalii airfield) to Asau;
Apia to Maota;
Faleolo Airport to Maota

Fagalii airfield is a grass strip very close to the centre of Apia. The international airport at Faleolo is 30 km west of Apia, between Apia and Mulifanua. Maota is a coral sand airfield some 5km south of Salelologa; Asau airfield is on the breakwater of Asau harbour. The services are all operated by Britten Norman Islander.

183. The number of passengers has been decreasing year by year. The services have been reduced, and the Islander fleet reduced from two to one. Air services now carry less than 10 percent of the total passenger movement between Upolu and Savaii.

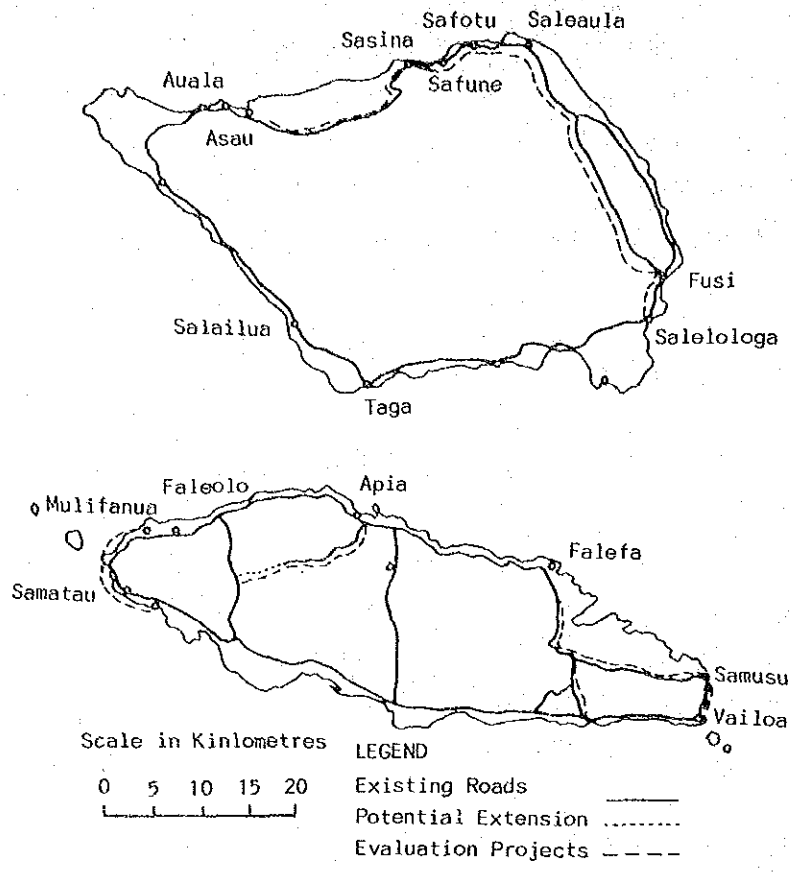
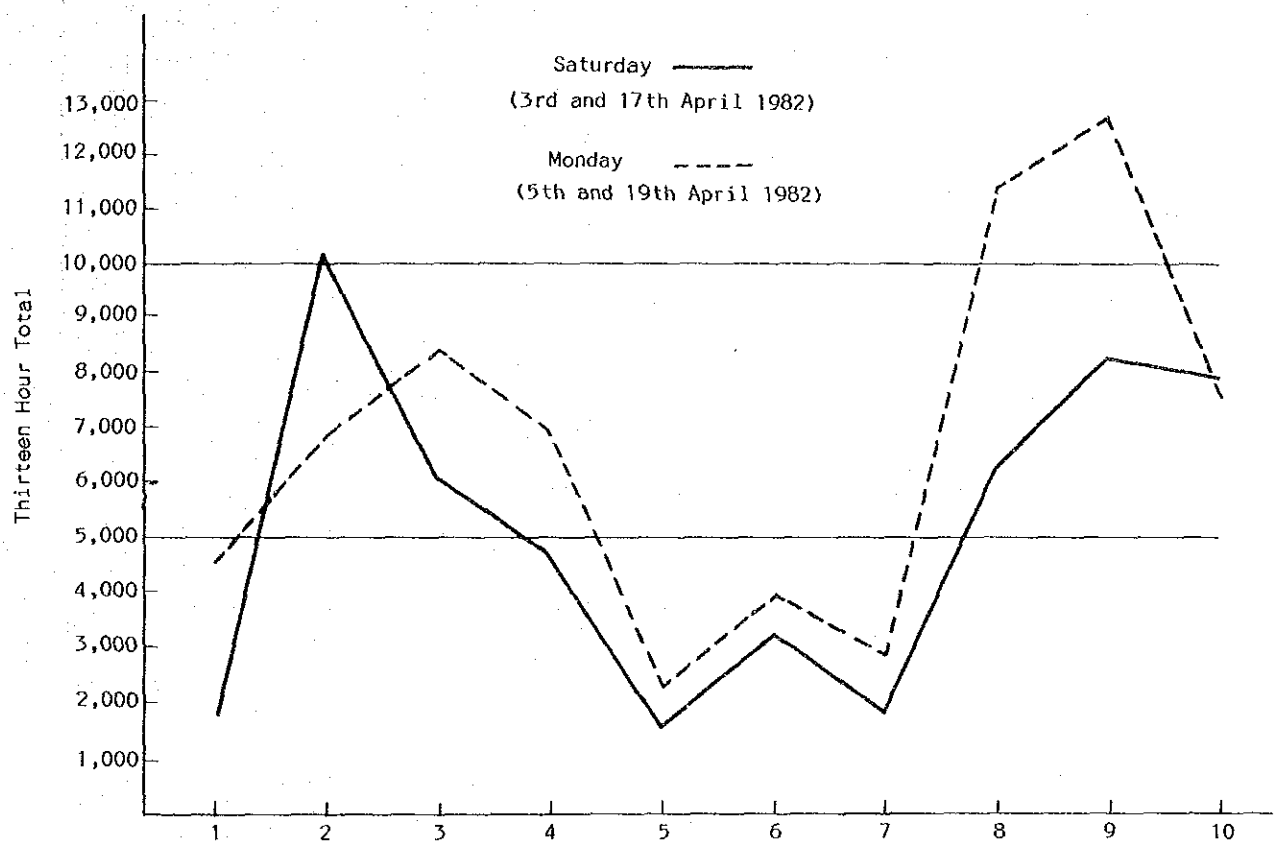


Fig. 1.2.29 Highway Network



LOCATION OF STATIONS

		STATIONS
Station	No. 1.	- Tusitala Hotel
"	2.	- Palm Court
"	3.	- N.Z. High Commission Office
"	4.	- Aggie Grey's Hotel
"	5.	- Apia Primary School
"	6.	- Sunset Club
"	7.	- Morris Hedstrom (S) Ltd. Billiard Saloon
"	8.	- Treasury Dept.
"	9.	- Marist Brothers School
"	10.	- Town Civic Theatre

Fig. 1.2.30 Stations and Thirteen Hour Traffic (6:00 - 19:00)

Source: Public Works Department.

Table 1.2.23 Frequency of Domestic Air Services, April 1986

	Total Flights per Week	Total Number of Seats Available Per Week
Fagalii - Asau	23	184
Fagalii - Maota	23	184
Falcolo - Maota	1	8
Falcolo - Asau	1	8

Source: Polynesian Airlines

Table 1.2.24 Domestic Passenger Traffic

Financial Year	Total Passengers
1983	23,228
1984	18,401
1985	13,691
1985	13,329

Source: Polynesia Airlines

5) Port Administration and Operation

(1) Functions of the Ministry of Transport

184. The Shipping Act 1972 No. 18 is the main ordinance which governs the activities in relation to ports. Under this Act the main functions and responsibilities of the Ministry of Transport are as follows:

① allocation of berths;

② supervision of cargo handling rules and regulations to ensure the most efficient use of the physical facilities of the ports of Apia and Asau, paying particular attention to the safety of hazardous cargoes;

③ control of the movements of shipping within the ports;

④ providing pilotage and port communication systems;

⑤ upkeep and maintenance of physical port facilities;

⑥ the levying, calculating and collecting of port dues and other charges on vessels and cargoes as per Port and Charges Regulations 1984; and

⑦ the maintenance of a ship registry and the issuance of seafarers certificates of competency, etc.

185. Fundamentally the Ministry of Transport has responsibility for almost all activities in relation to ports.

186. The organization chart of the Ministry of Transport is shown in Fig. 1.2.31.

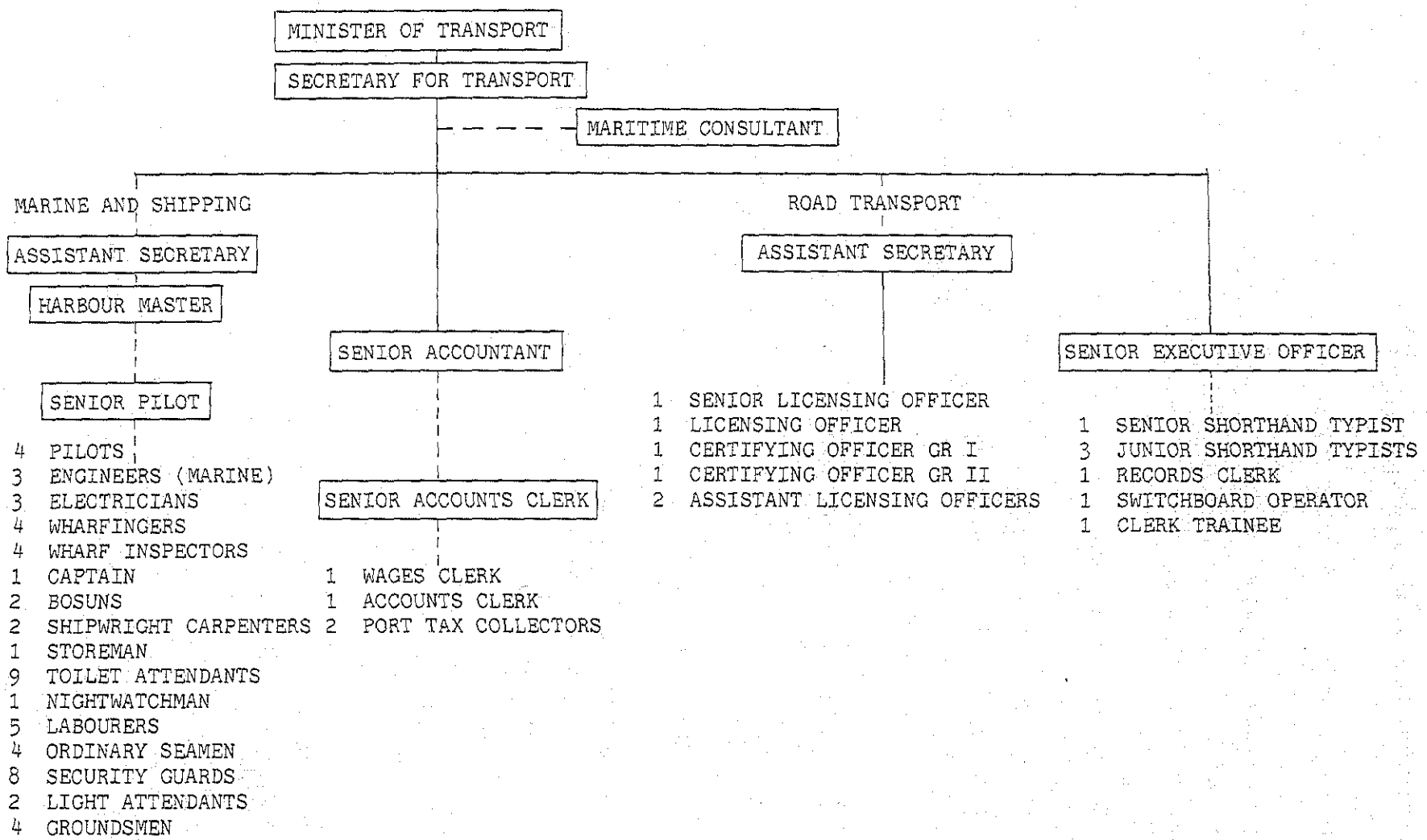


Fig. 1.2.31 Organization Chart: Ministry of Transport

(2) Other Related Organizations

187. There are other government offices and organizations concerned with the port activities, for example: Customs, Immigration, Quarantine, Copra Board, Western Samoa Shipping Corporation, etc.

188. The main functions of Customs are of course inspecting cargoes and collecting duties. Also the land area of international ports is under Customs control, so the Comptroller who is the permanent head of the Customs under the Minister has power to impose such restrictions as he thinks fit with respect to the use of international wharfs.

189. Immigration officers receive a list in duplicate of all passengers and crew members from the captain of every ship arriving in Western Samoa, and authorize their disembarking.

190. Quarantine officers who are Medical Officers grant clearance concerning infection to every ship arriving in Western Samoa.

191. Immigration and Quarantine officers are usually in their head offices which are not at the port, and when ships arrive the officers come to the port to perform their duties.

192. The Copra Board was established for the purpose of exporting and selling all stocks of copra under government control. The copra shed at the wharf is operated by this board. But at present, most copra is not exported directly, so it is not necessary for this shed to be located within the port area.

193. Western Samoa Shipping Corporation, which is wholly owned by the Central Government, undertakes not only the domestic ferry service between Salelologa and Mulifanua but also overseas ferry service to Pago Pago (American Samoa).

(3) Cargo Handling Flow and Procedure

194. The cargo handling flow at the wharf and the responsibility of each

organization are shown in Fig. 1.2.32.

195. Stevedoring work which includes cargo removal from the wharf to sheds and receiving or delivery work is provided by private companies under the shipping agents. From the shed or to the shed, shippers and consignees have to convey or arrange for the conveyance of their cargo on their own responsibility.

196. We can classify the items of port dues and other charges by payer and payee as follows:

① Payer : Shipping Agent
Payee : M.O.T.

Port Dues, Cargo Dues, Dockage, Light Dues, Pilotage, Wharf Cleaning Charge, Tug Service Charge, Storage of Empty Containers.

② Payer : Shipper/Consignee
Payee : M.O.T.

Storage Charge, Wharfage
Note) Shipper/Consignee pays this charge in cash to M.O.T.

③ Payer : Shipper/Consignee
Payee : Transport Company

Transport Charge

④ Payer : Shipping Agent
Payee : Stevedoring Company

Handling and Removal Charge

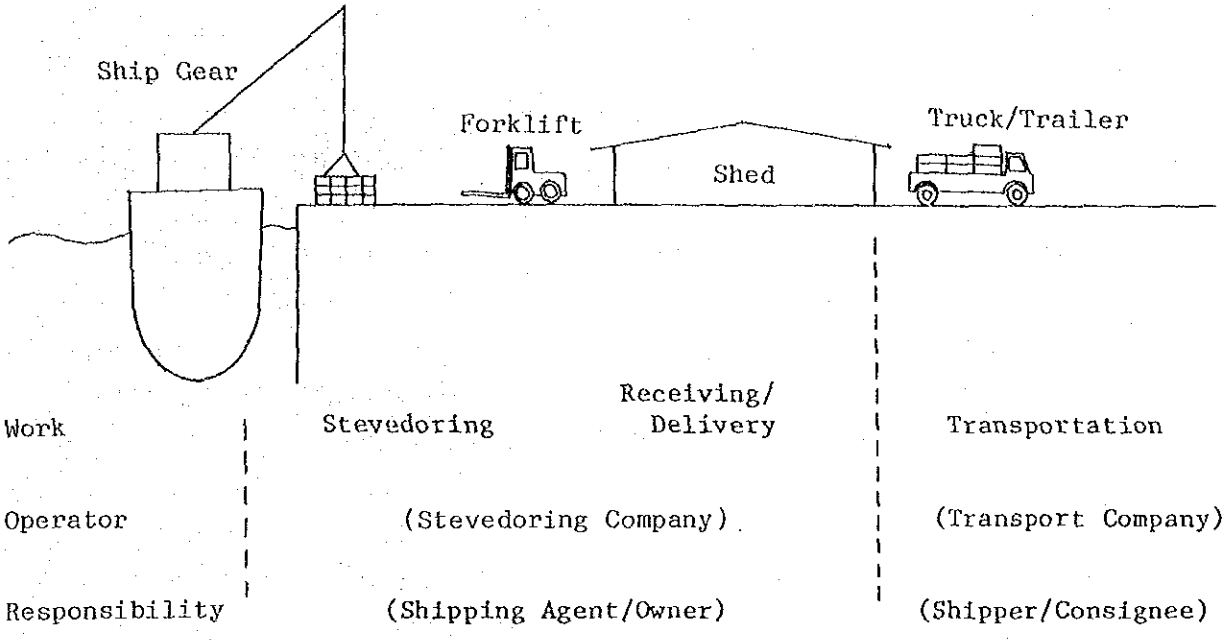


Fig. 1.2.32 Cargo Handling Flow

(4) Port Revenue

197. Port dues and other charges on vessels and cargoes as per Port Charges Regulations 1984 are collected by the Marine and Shipping Division which is a section of the Ministry of Transport.

198. Estimated Port Revenue for the last 3 years is as follows:

	1987	1986	1985
Light Dues and Pilotage	110,000 WS$	120,000 WS$	120,000 WS$
Port Dues	75,000	100,000	75,000
Wharfage	280,000	280,000	240,000
Storage of Cargoes	510,000	560,000	240,000
Storage of Containers	10,000	10,000	30,000
Berthage and Dockage	70,000	70,000	24,000
Levies	135,000	168,000	174,000
Miscellaneous	70,000	55,000	90,000
Total	1,260,000	1,363,000	993,000

(5) Port Expenditure

199. Personnel expenditures and maintenance expenses are necessary to maintain good port service and to keep port facilities in good condition.

200. Estimated Port Expenditure for the last 3 years are as follows:

	1987	1986	1985
.Salaries and Overtime	162,090 WS$	181,820 WS$	92,030 WS$
.Wages	82,965	80,100	64,572
.Beacons and Buoys	8,000	5,000	8,000
.Local Travel	2,650	2,500	2,000
.Overseas Travel	3,000	2,000	1,000
.Office Expenses	33,400	10,500	3,540
.Office Machines	500	500	260
.Office Furniture	500	500	-
.Machines nad Equipment	5,815	9,500	25,700
.Electricity and Fuel	55,000	47,000	48,500
.Operating Supplies	12,500	7,000	43,000
.Operation of Vehicles	113,000	103,000	96,000
.Building Maintenance	10,000	3,000	9,000
.Contingencies	5	5	-
.Total	489,425	452,425	384,602

Note 1) "Operation of Vehicles" is the operation cost of tugboats and pilot boats.

2) "Electricity and Fuel" is the fuel cost for each wharf, the head office and all navigational lights.

(6) Present Problems

201. The Minister of Transport must supervise all matters relating to ports and shipping, but the present organization of the ministry is not sufficient for the effective development and administration of the ports.

202. There are various problems with the present management system as follows:

① The present budget is insufficient.

② The Customs Department has statutory authority to control port activities considerably.

③ Comprehensive, long-term port development plans are not being prepared, and the maintenance of facilities and equipment is insufficient due to a lack of port engineers.

④ The present port statistics are insufficient for proper port planning and management.

(7) Intention of the Government of Western Samoa

203. The Government of Western Samoa would like to establish the Western Samoa Port Authority to provide a coordinated and integrated system of port and harbour facilities and port services and other related matters.

204. This Authority would also perform the cargo handling operations which are presently carried out by private stevedoring companies. The Government believes that if the cargo handling is performed by the Port Authority, they will be able to control cargo handling more efficiently and more safely, and the port revenue of the Government of Western Samoa will increase.

1-3 Evaluation of the Present Situation

1) Apia Port

(1) Port Facilities

i) Main Wharf

(a) Investigation of the Existing Main Wharf of Apia Port

205. The existing main wharf shown in Figs. 1.3.1 - 1.3.3 was constructed in 1966. Structurally, it is a vertical/batter H-shaped steel pile pier with concrete beam and slab. The steel piles are encased in precast concrete sleeves from the underside of the deck to sea bed. The concrete sleeves are filled with tremied concrete in order to protect the steel piles from corrosion as well as to increase the rigidity against buckling. The piles are spaced in a grid of 15' x 9' 1.5". The wharf is provided with two access bridges. The wharf is deteriorated, especially its supporting steel piles, and the live load on its concrete deck is limited.

206. To assess the serviceability of the wharf, an investigation on its structural strength has been carried out and the results are discussed in this chapter.

a) Method of the Investigation

207. The preliminary visual survey and the literature study led to the identification of the following survey items and investigation methods.

① Damage to the deck -

Overall visual survey on the superstructure:

concrete slabs, curbing, bollards, fenders

② Strength of the deck concrete -

Measurement of compressive strength by Schmidt hammer and laboratory test of a concrete core sample:

top surface of the slab

③ Subsidence of the deck -

Measurement of the elevation of the slab by level:

entire area of the slab

④ Damage to the beams -

Visual survey by boat:

all the beams supporting the concrete slab.

⑤ Damage to the piles -

Steel thickness measurement by ultrasonic thickness gauge and visual survey by divers:

entire length above sea bed for selected piles

b) Results of the Investigation

The results of the surveys are presented below.

- Damage to the Deck -

208. A careful visual observation was carried out and only a limited number of hairline cracks were observed. These small cracks are judged to have no effect on the structural strength of the wharf.

209. The curbing of the wharf is damaged at 16 locations and the fender system is also considerably damaged from berthing impact at about 5 places. No significant damage to the bollards was observed.

- Strength of the Deck Concrete -

210. The investigatin of the strength of the deck concrete was carried out by using a Schmidt hammer and at the same time by taking a core sample for a compressive strength test. The values measured by the Schmidt hammer are calibrated by the value obtained by the laboratory compressive strength test of the core sample. A considerable dispersion of the values measured by the Schmidt hammer is observed ranging from 150 - 240 kg/cm^2 in compressive strength.

- Subsidence of the Deck -

211. The elevation of the deck was surveyed for the entire area of the wharf using a level. Though a subsidence of about 10cm has taken place, at the extreme northern end of the deck, it is judged that no significant non uniform subsidence is shown since no siginificant cracks are observed on the slab surface as described before.

- Damage to the Beams -

212. The beams were checked by a visual survey by boat, and no significant damage was observed.

- Damage to the Piles -

213. Based on the results of the preliminary visual survey on the overall condition of the piles, 23 heavily damaged piles were selected for detailed underwater investigation in such a way as to enable a comparison of the present condition with the condition during the previous surveys carried out by the Royal New Zaland Navy in 1966 only five months after the completion of the wharf and by the Australian Development Assistance Bureau in 1977.
As for the thickness of the H-shaped steel pile, 16 points were measured using a ultrasonic thickness guage.
The results of the investigation on the damage of piles are summarized as follows.

① The severest condition of the damage of the concrete sleeves is that the concrete is missing below -8.0m.
② The corrosion rate is estimated as 0.08 mm/year using the thinnest datum.
③ The damage which has occurred since the completion of the construction is small in comparing the results of three surveys, in 1966, 1977 and 1987.

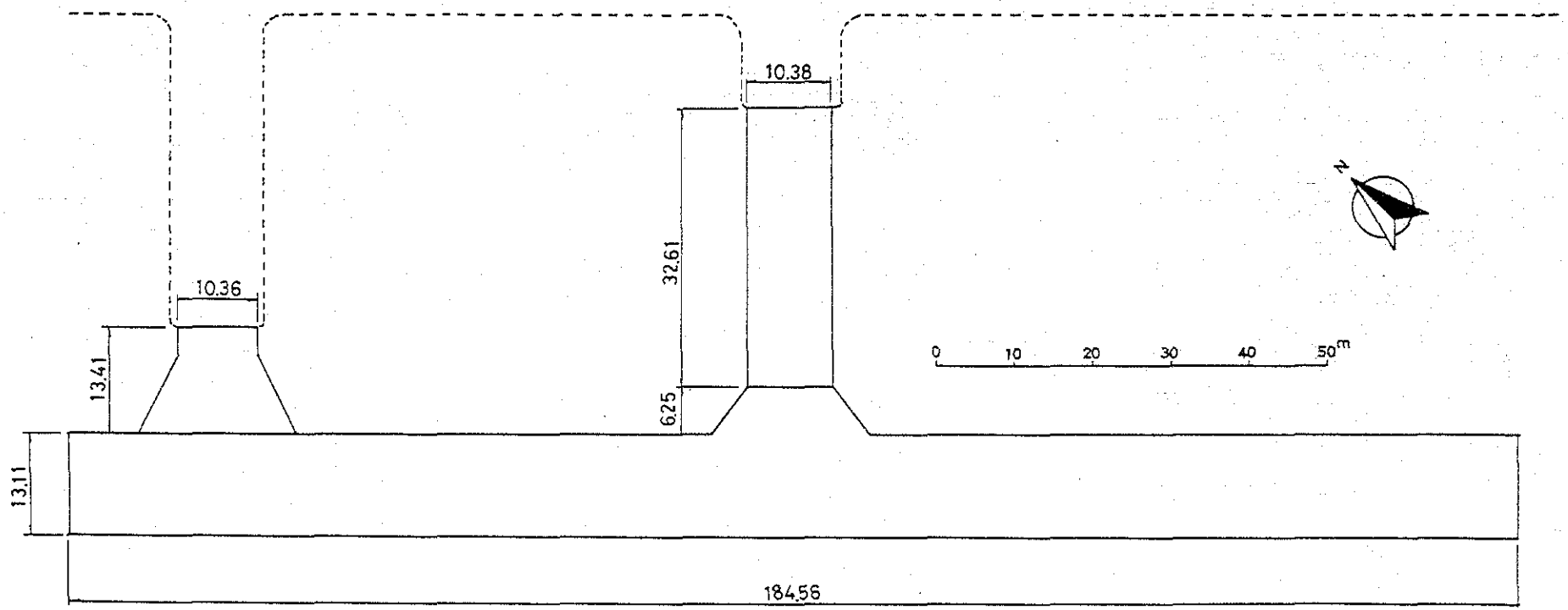


Fig. 1.3.1 Plan of Apia Wharf

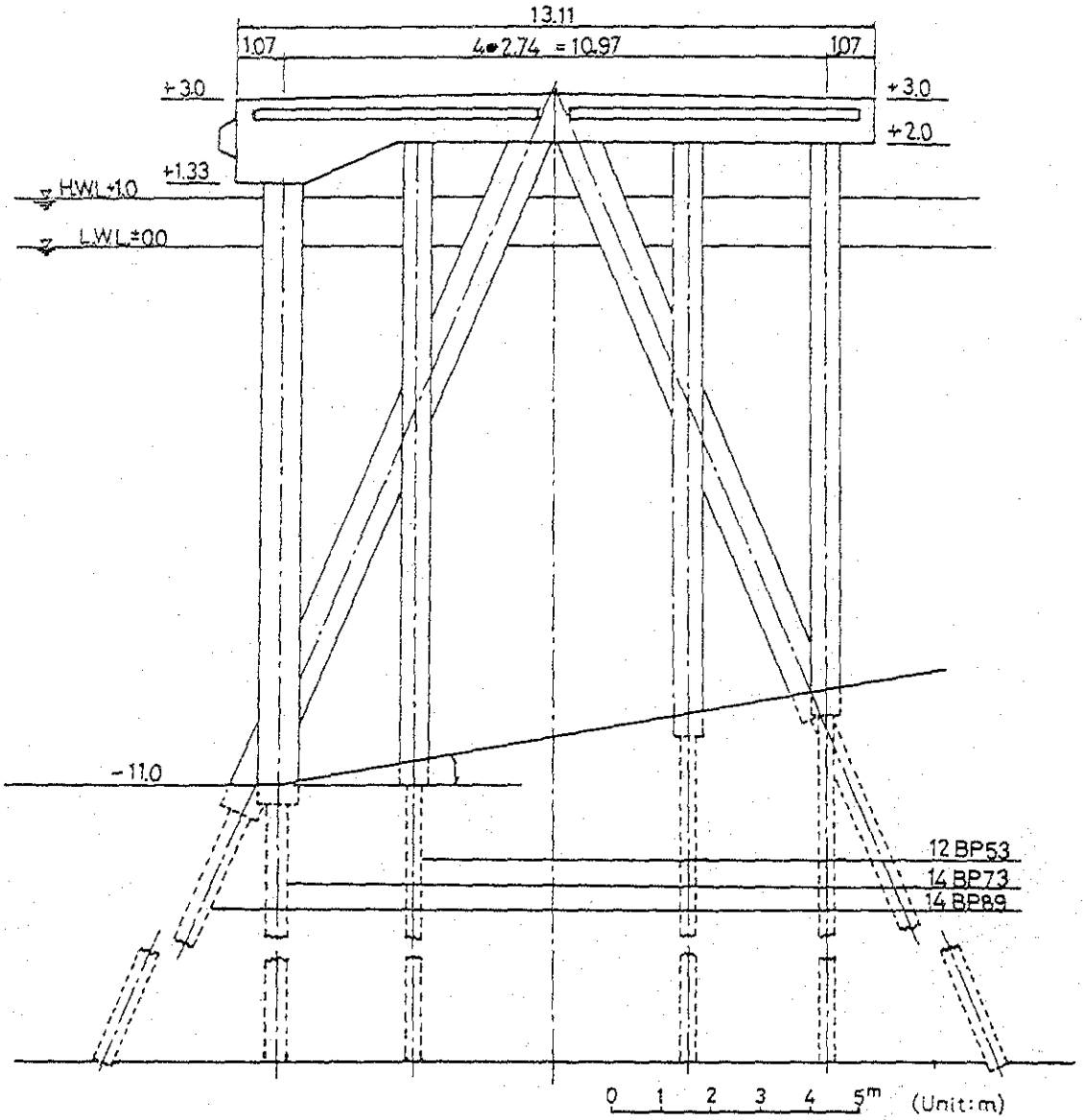


Fig. 1.3.2 Cross Section of Apia Wharf

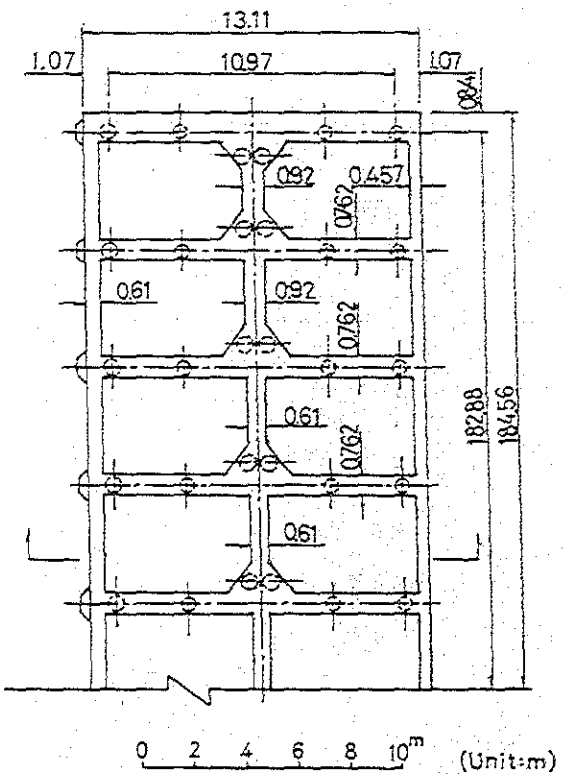


Fig. 1.3.3 Plan of Beams

(b) Structural Analysis

a) Objectives

214. The objectives of the structural analysis are to evaluate the present condition of the main wharf, to estimate the remaining life and to estimate the extended remaining life with the appropriate countermeasure.

b) Method of the Structural Analysis and Basic Assumptions

215. The schematic flow of the structural analysis of the main wharf is shown in Fig. 1.3.4.

- Assumptions for the Actual Acting Force Analysis -

Superstructure is a continuous beam.
Vertical force is distributed to the vertical piles and the coupled batter piles.
Horizontal force is distributed only to the coupled batter piles.

- Assumptions for the Allowable Force Analysis -

Piles are long columns with two sections: an H-shaped steel section and a concrete reinforced section.
Piles are supported under a fixed condition.
Allowable force of piles is equivalent to the buckling force of the column.
Allowable force of piles is considered to be decreasing with the lapse of time due to the corrosion of the H-shaped steel section.

216. The present structural strength of the wharf is evaluated by comparing the actual acting force with the allowable force. The remaining life of the piles is estimated based on the presumption that the future corrosion rate of the H-shaped steel section is equal to the present value. The extended remaining life of the piles is investigated for the case of cathodic protection.
A modeled cross section of the wharf is shown in Fig. 1.3.5.

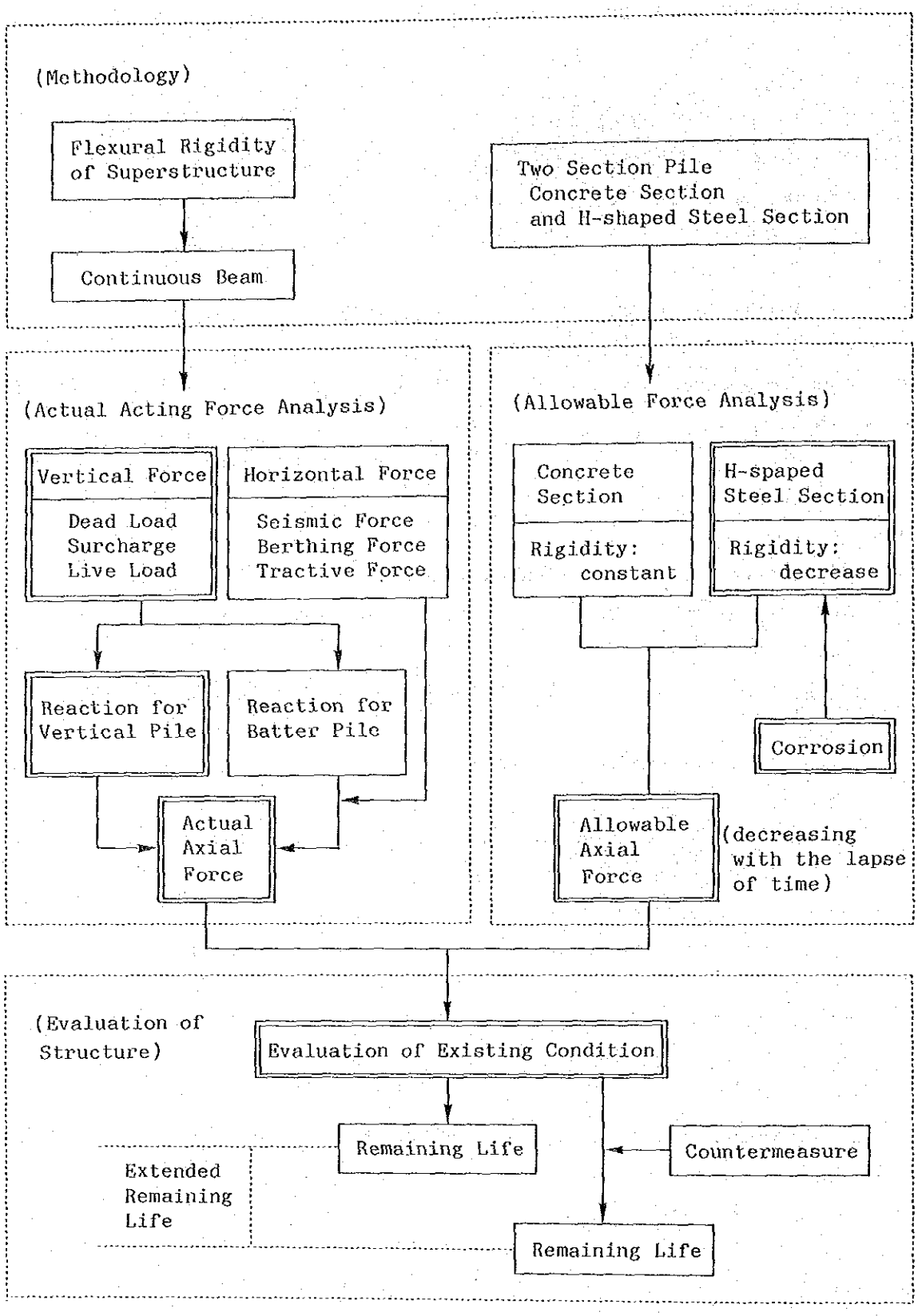


Fig. 1.3.4 Schematic Flow of the Structural Analysis of the Main Wharf

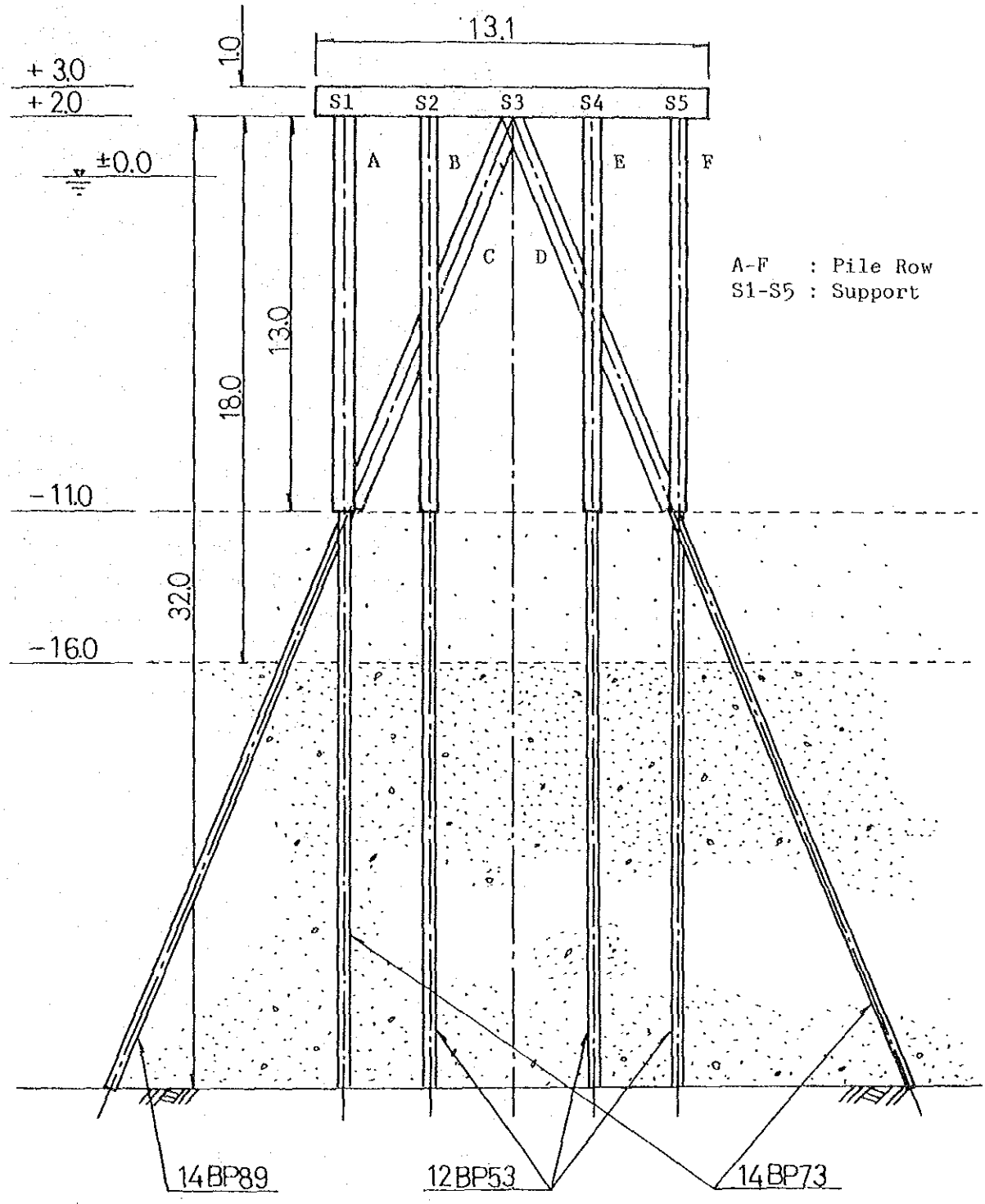


Fig. 1.3.5 Modeled Cross Section of the Wharf

c) Calculation of the Actual Acting Force

217.

- Vertical Force -

Dead Load: $Wd = 1.59\ t/m^2$

Surcharge: $Ws = 0.7\ t/m^2$

for both ordinary and earthquake conditions

Live load: $P\ell$ = 48.1 tons

forklift weight	28.1 t
container cargo	20.0 t

218.

- Horizontal Force -

Berthing Force: Pb = 80t, Pb_i = 7.5 t/coupled batter piles
ship size is 10,000 GRT.
berthing speed is 0.15 m/s.

Tractive Force: Pt = 35 t, Pt_i = 3.3t/coupled batter piles
ship size is 10,000 GRT

Seismic Force: Ps_i = 20.6 t/coupled batter piles
seismic coefficient is 0.15

219.

- Cases -

Cases of load combination to calculate the reaction of the continuous beam are as follows:

for Vertical Piles:	Dead Load and Surcharge
	Dead Load and Forklift Load
for Batter Piles:	Dead Load and Berthing Force
	Dead Load, Surcharge and Tractive Force
	Dead Load, Surcharge and Seismic Force

220.

- Results -

Results of the actual acting force calculated as the maximum reaction for each pile are shown in Table 1.3.1.

Table 1.3.1 Actual Axial Force for Each Pile

	Vertical Pile		Coupled Batter Pile	Vertical Pile	
Row	A	B	C1 D	E	F
Type of H-shaped Steel	14BP73	12BP53	14BP89 14BP73	12BP53	12BP53
Actual Axial Force (tons)	32.1	43.5	52.8	4.45	32.1

d) Calculation of the Allwable Force

221.

- Assumptions for calcualtion -

Virtual Surface: - 16m
Pile Length: 18m
H-shaped steel section 10m
Concrete reinforced section 8m
Supporting Condition: fixed ends
Corrosion Rate: Vc = 0.08 mm/y
Allowable Stress of Steel: SS41 grade

222.

- Results -

Results of the allowable force calculated as the criticla buckling load are shown in Table 1.3.2.

Table 1.3.2 Allowable Force for Each Pile

	Vertical Pile		Coupled Batter Piles	Vertical Pile	
Row	A	B	D	E	F
Type of H-shaped Steel	14BP73	12BP53	14BP73	12BP53	
Allowable Forece (tons)	144.8	90.4	217.4	90.4	91.1

223. The relation between the actual acting force and the allowable force in 1966 is shown in Fig. 1.3.6. As the corrosion rate of the H-shaped steel sections is assumed equal for all the piles, it is concluded that the piles of rows B and E are exporsed to the severest conditions.

e) Evaluation of the Structural Strengh

- Evaluation of the Existing Condition -

224. As mentioned in the previous sub-section, the piles of rows B and E are the critical ones for evaluating the strength of the entire structure. The chronological allowable forces on the piles of rows B and E are shown in Fig. 1.3.6. The ratio of the critical allowable force to the actual acting force on the vertical piles of row B at present is estimated at about 1.2.

- Remaining Life -

225. The remaining life of the piles of rows B and E with a corrosion rate of 0.08mm/y is estimated at about 8 years from 1987 to 1995.

- Extended Remaining Life -

226. If the cathodic protection is carried out, the corrosion of the H-shaped steel would be prevented. It is assumed that the cathodic protection would reduce the corrosion rate to 25% of the present value of

0.08mm/year. Therefore, a corrosion rate of 0.02mm/year is considered reasonable. The extended remaining life is thus estimated at about 15 years from 1991 to 2006 as shown in Fig. 1.3.7.

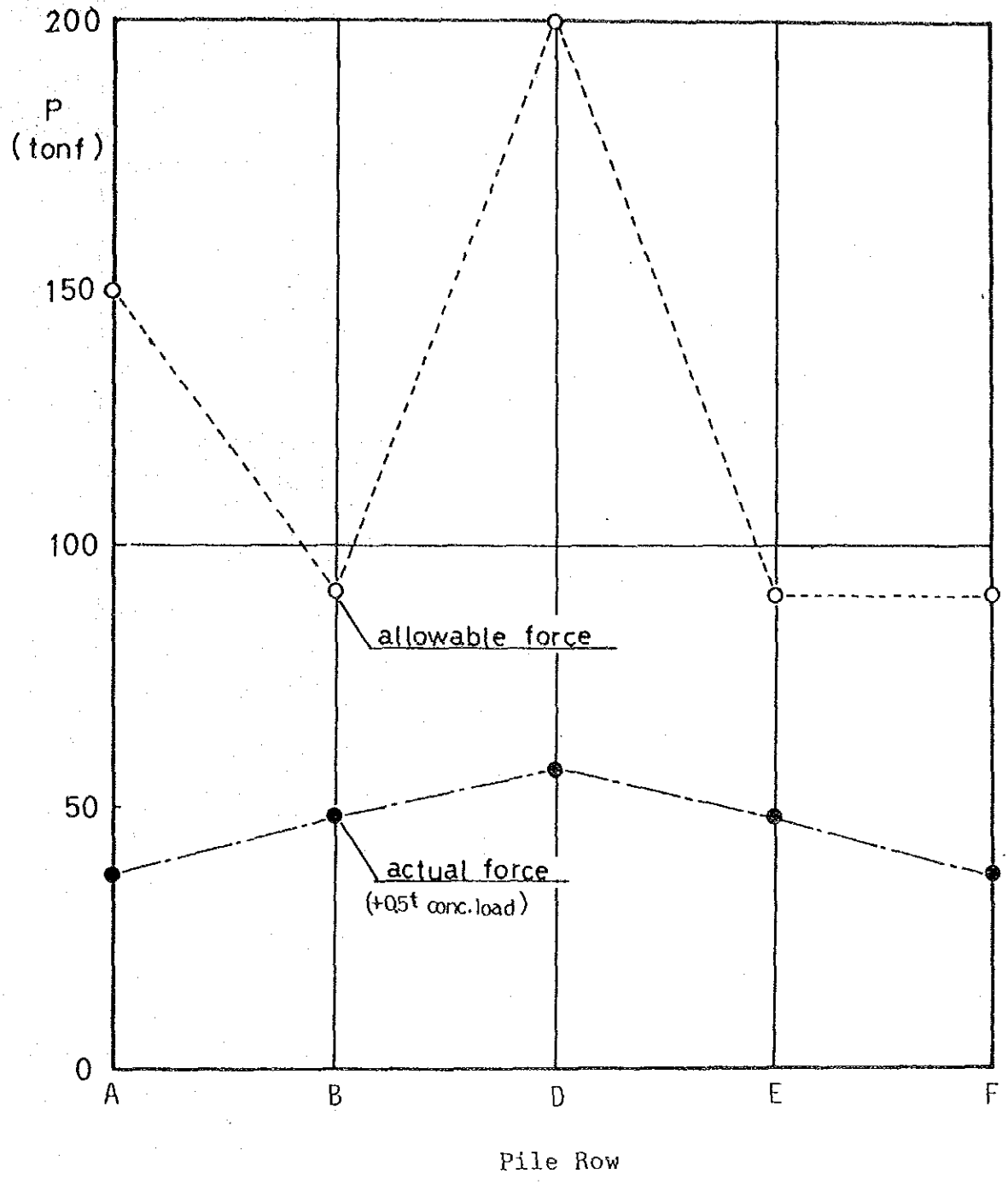


Fig. 1.3.6 Relation between the Actual Acting Force and the Allowable Force

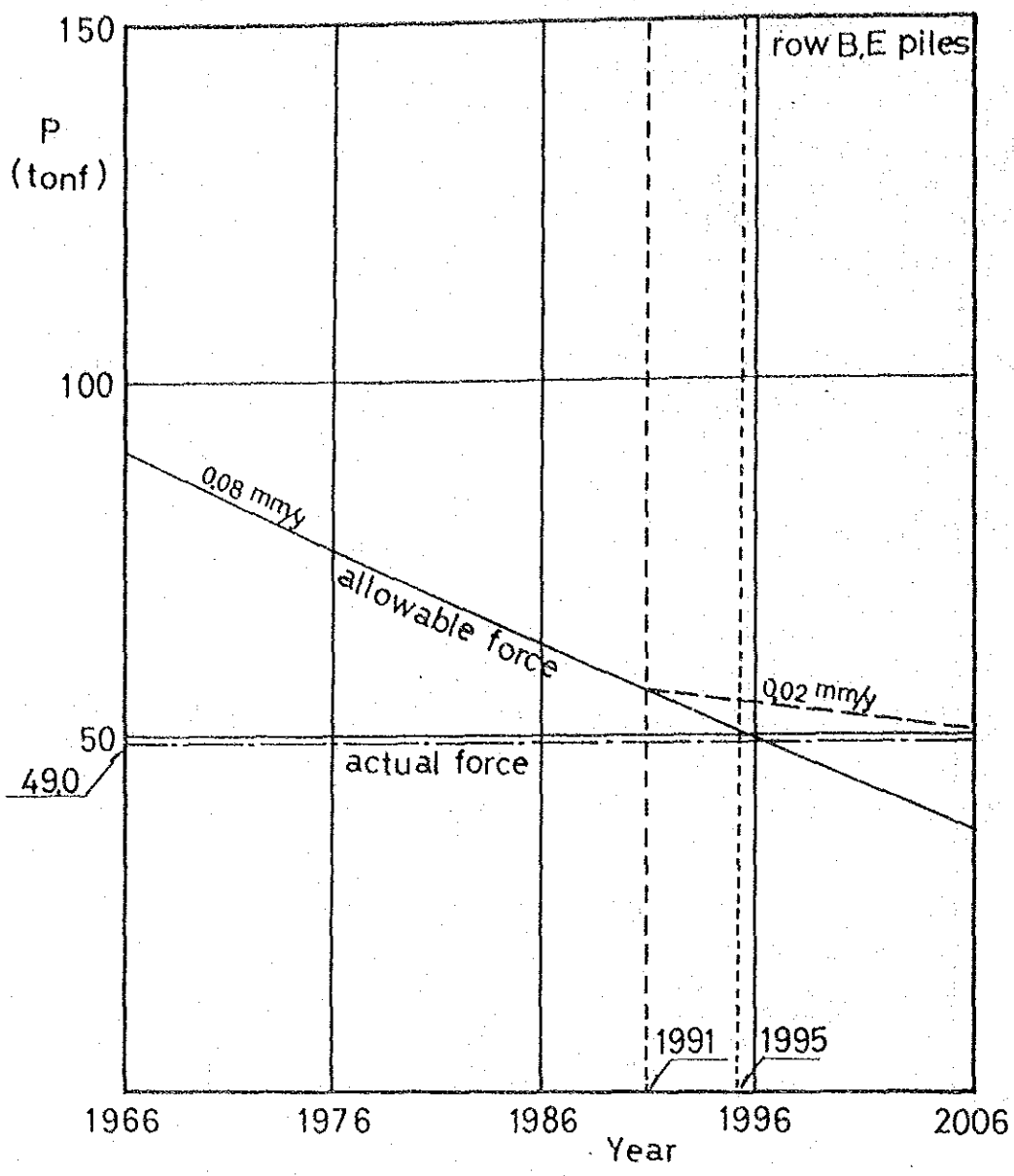


Fig. 1.3.7 Reduction of the Allowable Force

ii) Container Yard

227. At present, container storage and handling is carried out in the limited space occupied by sheds and other buildings, and yard conditions are not good because of the lack of pavement and bad drainage. So a single large open space near to the berth with pavement and good drainage is necessary.

iii) Sheds

(a) Copra Shed No.4

228. As mentioned above, copra is gathered mainly from each farm in Savaii and the western part of Upolu, carried to the port area, and then carried to the mill. Thus, it is not necessary for copra to pass through the port area. The Copra Shed should be removed out of the port area as soon as possible.

(b) Shed No.2

229. Shed No.2 was destroyed by fire in 1982. It should be pulled down to create an open space for container storage and handling. The functions of Shed No.2 may be replaced by Copra Shed No.4, as this shed will no longer be used to handle copra.

iv) Ferry Terminal

230. Bollards for the "Queen Salamasina" broke down in 1986, and since that time her propeller has been in danger during the rainy season. Also, the people around the port area are greatly disturbed by the noise in the night which occurs from the unsteady mooring. It is necessary to repair or replace the bollards immediately.

v) Tugboats

231. Both of the tugboats are out of order, and it is clear that the bigger one "the Pualele (425 bhp)" has a low capacity considering the size of the ships using the port and the occassional strong winds. So it is necessary

to bring in an additional bigger tugboat.

(2) Calumness of the Water

232. Seas and swells entering the harbour directly from the open sea may be large enough to interfere with the mooring of ships and cargo handling processes even without any resonance.

233. As results of our survey, we found that the main period of the entering waves is about 10 seconds, and the calmness of the basin in front of the berth is not good in the rainy season. The basin could be protected by some structure, such as a breakwater. At the Port of Apia, such a structure would effectively make the basin more calm.

(3) Siltation in the Basin

234. The calculated rate of sedimentation in the turning basin is approximately 9,500 m^3 per year, and the sedimentation will continue. So in the future it will become necessary to dredge and maintain the basin. The dredged sand might be used as both reclamation material and construction material.

(4) Cargo Handling

235. The apron (width 13m) and port area are connected by two approaches. The narrowness of the apron and approaches and the wharf load limits reduce handling efficiency.
The wharf load limits are as follows:

① Wharf deck
live load : 2.4 tons per square meter
truck load : 13.6 tons per wheel at 1.4m center

② Approach Structures
live load : 1.2 tons per square meter
truck load : 7.2 tons per wheel at 1.8m center

236. For the purpose of improving cargo handling efficiency, it is necessary to improve these areas. Especially, Roll-on/Roll-off type vessels cannot function properly because of the narrowness of the apron.

(5) Safety

i) Ferry Passengers and Copra Movement

237. As mentioned in 1-2, the passengers of the Pago Pago ferry make cargo handling very dangerous. The copra movement to shed No.4 also makes cargo handling dangerous. The copra shed does not necessarily have to be in the port area. It is necessary to separate the passenger area from the cargo handling area, and to remove the copra shed out of the port area as soon as possible.

ii) Leading Light and Beacon

238. According to captains who have called at Apia Port several times, there are two problems concerning the lights and beacons as follows:

① It is difficult to identify the leading lights from other lights such as town lights, etc.
② The turning basin at Apia harbour is small, so beacons should be installed on the mooring buoys.

(6) ADP Port Container Park Sub-project

239. As a port improvement project which is being carried out by another agency, the Port Container Park Subproject of the Asian Development Bank is at the appraisal stage. The proposed layout for the container handling and storage area is illustrated in Fig. 1.3.8.

240. We expect this project to be carried out as soon as possible, but the layout of the block for 378 units for stacking empty containers for shipment with no corridors between stacks is somewhat confusing. Corridors between stacks are required for efficient container handling using forklifts.

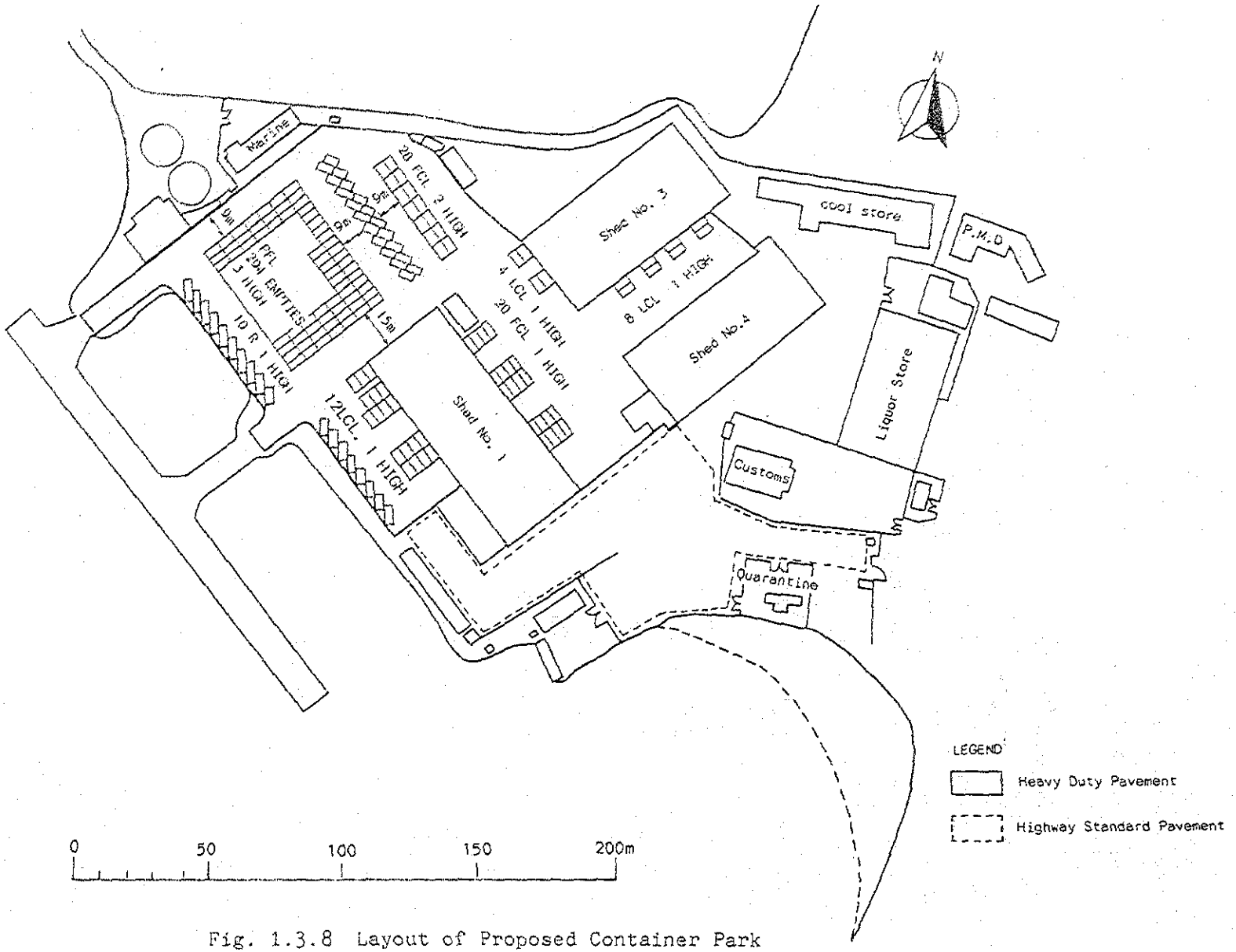


Fig. 1.3.8 Layout of Proposed Container Park

2) Asau Port

(1) Entrance Channel

241. The entering vessels have to navigate at full speed against the waves over the reef and against side winds, but the width and depth of the channel are not sufficient for the safe passage of vessels. And furthermore, because of the shortness of the breakwater the sea condition at the entrance of the channel is very rough.

242. It is necessary to dredge the channel deeper and wider, and also to extend the breakwater which would protect the channel from the waves.

(2) Leading Markers

243. The present leading markers are not accurate, so urgent resiting is necessary.

3) Mulifanua Port

(1) Beacons

244. According to the captain who is operating the ferry boat between Mulifanua and Salelologa, the beacons are not sufficient for safe navigation.

(2) Parking Lot

245. The ferry terminal has been upgraded so there are few problems except for the lack of a sufficient parking area.

4) Salelologa Port

(1) Basin

246. The captain said there is a shallow reef in front of the berth that may impede safe berthing in case of north wind.

(2) Beacons

247. As at Mulifanua Port, beacons are not sufficient for safe navigation.

(3) Parking Lot

248. There is no sufficient parking lot for the users of the ferry.

5) Aleipata Port

249. The Aleipata Port Project was started to provide ferry service to Pago Pago. But it seems to be premature for the following reasons:

① Most shippers, which carry their cargoes directly to the terminal themselves, and most passengers live around Apia or west of Apia, so Aleipata is inconvenient and costly for their use.

② Considerding the land transportation between Aleipata and Apia (at present it takes nearly 2 hours), the merit of the shortening of the total travel time is not so large.

③ Road development between Aleipata and Apia which includes upgrading wooden bridges is necessary for this plan, so the total construction cost would be very high.

④ The present port plan offers no protection for the harbour against the waves entering from the open sea to the southeast in the winter season.

CHAPTER 2
PORT CONDITIONS IN THE TARGET YEAR

Chapter 2 Port Conditions in the Target Year

2-1 Future Socio-economic Situation

1) Forecast Socio-economic Indices

(1) Population

1. The 1986 population census of Western Samoa counted 159,000 persons, an increase of just 2,600 compared with the population in 1981. The annual average growth rate from 1981 to 1986 was 0.33 per cent, or 3.3 persons per 1000 population, which means that if this growth rate continues the population would require more than 200 years to double in size. This is an exceptionally low rate of population growth for a developing country. The low annual growth rate from the 1970s is largely attributable to the continuing outflow of Samoans to overseas destinations, principally to New Zealand.

2. The population increase in the past 20 years (from 1966 to 1986) is formulated as follows

$$Y = 7{,}611\ X^{0.433} \qquad (Y = 0.999)$$

Y: Inereased population from 1966 (131,377 in 1966)

X: Year from 1966

Y: Correlation coefficient

From this relationthe population in 2005 is estimated to be 169 thousand persons.

Table 2.1.1 Population and Rate of Change, Western Samoa, 1966, 1971, 1976, 1981 & 1986

Year	National Population	Upolu	Savaii
1966	131,377	-	-
1971	146,627	106,046	40,581
1976	151,983	109,765	42,218
1981	156,349	113,199	43,150
1986	158,940	114,815	44,125
Average annual growth rate (per cent)			
1966 - 1971	2.22	-	-
1971 - 1976	0.72	0.69	0.79
1976 - 1981	0.57	0.62	0.43
1981 - 1986	0.33	0.28	0.45

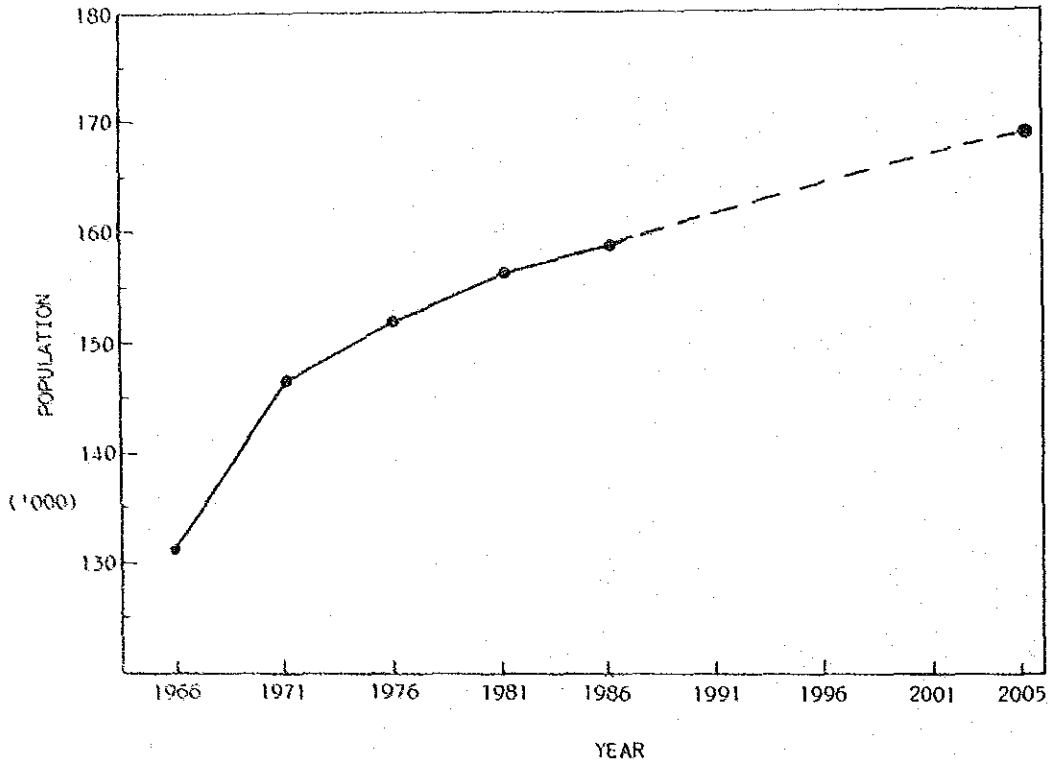


Fig. 2.1.1 Population Forecast

(2) Gross Domestic Product (GDP)

3. The past real GDP mentioned in Chapter 1-1 is as follows:

	1980	1981	1982	1983	1984	1985
Real GDP	93.7	92.7	93.2	95.2	97.1	98.6 (Mill. WS$)

The annual growth rate of GDP from 1981 to 1985 was 1.6%, but in three recent years, from 1982 to 1985, the increase rate was 1.9%.

4. Concerning GDP in the future, the only official forecast was made in the report "Western Samoa Socio-economic Situation Development Strategy and Assistance Needs" by the Government of Western Samoa (hereafter referred to as the Socio-economic Report). In the Socio-economic report, the annual growth rate of GDP is projected to be 2.5% from 1985 to 1990. But no forecast is presented for the far future (Table 2.1.2).

5. In this report, GDP in the target year (2005) is calculated considering the Socio-economic Report. But because of the uncertainty, in this report forecasts are made for two cases.

Case - 1: The annual growth rate of 2.5% will continue until 2005.

Case - 2: Considering the present situation, the annual growth rate of 2.5% seems to be a little optimistic. So in this case the rate is set at 1.9%, that is the same as the recent annual growth rate.

The GDP in 2005 is projected as follows.

Case - 1: 159 million WS$ (1980 prices)
Case - 2: 144 million WS$ (1980 prices)

6. In this report, the GDP in 2005 is adopted to be 150 million WS$ (1980 prices), considering both estimates.

Table 2.1.2 GDP forecast by the Government of Western Samoa

	1985	1986	1987	1988	1989	1990
Growth Rate (GDP, %)	2.0	2.5	2.5	2.5	2.5	2.5
GDP Deflator	8.0	7.0	6.0	6.0	6.0	6.0
Nominal GDP (Million WS$)	202.1	221.7	240.8	261.7	284.4	308.9
Real GDP (1980 Prices, Million WS$)	97.1	99.5	102.0	104.6	107.2	109.9

Source: "Western Samoa Socio-economic Situation Development Strategy and Assistance Needs" Nov. 1985.

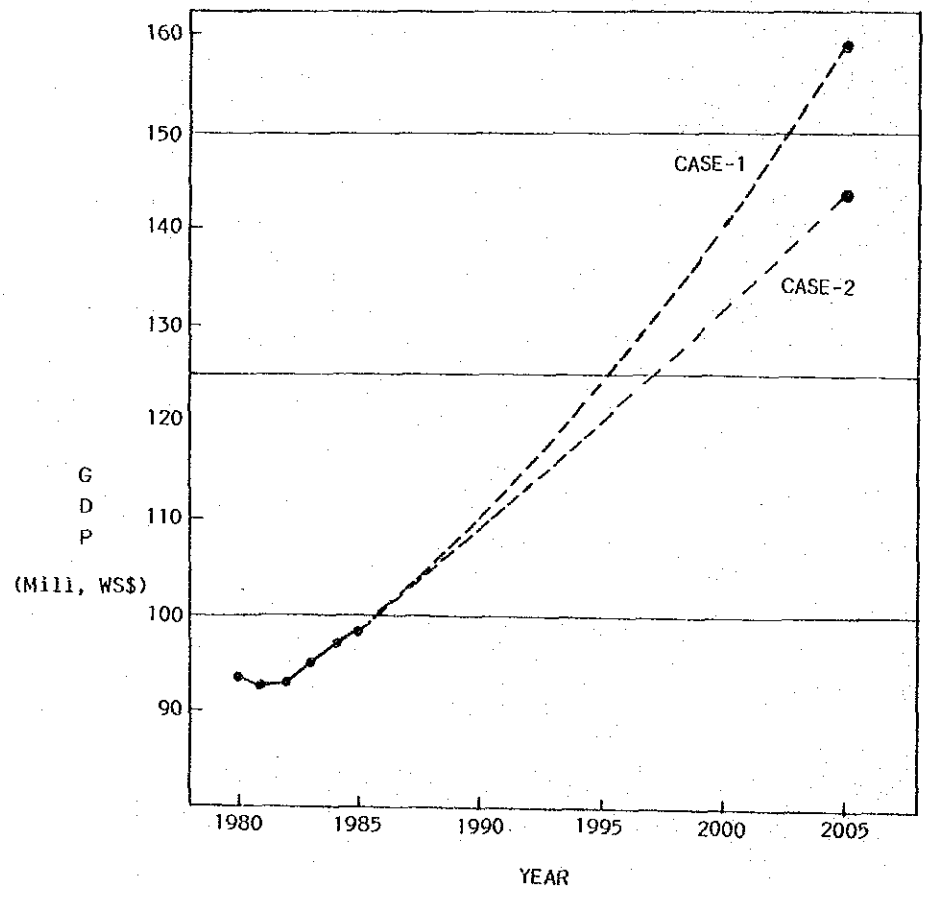


Fig. 2.1.2 GDP Forecast

(3) Investment

7. Gross investment in Western Samoa from 1979 to 1983 is shown in Table 2.1.3. The investment share in GDP was about 30 per cent in recent years.

8. In the Socio-economic Report, the future investment is also calculated and analyzed as follows: "It is projected that gross investment will gradually increase its share in GDP from an estimated 29.7 per cent in 1985 to 34.7 per cent in 1990, which is comparable with the 1979 level when the investment ratio was 33.1 per cent. The rate of growth in GDP achieved in recent years or projected for the future in this exercise implies a very high incremental capital output ratio. The explanation probably lies in the nature of government expenditure which has been considered here rather inappropriately as investment."

9. So it is difficult to forecast the investment from 1990 to 2005. Here it is projected that the share in GDP will continue at 34.7% until 2005. Then the investment in 2005 will be 52.1 million WS$ (1980 prices). That means in 2005, the investment will increase up to 1.7 times the 1985 level, when the investment was about 30 million WS$ (1980 prices).

Table 2.1.3 GDP and Investment

(1) Past Record

(In Million WS$)

	1979	1980	1981	1982	1983
Nominal GDP	103.0	108.9	130.4	154.4	183.5
Gross Investment	34.1	42.3	32.9	46.3	55.5
Private investment	(5.7)	(16.2)	(5.7)	(13.2)	(13.2)
Government	(28.4)	(26.1)	(27.2)	(33.1)	(42.3)
Share in GDP (%)	33.1	28.8	25.2	30.0	30.2

(2) Forecast

(In Million WS$)

	1985	1986	1987	1988	1989	1990
Nominal GDP	202.1	221.7	240.8	261.7	284.4	308.9
Investment	60.1	60.9	72.1	81.7	93.5	107.1
Private	14.3	15.6	17.9	20.3	22.7	25.4
(Share)	(23.8)	(25.6)	(24.9)	(24.8)	(24.3)	(23.7)
Government	45.8	45.3	54.2	61.4	70.8	81.7
(Share)	(76.2)	(74.4)	(75.1)	(75.2)	(75.7)	(76.3)
Share in GDP(%)	29.7	27.5	29.9	31.2	32.9	34.7

Source: "Western Samoa Socio-economic Situation Development Strategy and Assistance Needs"

2) Economic Development Plans in Western Samoa

(1) Western Samoa's Fifth Development Plan (1985-1987)

i) Objectives

10. The objectives guiding Western Samoa's development efforts defined in the Fifth Development Plan (DP5) are as follows:

① to increase production, particularly in the case of village agriculture, by working through existing leadership and social organizations;

② to move towards true economic independence and self-reliance;

③ to provide greater opportunities for Western Samoan citizens to participate more actively in the development process;

④ to ensure a fair distribution of the fruits of economic development and the satisfaction of basic economic, social and cultural needs; and

⑤ to protect the environment.

ii) Program Strategy

(a) Agriculture, Forestry and Fisheries

11. The development strategy in agriculture emphasizes both small-scale village-based farming and larger, more commercially oriented operations. Western Samoa Trust Estates Corporation remains a key pillar in attempts to achieve major production increases in the short term but other commercial operations will be increasingly encouraged.

12. The forestry programme is premised on the need to conserve the country's forestry resources and to protect vital water catchment areas. The programme is dominated by reforestation projects on Savaii including the replanting of areas destroyed by fire in 1983. An interesting new

element is the afforestation of areas on Upolu for wood-fuelled power generation.
The main programme elements are the restoration of FADs and the development of green mussel culture, a promising new industry.

(b) Industrial and Commercial

13. Industrial strategy seeks to foster the development of industries that make the maximum use of the country's natural resources and with high foreign exchange earning capacity. Prime examples are the recent establishment of a coconut oil mill and expansion of coconut cream processing. During DP5, a Small Industries Centre will be established to provide factory space in order to stimulate further industrial activity.

14. Tourism is set for a major expansion with the commencement of work to upgrade Faleolo Airport and to expand hotel facilities. This calls for a reorganization of the tourist bureau and an upgrading of its promotional and facilities improvement work.

15. The reorganization of the marketing cycle for major export crops is planned as a means of providing a more effective service in this vital area. An Export Development Board is to be established to be responsible for the administration of trade and marketing of Samoa's agricultural exports.

16. In road transport, emphasis is given to upgrading areas of existing roads while both major and minor sea and air transport projects will be undertaken. The major projects are the upgrading of the Mulifanua and Salelologa port facilities and the upgrading of Faleolo Airport.

17. Individually, the energy programme is the largest component in DP5, reflecting a continuing interest in promoting substitutes for imported energy. Two major projects are the wood-fuel development and the Afiamalu pump storage project.

(2) Western Samoa Socio-Economic Development Strategy and Assistance Needs.

18. The basic concept of the report is the same as under the Fifth Development Plan. The report was prepared for the Asian-Pacific Round Table Meeting Concerning Implementation of the Substantial New Program of Action for the Least Developed Countries by the Government of Western Samoa in November 1985.
In the report the future socio-economic situation is explained. As future GDP and investment are presented above, here only the main indices are summarized from the report.

i) General Review of Current External Assistance

19. Western Samoa has been dependent upon external assistance to bridge a significant portion of its revenue gap. The role of private transfers is just as significant. With public investment claiming 75 per cent of gross investment, the level of investment in the country and, in particular, the government's development expenditure are greatly influenced by the availability of external assistance in the form of grants and concessional loans.

ii) Balance of Payments

20. Consistent with the projected national income target, balance of payments projections have been prepared and are presented below. The trade balance is projected to worsen over the next five years.

(Unit: Million WS$)

	1985	1986	1987	1988	1989	1990
Exports	35.2	37.6	40.7	44.4	48.2	50.5
Imports	104.7	110.9	120.9	130.9	142.4	154.5
Trade Balance	-69.5	-73.3	-80.2	-86.5	-94.2	-104.0
Private transfers (net)	48.0	52.9	55.5	58.3	61.2	64.2
Current account	-22.1	-21.0	-22.7	-25.1	-28.2	-33.0
Official Transfers *	28.9	34.8	35.5	40.7	42.7	45.9

* Total for gross oficial capital inflow including borrowing and grants

iii) Projected Exports

21. Projected exports from 1986 to 1990 are presented in Table 2.1.6. But judging from the record until 1985 (see Table 1.1.14), the projected volumes seem to be a little too optimistic except for taro.

iv) Projected External Assistance

22. Total gross external assistance requirements have been calculated on the basis of the projected net external assistance requirements and the projected foreign debt amortization. In addition, provisions have been made for IMF repurchases and a building-up of foreign reserves required to finance the increased import requirements. The results are shown in Table 2.1.7.

23. The relatively high ratio of gross external assistance requirements to net external assistance requirements reflects the high foreign debt amortization obligations. Gross external assistance requirements are projected to increase from an estimated 13.1 million US$ in 1985 to 18.0 million US$ in 1990. This represents an average annual increase of 3.5 per cent.

v) Budgetary Position and External Assistance Needs

24. The level of government development expenditure is projected to grow at a rate of about 6.2 per cent per annum in real terms with a slight decline in 1986 because of the recent completion of some large projects. The tables show how the deficit resulting from the projected levels of current and development expenditure and current revenue is expected to be financed. One of the main assumptions underlying the projections is that current revenue will grow at the same rate as GDP: current expenditure is projected to remain at a constant level in real terms during the 1986 to 1990 period. The resulting deficit is projected to be financed almost entirely by foreign assistance on a net basis, including IMF repurchases. This is necessitated by the very heavy foreign debt amortization payments during the next five years.

Table 2.1.4 Sectoral Breakdown DP5 Development Expenditure
(in thousands of WS$)

	1985	1986	1987	Total Costs	Percentage of Total DP5 Programme	Aid Component	Aid Component as a percentage of Sectoral Programme
Total DP5 Programme Costs	41,257	50,076	55,646	146,979	100	114,229	77.7
Agriculture, Forestry and Fisheries	8,418	10,415	10,353	29,186	19.9	20,854	71.5
Infrastructure	22,237	28,181	34,201	84,619	57.5	73,317	86.6
Social Services	1,598	1,685	1,668	4,951	3.4	4,070	82.2
Industry and Commerce	8,681	9,751	9,079	27,511	18.7	15,665	56.9
Public Administration	323	44	345	712	0.5	323	45.4

Table 2.1.5 Flow of Official Assistance 1979 to 1984

(In Million WS$)

	1979	1980	1981	1982	1983	1984
Grants	17.6	14.9	15.7	14.3	23.8	21.5
Project	16.3	12.6	12.1	13.6	21.8	19.8
Other	1.3	0.3	2.8	0.7	2.0	1.7
Loans (net)	8.0	7.3	6.2	4.0	5.9	10.5
Total	25.6	22.2	21.9	18.3	29.7	32.0
Total Assistance as % of GPD	28.4	21.6	20.1	14.0	19.2	17.4
Total Assistance as % of Resource Gap	-	57.2	47.5	43.3	58.9	58.0
Total Assistance as % of Development Budget	82.3	83.8	81.4	68.8	78.4	72.4
Grants as % of Total Assistance	68.8	67.1	71.7	78.1	80.1	67.2

Table 2.1.6 Projected Exports 1986 to 1990

	1986	1987	1988	1989	1990
Coconut oil - volume (mt)	13,500	14,000	14,500	15,000	15,000
Copra meal - volume (mt)	6,900	7,200	7,425	7,680	7,680
Cocoa - volume (lt)	850	900	900	950	950
Taro - volume (cases)	160,000	170,000	175,000	180,000	185,000
Bananas - volume (ctns)	20,000	25,000	25,000	30,000	30,000
Timber - volume ('000 bd ft)	2,000	2,100	2,100	2,100	2,100
Veneer - volume (M^3)	1,500	1,600	1,700	1,750	1,850

Table 2.1.7 Projected External Assistance Requirement, 1985 to 1990

(in million WS$)

	1985*	1986	1987	1988	1989	1990
Projected Resource Gap	64.9	68.1	74.2	79.7	86.6	94.6
Private Transfers	48.0	52.9	55.5	58.3	61.2	64.2
Interest payments (External)	-5.2	-5.6	-3.9	-3.7	-3.2	-2.6
(Out of which Government)	(-3.6	-3.6	-3.3	-3.1	-2.6	-2.1)
Net External Assistance Requirement	22.1	20.8	22.6	25.1	28.5	33.0
Loan Repayments	9.3	9.4	5.7	6.3	6.8	7.3
IMF (Re) purchases	-0.6	3.1	5.2	6.8	4.9	2.6
Foreign Exchange Build-up	-1.9	1.5	2.0	2.5	2.5	3.0
Total Gross External Assistance Requirements	28.9	34.8	35.5	40.7	42.7	45.9
Total in Million US$	13.1	15.2	15.0	16.7	17.1	18.0

Note: * Tentative estimate

(3) Industrial Free Zone

25. To encourage the development of export enterprises in Western Samoa, "The Industrial Free Zone Act" was enacted in 1974.

26. However, since this law was enacted, no major decisions have been carried through except as noted below.

27. For the purpose of establishing an Industrial Free Zone, 100 acres of land was allocated at Vaitele which is to be the center of the industrial zone in Western Samoa (Table 2.1.8). Western Samoa has formally joined the Multilateral Investment Guarantee Agency - (MIGA World Bank) with a view to attract foreign investors to Western Samoa (Fig. 2.1.3).

28. Concerning the promotion of enterprise there is another act, the "Western Samoa Enterprises Incentives 1984 and Amendment." The Act is to encourage the establishment and expansion of enterprises in Western Samoa by making provisions for the grant of certain relief from excise duty and income tax to persons engaging in approved enterprises.

29. Beside these two acts, a study about a small industry center is being carried out. This is one of the studies financed by the Asian Development Bank which include the Container Park Study. The small industry center will also be built at Vaitele. Most products produced in the center will be domestically consumed.

(4) Tourism Master Plan

30. The Government of Western Samoa developed the Tourism Master Plan in 1984. In the Master Plan the market target is anticipated as follows:

31. "In this plan, the number of tourist arrivals could be increased from 26,000 arrivals in 1983 to 52,000 in 1988 and 115,000 in 1993. This increase represents annual growth rates of 10-20% during the ten-year period. After 1993, growth rates could stabilize at about 10% annually which would still result in substantial expansion of tourism. The present average length of stay of tourists of 3.5-4.0 days can be lengthened to

Table 2.1.8 Main Industrial Facilities in Western Samoa

Industry	Ownership	%	Location	Area (Acres)	No. of Labourers	Capacity Per Annum	Exports (1986) Actual Production Kind	Volume	Trans.	Destination	Imports (1986) Materials & Fuel Kind	Volume	Trans	Origin
Beer	Cov't of W. Samoa	50	Vaitele	10	80	Beer 6 million litres S/drinks 2.5 Million litres	Beer s/ drinks	300,000 litres	Ship	Pachific Island Hawaii	Raw Material	SValue 2.5m	Ship	Europe Australia N.Z.
	Consortium of German Firms	26.5												
	Others	23.5												
Cigarettes	Rothmans NZ Company Ltd.	60	Vaitele	3	55	Cigarettes 1.6m Packet Edition 2.9m	Rothmans Consulate Peter Styvesant Pocket Edition	144,283 ctns	Air Ship	Pacific Island	"	2.4m CIF excluded	Ship	N.Z.
	Govt. of W. Samoa	40												
Matches	W.S Match Company Ltd.	31.3	Vaitele	2.5	32	Matches 3500 ctns					"	25,000	Ship	N.Z. Australia
	Development Bank	22.7												
	Wilkinson Sword Group	46												
Coconut Oil AND Copra Meal	Samoa Coconut Products Limited		Vaitele	7.5	60	25000 tons	Coconut Oil Copra Cake	19750M.T	Ship	Europe N.Z. U.S.A. Aust.	Spare Parts		Air	Japan Germany U.S.A.
	Verissimo and Associates	25												
	Govt. of W. Samoa including WSTEC and Copra Board	75												
Timber	New Samoa Industry Limited					1,440,000B.F.	Timber	192,000 B.F.	Ship	American Samoa	Saw Mill Spare Parts	15,000 p.a.	Ship	Japan
	SFP -	50	Vaitele	5	35									
	Mr. Tangichui- (Japan)	50												
Veneer	Samoa Veneer Products Limited													
	Govt. of W. Samoa	85	Asau				Plywood Veneer							
	Ralph Symonds Ltd.	15	Savaii											

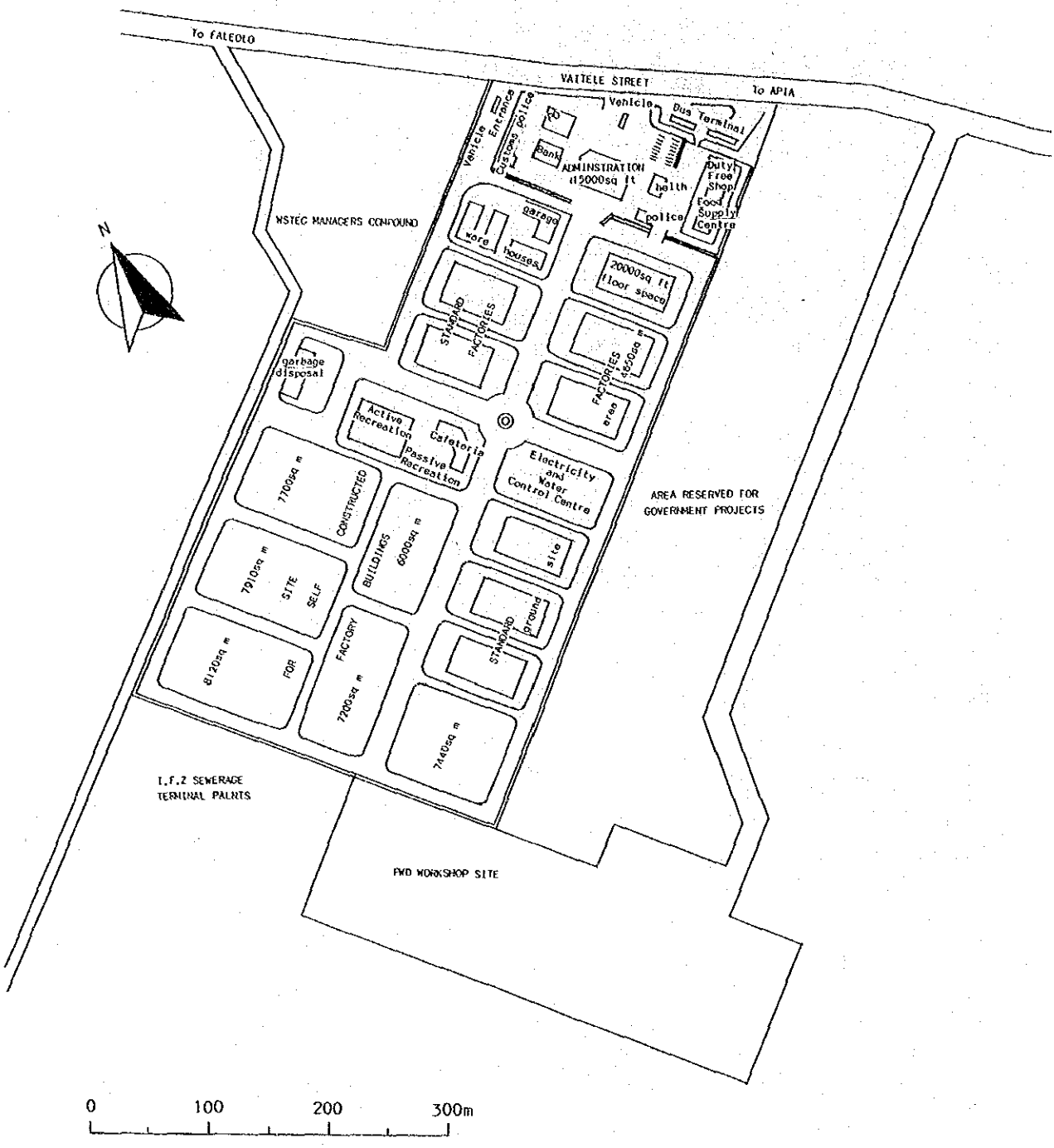


Fig. 2.1.3 Image Plan of Western Samoa Industrial Free Zone

about 6.0 days in 1993 generating an increase from 74,000 tourist rooms nights in 1983 to 200,000 room nights in 1988 and 585,000 room nights in 1993. These targets represent about four times growth in tourist arrivals and eight times increase in room nights" (See Table 2.1.9).

32. The tourist arrivals of the past four years are presented below:

	1983	1984	1985	1986	Annual Increase
Total	36,717	40,430	43,919	49,710	10.6%
American Samoa	14,209	15,529	17,399	18,371	8.9%
(Share)	38.7	38.4	39.6	37.0	
Others	22,508	24,901	26,520	31,339	11.7%
(Share)	61.3	61.6	60.4	63.0	

Judging from the actual records the projected target in 1988 seems to be impossible to achieve. And the same can be said of the 1993 target.

33. The growth rate projection should be based on the past records, because in Western Samoa there is no special plan to promote tourism. Using the growth rate of 11.7% per annum, the number of vistors excluding American Samoans will reach 256,000 in 2005.

34. This is also optimum, because if the average tourist stay is 6 days, there will be more than 4,200 tourists per day. And considering the peak ratio, this number will go up to 5,000 - 6,000.

35. If the tourist arrivals increase, the need for imported goods will also increase, as explained in the Tourism Master Plan.

Table 2.1.9 Market Targets of Tourist Arrivals and Tourist Room Nights

Year	Tourist Arrivals	% Annual Increase	% Using Accomm.	T.A's in Accomm.	Average Length of Stay	Tourist Room Nights
1983	26,000*		75	19,500	3.8	74,100
1984	28,600	10	75	21,100	3.9	82,500
1985	32,000	12	75	24,000	4.0	96,100
1986	36,800	15	75	27,600	4.3	118.700
1987	43,100	17	75	32,300	4.5	145,400
1988	51,700	20	80	41,400	4.8	198,700
1989	62,000	20	80	49,600	5.0	248,000
1990	74,400	20	80	59,500	5.3	315,500
1991	87,000	17	80	69,600	5.5	382,800
1992	100,100	15	80	80,100	5.8	464,500
1993	115,100	15	85	97,800	6.0	586,800

* Excluding American Samoans but including ethnic Samoans from other countries. The 1983 tourist arrival figure is derived from extrapolation of the recorded arrival data for the first part of 1983, the hotel occupancy rates and the hotel tourist tax receipts.

Source: Tourism Master Plan

(5) Other Development Plans

i) Forestry

36. Table 2.1.10 tabulates the expected total volume of what the forestry officials consider forest produce of high export potential. This table covers the entire reforestation programme in Savaii from the beginning.

37. The output of high quality wood beginning in 2018 is expected to increase dramatically as the proportion of 1987 planting devoted to higher quality species increased significantly, possibly by as much as 50%, in both Western Savaii and Eastern Savaii.

38. So in the target year (2005), exports of high quality wood are expected to reach approximately 10,000 m^3 per annum. Besides that, some

Table 2.1.10 Potential for Export from Reforestation Program

(Northwestern Savii) Asau

Year	Area/(ha) Planted	SPP	Rotation	m^3/ha	Total Volume (m^3)	Year of Harvest
1970	4	Mix				
1971	16	Mix				
1972	18	Teak	30	160	2,880	2003
1973	19	Mah	30	250	4,750	2004
1974	52	Mah	30	250	13,000	2005
	84	Teak	30	160	13,440	2005
1975	108	Mah	30	250	3,240	2006
	16	Mah	30	250	480	2006
1976	38	Mah	30	250	9,500	2007
	19	Teak	30	160	3,040	2007
1977	42	Mah	30	250	10,500	2008
1982	17	Mah	30	250	4,250	2013
1983	60	Mah	30	250	15,000	2014
1984	61	Mah	30	250	15,250	2015
1985	60	Mah	30	250	15,000	2016
to						
1986	44	Mah	30	250	11,000	2017

(Southeastern Savaii) Salelologa Based Project

Year	Area/(ha)	SPP	Rotation	m^3/ha	Total Volume (m^3)	Year of Harvest
1985	12	Mah	30	250	3,000	2016

volume of natural woods and chips is also likely be exported. But considering the wood'quality, land ownership, domestic demand and the uncertainty of the chipping operation, the additional volume will probably be quite small. Accordidng to the Agriculture Department, this volume will not exceed 10,000 m^3.

ii) Agriculture

39. The main export commodities in Westren Samoa are agricultural products and processed agricultural goods. So the future development of the agricultural sector is very important for the port activities. At present, official projections are presented only in the Socio-economic Development Strategy and Assistance Needs Report as noted above.

40. In our study, the approximate annual volume to be exported in the next five and ten years is based on Agriculture Department projections. The annual export volume of the main agricultural products is projected as follows:

	Next 5 years	Next 10 years
Coconut Oil	18,000 tons	21,000 tons
Copra Meal	9,000	10,500
Cocoa	3,000	4-5,000
Taro	8,000	8,000
Other Fresh Produce	3,500	6,500

41. Additionally, some fruits such as avocado, mango, lemon and papaya are going on to be exported. But the future export volume is unclear.

iii) Energy Supply

42. The electric energy supply presently relies on diesel and hydro energy generation. The diesel generation in 1985 was 11.5 Gwh, 32% of the total, and consumed 3,500 kilolitres of fuel.

43. The Electric Power Corporation is planning to construct some additional hydro energy generating stations. In 2000 the total energy generation will be up to 87.7 Gwh, 2.4 times the present generation. Diesel generation will be decreased to 5% of the total, or 4.4 Gwh. Then the consumption of the fuel will decrease to 1,300 kilolitres, or 1,100 tons.

iv) Summary

44. Concerning the relation between port activities and development plans, we estimate that only the development plans presented i) to iii) above give reliable information concerning future demand.

2-2 Forecast of International Maritime Trade

1) Containerisation

(1) The Present Share of Containerisation

45. The containerisation rate in the liner trade differs from route to route. The cargo mix accounts for the differences. Here are some examples:

- North Atlantic 90%
- Europe/Far East 80%
- Europe/West Coast of Africa 30%

The distribution of the present containerized trade among the various trade routes and by ship type has been surveyed by the University of Liverpool Marine Transport Centre.

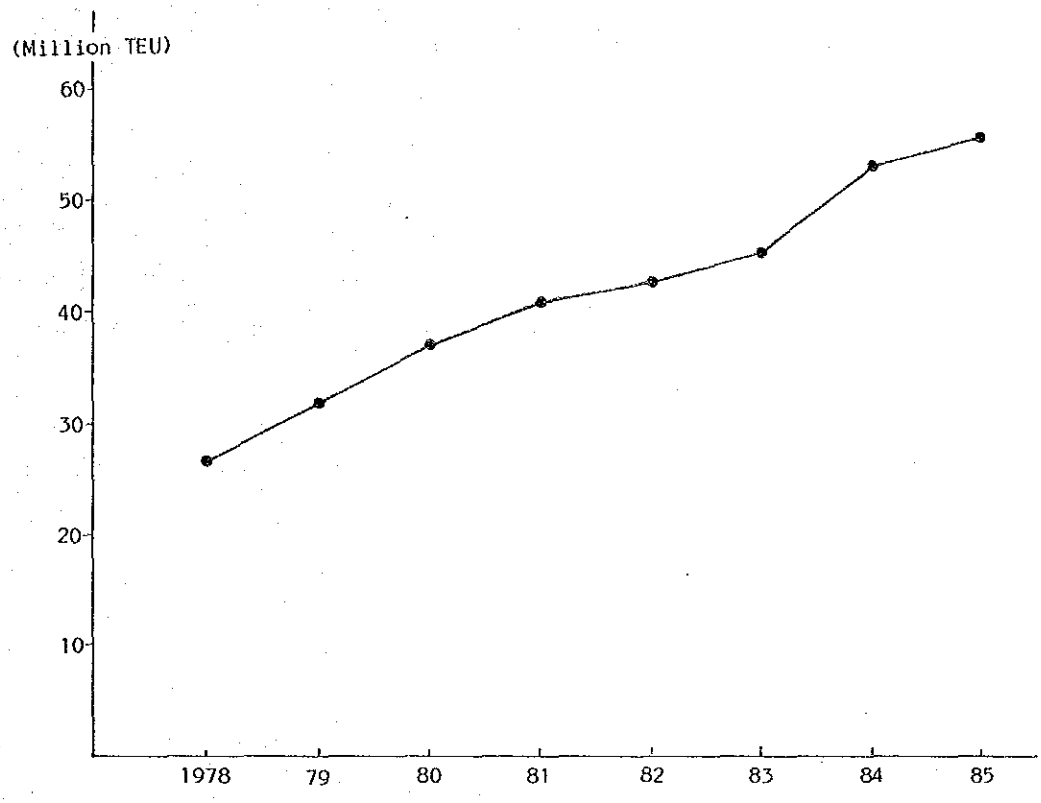
46. The following tables set out these distributions:

① Distribution of deep sea container trade according to ship type:

Fully cellular	60%
Roll-on/Roll-off	22%
Semi-container	18%

② Distribution according to route:

North America/Far East	20%
Europe/North America	18%
Europe/Far East	9%
Europe/Middle East	8%
North America/Carribean, Hawaii	7%
Rest of the world	38%



Source: Containerization Inernational Yearbook

Fig. 2.2.1 Container Cargo in the World

(2) Future Evolution

47. Container cargoes will increase, because tha pysical volume and the value of semi-finished and finished goods will rise.

(3) Ship Size

48. As for container vessels on the main routes such as North Atlantic, Europe/Far East, and North America/Far East, the ship size is getting larger towards the Panamax size, and on these routes most of the vessels can carry more than 2500 TEU. In this case, berths require the following main features:

length	:	at least 300m
backup area	:	at least 300m
depth of berth	:	at least 12m
cranes	:	at least 2 gantry cranes per berth

2) Regional (South Pacific) Maritime Transport

(1) Past Trends

49. Agricultural exports from the South Pacific Region in the past years have shown in aggregate terms a rapid rise. A division of this phenomena however reveals that most of this growth was accounted for by Papua New Cuinea, Fiji and the Solomon Islands.

50. As regards imports, the late 1970's marked a period of steady growth in import tonnages. But since 1980, the world recession has resulted in much slower growth.

(2) Trade Forecast

51. A trade forecast is presented in the report Shipping Study, Analysis Report, International Trade by Touche Ross & Co., Management Consultants. According to the report in this region the import tonnage will tend to outstrip the export tonnage. And this tendency will be more rapid in the case of higher growth (Table 2.2.1).

(3) Shipping Services

52. It is likely that the pattern of shipping services will follow changes in trade. On this basis it is expected that shipping services to and from Southeast Asia and Japan will become more important. This trend can be seen in the trade of Western Samoa.

53. Container cargo will grow substantially, and logically one would expect a growing need for container facilities.

54. The South Pacific is, and will remain, a region of marginal significance in terms of world trade. Thus, the nature and development of its maritime trade can be expected to have little influence on international shipping trends, either in terms of ship design or in terms of service levels compared with those provided on the world's major routes. In this region, little difference is expected in the field of maritime transport.

55. And considering that at present there is no quayside container equipment (gantry cranes), the ship types which will serve this region will remain the same as at present. The main ship types will continue to be Roll-on/Roll-off, self-suspended container and general cargo vessels.

Table 2.2.1 Summary of Trade Forecasts: South Pacific Region
(000 tons)

	1982 (actual)	1985	1990	1995
A. Base Forecast				
(Exports)				
Agricultural Products	1,980	2,150	2,440	2,700
Mineral Products	3,951	3,680	4,055	4,420
Total	5,931	5,830	6,495	7,120
(Imports)				
General Cargo	3,049	3,490	4,380	5,490
Bulk Cargo	1,827	2,080	2,605	3,247
Total	4,876	5,570	6,985	8,737
B. High Forecast				
(Exports)				
Agricultural Products	1,980	2,600	3,030	3,510
Mineral Products	3,951	4,465	4,970	5,370
Total	5,931	7,065	8,000	8,880
(Imports)				
General Cargo	3,049	3,800	5,490	7,930
Bulk Cargo	1,827	2,268	3,264	4,692
Total	4,876	6,068	8,754	12,622

Source: "Shipping Study: Analysis Report: International Trade" by Touche Ross & Co., Management Consultants

2-3 Cargo Volume Forecast

1) Forecast Method

56. Two methods are used to forecast general cargo volume, the macro method and the micro method. In the macro forecast, the correlation betweeen cargo volume and GDP are used to forecast the total cargo volume as a group.

57. On the other hand, in the micro forecast, the volume of each of the main commodity groups in the target year is forecast considering development plans and socio-economic data such as population, vehicles, and so on.

58. After the calculation by the two methods, the cargo forecast is then fixed. Fig. 2.3.1 presents a flow chart of the process.

2) Macro Forecast

59. As explained in Chapter 2-1, the GDP of Western Samoa in expected to increase up to 150 million WS$ in 2005. For the correlation between GDP and cargo volume, only the volume of general cargoes handled at the ports of Apia and Asau is considered because of the clearness of the data. Thus, the macro forecast does not include tanker cargoes. The GDP covers the past 6 years (1981-1986).

The equation is as follows;

$V = AX + B$ V: cargo volume
X: GDP (in million WS$)
A,B: constants

$V = 3823\ X - 235{,}821 \quad (r = 0.807)$

The correlation coefficient is not so high, but it is based on the only available data. Based on the equation in 2005, the volume of general cargo will be 338,000 tons, approximately 2.3 times the present volume. This means an annual increase rate of 4.5%.

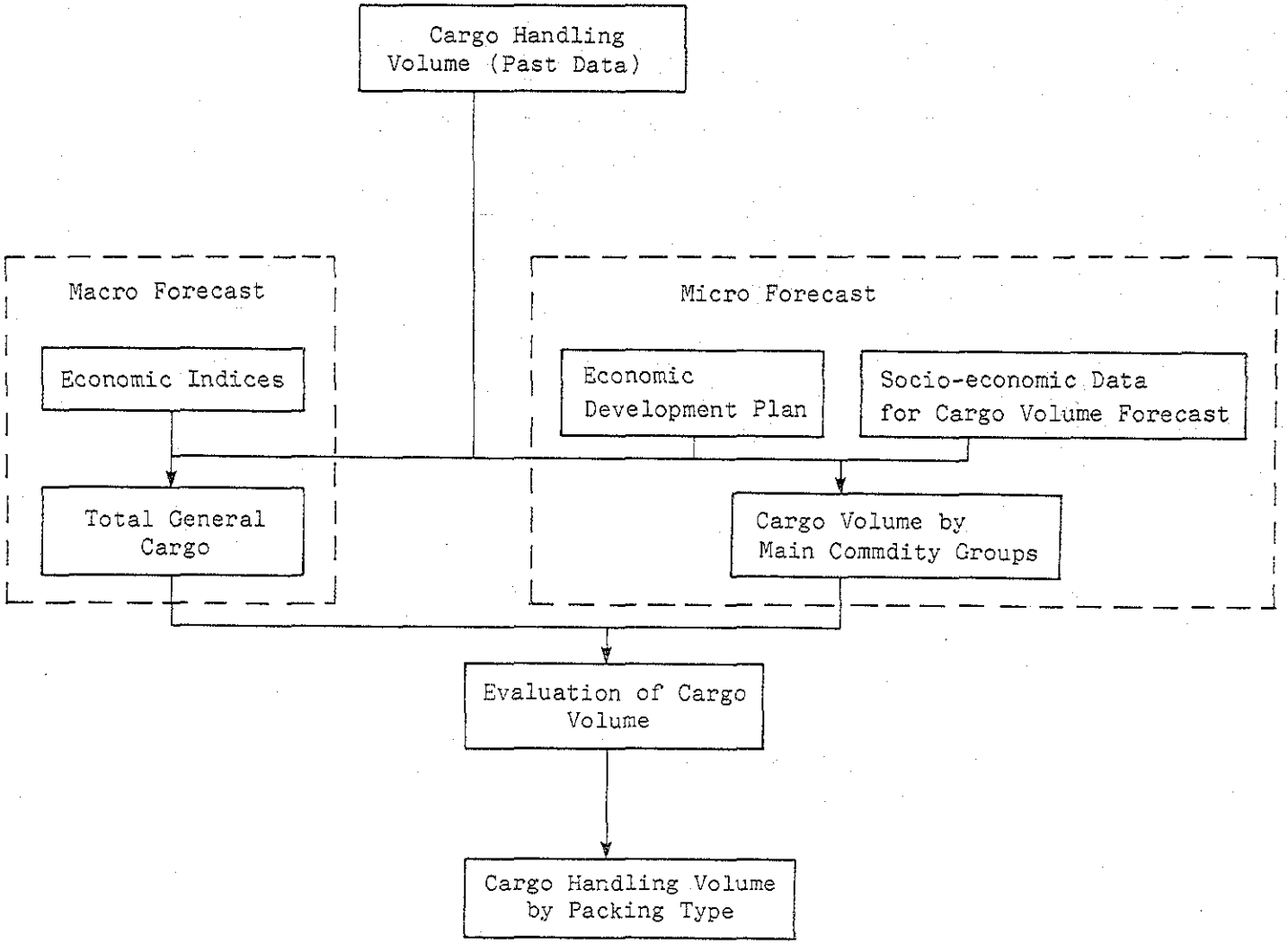


Fig. 2.3.1 Cargo Forecast

3) Micro Forecast

60. A cargo volume forecast by main import and export commodity groups is presented as the micro forecast.

(1) Commodity Groups

61. i) Import

Commodities: Oil products, Sugar, Cement, Steel products, cereals and Others

ii) Export

Commodities: Timber, Agricultural products, Coconut oil and others

(2) Import Commodities

i) Oil Products

(a) For motor vehicles (motor sprits, distillate fuels)

62. The premise of the forecast is that the import volume is proportionate to the number of motor vehicles in Western Samoa. There were 4,370 motor vehicles other than motorcycles in 1985, that is 27.6 vehicles per thousand persons. From 1974 to 1985, the annual increase rate of the number of motor vehicles per thousand persons, hereafter referred to as the unit number of vehicles, was 1.43%, but the increase was 1.3% in 1974-1980, and 1.6% in 1980-1985.

63. On the other hand, throughout the world the unit number of vehicles increased at an annual rate of 2.9% from 1970 to 1983. So it is estimated that by 2005, the increase rate of unit number of vehicles in Western Samoa will increase up to the present world average.

64. Then as the unit number of vehicles will be 42.4 in 2005, the total number of motor vehicles in Western Samoa will be 7,170.

	Number of Motor Vehicles (A)	Population (B) (1,000)	Unit Number of Vehicles A/B
1985	4,372	158	27.6
2005	7,170	169*	42.4

*Estimated in Chpater 2-1.

65. The unit number of vehicles in 2005 is not so large compared with the present situation of developing countries. From the forecast of the number of motor vehicles, the volume of oil products which will be imported in 2005 will be as follows.

	Number of Vehicles	Oil products (tons)
1985	4,372	18,044
2005	7,170	29,600

Note: Not including the fuel for diesel energy generation.

(b) For airplanes (kerosine, white spirits)

66. The total arrivals and departures by airplane show no clear trend from 1980 to 1984 as follows.

Year	1980	1981	1982	1983	1984
Arrivals & Departures	121	135	123	113	126(thousand)

And also the imported oil volume has fluctuated year by year.

67. On the other hand, the number of tourists, except from American Samoa, has increased from 21,000 in 1981 to 31,000 in 1986, an annual increase rate of 8%.

68. The consumption volume of airplane fuel is related to the number of person-kilometers of the air passenger transportation. From 1980 to 1984 the annual increase rate of person-kilometers transported by airplanes was 4.3% throughout the world.

At present there is no data on the passenger-kilometers by air in Western Samoa. Herein, it is assumed that the increase of the passengerkilometers until the target year will be at the same rate as the present average world increase rate. The reasons for this assumption are as follows:

① The number of tourists to Western Samoa has been increasing.
② Tourism development will be promoted.
③ As emigration to other countries continues, the number of Samoans travelling to and from Western Samoa will also increase.

Then the volume of airplane fuel will be 14,200 tons in the target year, that is 2.25 times the present figure.

(c) For Diesel Energy Generation

69. As described in Chapter 2-1, the consumption of fuel will decrease from 2,900 tons in 1985 to 1,100 tons in 2,000. Then the fuel consumption in 2005 is estimated to be 800 tons assuming the same annual decrease rate from 2000 to 2005 as from 1985 - 2000.

(d) Total Volume of Oil Products

70. From (a), (b) and (c), the total volume of oil products that will be imported in 2005 is 44,600 tons, 1.8 times the volume in 1986.

ii) Sugar

71. The forecast of the volume is based on the sugar consumption per capita. The sugar consumption per capita in Western Samoa, Japan and the world is shown in Table 2.3.1.

Table 2.3.1 Sugar Consumption per Capita in 1983

	Total sugar consumption (tons)	Population (thousand)	Consumption per capita (kg)
Western Samoa	8,870	157	56.5
Japan	2,640,000	120,000	22.0
World	97,000,000	4,690,000	20.7

72. From the above table it is clear that the sugar consumption per capita in Western Samoa is far above the world average. Thus, it is estimated that the per capita consumption will not increase, but will remain at the same level as at present. The import of sugar in 2005 is estimated as follows:

56.5 kg x 169,000 = 9,500 tons

iii) Cement & Steel Products

73. The import of cement and steel products depends on governmental and private investment. In 1983 the total investment was 28.8 million WS$ (in 1980 prices). We estimate that the percentage of the investment within GDP will be 34.7% in 2005, the same as the governmental forecast in 1990. Then the investment will be 52.1 million WS$ in 2005 (GDP=150 million WS$).

74. From the above, the import volume of cement and steel products will be as follows in the target year.

Table 2.3.2 Import Volume of Cement and Steel Products

	Average in 1981-1983	2005
Cement	9,700 tons	17,600 tons
Steel Products	6,000	10,900

Note : There were significant fluctuations from 1981 to 1983.

iv) Cereals

75. For the forecast of the volume of imported cereals in the target year, a time-series analysis is carried out using 3-year moving averages to eliminate short-term fluctuations. The historical volume of imported cereals is as follows:

Year	1978	1979	1980	1981	1982	1983	Annual increase rate
Volume (tons)	6,992	7,442	7,843	8,651	8,256	8,807	4.72%

Note : 3-year moving averages

Based on the historical data, the volume is expected to increase to 24,300 tons in the target year 2005.

v) Others

76. The cargo volume of other commodities in generally forecast using a time-series analysis. But as there is no special data available concerning other commodities except the data from 1981 to 1983, the volume is forecast based on the trend of total imports of general cargo.

77. The volume of other commodities in 1983 was 62,200 tons, and that of the three year moving average in 1982 was 52,200 tons. The volume of total general cargo using three year moving averages increased at an average annual rate of 5.36% from 1981 to 1986. Accordingly, the volume of other commodities is estimated to increase from 62,200 tons in 1983 to 196,000 tons in 2005 or from 52,200 tons in 1982 to 174,000 tons in 2005.

vi) Total Imports

78. From the above, the total volume of import cargo will be 280,900 - 302,900 tons, or 2.1 - 2.3 times the present volume, as summarized below.

	(2005)
Oil Products	44,600 tons
Sugar	9,500
Cement	17,600
Steel Products	10,900
Cereals	24,300
Others	174,000 - 196,000
Total	280,900 - 302,900

(3) Export Commodities

i) Timber

79. Timber is now exported mainly from Asau Port, at a volume of about 3,000 tons per year. The export volume of timber in the target year is based on the data obtained from the field survey. The main information is from the Agriculture Department. According to this information, projected timber exports in the year 2005 are as follows:

From nature	10,000 tons
From reforestation	10,000 tons
Total	20,000 tons

80. Additionally, the export of chips is being considered. However, quality chips are made of only uniform wood, whereas the natural timber in Western Samoa is a mixture of over ten different species. Thus, the potential for chip exports utilizing natural stands seems rather low.

ii) Agricultural Products

81. The future export volumes of agricultural products are estimated based on data from the Agriculture Department of Western Samoa. The results are as follows:

	Commodities	1985	2005
1	Copra meal	6,000 tons	10,500 tons
2	Cocoa	600	4,500
3	Taro	7,200	8,000
4	Other fresh products	-	10,000
	Total of 1 - 4	13,800	33,000
5	Coconut oil	12,100	21,000

iii) Others

82. The cargo volume of other commodities is generally forecast using a time-series analysis. But as there is no special data available concerning other commodities, the volume is forecast based on the trend of total exports of general cargo, which increased at an average annual rate of 2.8% from 1981 to 1986. Accordingly, the volume of other commodities is estimated to increase from 24,300 tons in 1986 to 41,000 tons in 2005.

iv) Total Exports

83. From the above, the total volume of export cargo in the target year will be 115,000 tons, or 2.1 times the present volume as summarized below.

	(2005)
Agricultural products	33,000 tons
Timber	20,000
Coconut oil	21,000
Others	41,000
Total	115,000

4) Estimated Cargo Volume in 2005

84. The results of the macro forecast and the micro forecast are as follows:

(1) Macro Forecast (general cargo only)

	(1986)	(2005)	Annual Increase Rate (1986-2005)
Total general cargo	146,800 tons	338,000 tons	4.5%

(2) Micro Forecast

i) General cargo

Import	105,700	236,300-258,300	4.3 - 4.8
Export	41,100	94,000	4.5
Total	146,800	330,300-352,300	4.3 - 4.7

ii) Tanker Cargo

Import	25,500	44,600	3.0
Export	13,800	21,000	2.2
Total	39,300	65,600	3.0

85. The total volume of general cargo under the micro forecast is 330,300 - 352,300 tons. As the projected volume of general cargo under the macro forecast, 338,000 tons, is within the range of the micro forecast and at the lower side, herein the volume of 338,000 tons is adopted as the study team estimate. Thus, in the year 2005, the total cargo throughput is estimated to reach 403,600 tons: 338,000 tons of general cargo and 65,600 tons of tanker cargo. The cargo forecast is summarized in Table 2.3.3.

Table 2.3.3 Projected Cargo Volume by Commodity in Western Samoa in 2005

Commodity			Cargo Volume (tons)
General Cargo	Import	Sugar	9,500
		Cement	17,600
		Steel Products	10,900
		Cereals	24,300
		Others	181,700
		Total	244,000
	Export	Copra Meal	10,500
		Cocoa	4,500
		Taro	8,000
		Other Fresh Products	10,000
		Timber	20,000
		Others	41,000
		Total	94,000
	Total		338,000
Oil	Import	Oil Products	44,600
	Export	Coconut Oil	21,000
	Total		65,600
Total	Import		288,600
	Export		115,000
	Total		403,600

5) Cargo Throughput at Asau Port and Apia Port

(1) Asau Port

86. The commodities handled Asau Port are oil products for import and timber for export.

i) Oil Products

87. Asau's share of the imported oil products for motor vehicles and

diesel energy generation in Western Samoa has fluctuated from 9.4% to 15.7% during the 4 year period 1983-1986, and the average share in the period was 13.5%. We estimate a share of 13.5% in the future. Thus, the volume is estimated to reach 4,100 tons.

ii) Timber

88. Virtually all of the timber exports are handled at Asau. Thus, the export volume will be 20,000 tons according to the micro forecast. Table 2.3.4 summarizes the cargo which will be handled at Asau.

Table 2.3.4 Cargo Volume through Asau Port

(tons)

	Commodity	2005	1986
Import	Oil Products	4,100	2,400
Export	Timber	20,000	3,000
	Total	24,100	5,400

(2) Apia Port

89. Table 2.3.5 and Fig. 2.3.2 show the cargo volume which will be handled at Apia Port. The volume is calculated from the total cargo minus the cargo at Asau Port.

Table 2.3.5 Cargo Volume by Commodity at Apia Port in 2005

Commodity			Cargo Volume (Tons) 2005	1986
General Cargo	Import	Sugar	9,500	-
		Cement	17,600	-
		Steel Products	10,900	-
		Cereals	24,300	-
		Others	181,700	-
		Total	244,000	105,700
	Export	Copra Meal	10,500	-
		Cocoa	4,500	-
		Taro	8,000	-
		Other Fresh Products	10,000	-
		Others	41,000	-
		Total	74,000	38,100
	Total		318,000	143,800
Oil	Import	Oil Products	40,500	23,100
	Export	Coconut Oil	21,000	13,800
	Total		61,500	36,900
Total	Import		284,500	128,800
	Export		95,000	51,900
	Total		379,500	180,700

Note: - data not available

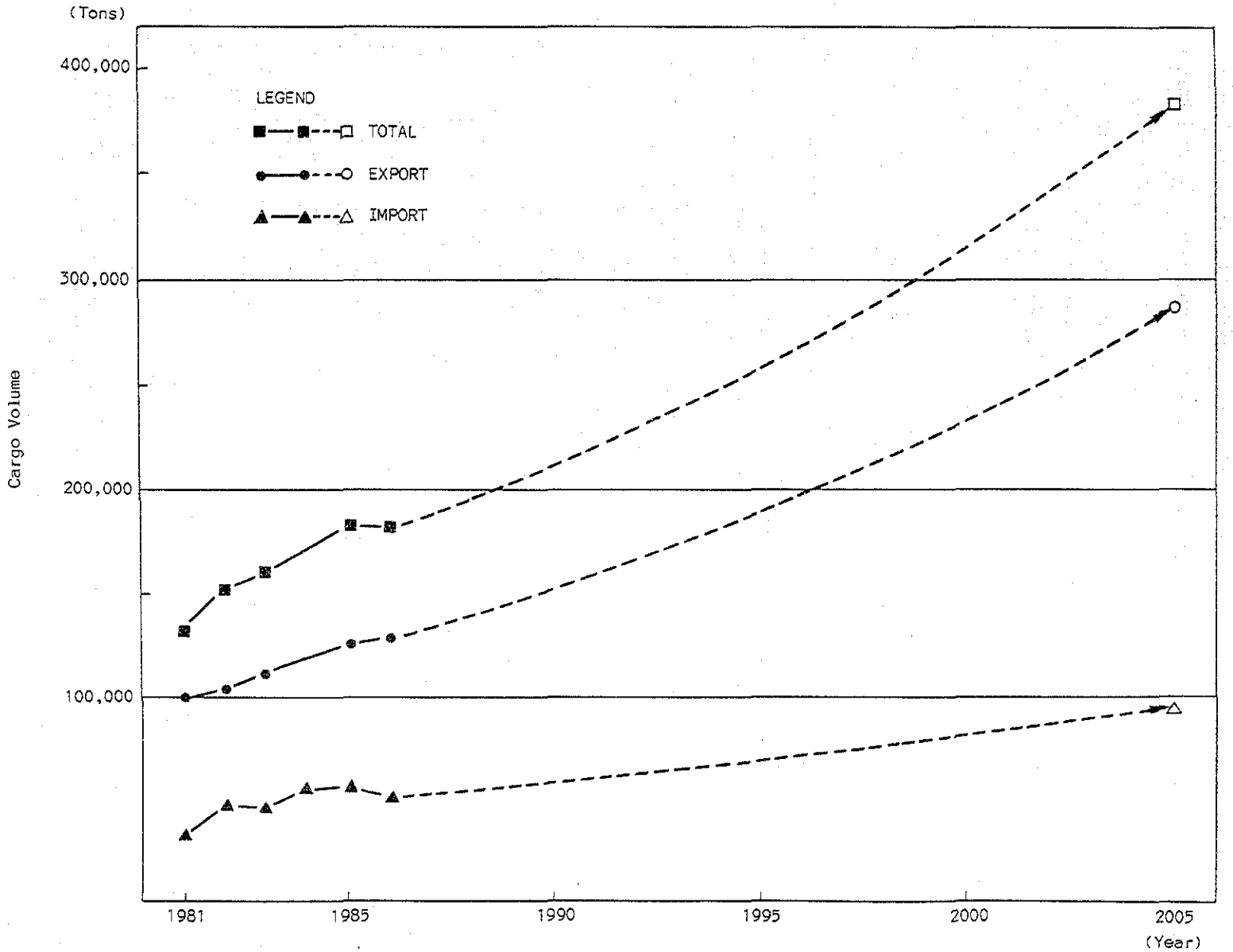


Fig. 2.3.2 Cargo Volume Through Apia Port

i) Ferry Cargo

90. The forecast of the ferry cargo in the target year is presented below. It is estimated that the ferry cargo will increase at the same rate as the total general cargo at Apia Port. The estimated ferry cargo in the target year is as follows;

	(1986)	(2005)
Import	6,700 tons	15,500 tons
Export	2,600	5,100
Total	9,300	20,600

ii) Cargo Volume Handled at Each Berth.

91. Table 2.3.6 shows the cargo volume to be handled at each berth.

Table 2.3.6 Cargo Volume Handled at Each Berth at Apia Port

	Berth Name		Cargo Volume (tons) 1986	2005
Import	Main Wharf (General Cargo)		99,000	228,500
	Ferry Terminal		6,700	15,500
	Buoy Berth		23,100	40,500
	Total		128,800	284,500
Export	Main Wharf	General Cargo	35,500	68,900
		Coconut Oil	13,800	21,000
	Ferry Terminal		2,600	5,100
	Total		51,900	95,000
Total	Main Wharf	General Cargo	134,500	297,400
		Coconut Oil	13,800	21,000
	Ferry Terminal		9,300	20,600
	Buoy Berth		23,100	40,500
	Total		180,700	379,500

iii) Container Cargo

(a) Present container cargo

92. The volume of container cargo handled at Apia Port in 1986 was 4,890 TEU of imports and 1,390 TEU of exports. As one TEU equals about 15 tons of cargo based on statistical surveys, the percentage of the container cargo within the general cargo can be calculated as follows;

	Import	Export	Total
TEU	4,890	1,390	6,280
Container Cargo (A) (Tons)	73,350	20,850	94,200
General Cargo (B) (Tons)	99,000	35,500	134,500
A/B (%)	74.1	58.7	70.0

(b) Forecast container cargo volume in the target year.

93. Container cargo shipped on well containerized routes comprises almost 90 percent of total liner vessel cargo as shown in Chapter 2-2. Considering the present situation of containerization in Western Samoa and the world tendency towards increased containerization, the container cargo in Western Samoa will increase to at least 85 percent of imports and 70 percent of exports in the target year. Table 2.3.7 shows the result of the container cargo forecast for the year 2005.

Table 2.3.7 Container Cargo at Apia Port (2005)

	Import	Export	Total
TEU	12,900	3,200	16,100
Container Cargo (A) (Tons)	194,200	48,200	242,400
General Cargo (B) (Tons)	228,500	68,900	297,400
A/B (%)	85	70	81.5

2-4 Vessels

1) Number of Vessel Calls

(1) Apia Port

i) Main Wharf

(a) Liner vessels

94. The number of loaded containers handled at Apia was 6,280 TEU in 1986, and it will increase up to 16,100 TEU in 2005, 2.6 times the present TEU. As about 140 liner vessels call at APia now per year, the number of import and export containers is estimated to be only 37 TEU per vessel including empty ones. In the future the number of containers handled per vessel will increse. In this study considering the present routes, calling frequencies and containers handled per vessel, the number of vessel calls is estimated assuming that the half of the increase of TEU will contribute to the vessel increase. The number of liner vessels in 2005 is estimated 250.

(b) Trampers

95. The trampers which use the main wharf are general cargo vessels and tankers for coconut oil. At present, about 40 tranper vessels call each year. The cargo volueme is expected to increase to 1.4 times the present volume, from 54 thousand tons to 77 thousand tons, in 2005. Though the present vessels are small, 2 to 3 thousand GRT, in the forecast of the vessels which will call at Apia in the target year it is assumed that some larger vessels will call or the handling volume per vessel will increase. The number of vessel calls is estimated to be 1.2 times the present number, or 50, in the target year.

(c) Others

96. Passenger vessels call at Apia only several times per year now, but about 30 vessels are already cruising in the South Pacific region. The demand for cruising in this region is expected to increase and the

Government of Wester Samoa is projected to promote the tourism. Then in the target year at least 10 passenger vessels are expected to call each year. From the above estimates, the vessels which will use the main wharf will total 310 in 2005.

ii) Tankers (Buoy Berth)

97 The oil companies plan to increase the size of the vessels which will carry oil products to the port. So, in spite of the projected increase in oil imports, the number of vessel calls is not expected to increase, but will likely remain at about 2 calls per month for a total of 24 calls per year.

iii) Ferry

98. The frequency of ferry services depends on both passengers and cargo. At present, ferry services are provided twice a week, but based on the cargo forecast and the capacity of the Queen Salamasina, the frequency of ferry services will have to increase to 3 times for week for a total of approximately 150 vessel calls per year.

(2) Asau Port

i) General Cargo Vessels

99. It is estimated that for timber exports, vessels will call once every two months for a total of 6 calls per year. At present, other general cargo vessels call approximately 4 times per year, and the frequency of these port calls is expected to remain the same in the target year. Thus, in the year 2005 a total of 10 general cargo vessels are expected to call at Asau Port each year.

ii) Tankers

100. The number of tanker calls in the target year is expected to remain the same as at present, once every two months, or six times per year.

Table 2.4.1 Forecast Vessel Calls

Apia Port	Main Wharf	310
	Buoy Berth	24
	Ferry	150
	Total	484
Asau Port	Total	16

Note: does not include yachts

2) Vessel Size

(1) Apia Port

i) Commercial Vessels

101. As for the size of vessels which will call at Apia in the target year, it is assumed that the average vessel size will increase along with the cargo increase, but that the maximum size of vessels which will call at the port will remain the same as at present. The maximum size of vessels which presently call at Apia are as follows.

Vessel Type	Size (GRT)
Cargo	10,000-11,000
Passenger	20,000-25,000

102. The standard dimensions corresponding to the maximum vessel sizes are as follows.

Vessel Type	Draft	Length
Cargo	9.1m	160 to 170m
Passenger	9.2 to 10.0m	200 to 210m

ii) Yachts

103. As for the size of yachts, the maximum size which calls at Apia now is about 50-60 GRT with few exceptions. From the field survey at Apia and Pago Pago, we estimate that in the target year the yacht size will remain the same as at present.

(2) Asau Port

104. As for Asau Port, it is assumed that the maximum size of vessels for timber export will be 3-4,000 GRT (5,000 DWT) considering the export volume. The standard dimensions of the design vessel are:

Draft : 6.8m Length : 100m

CHAPTER 3
MASTER PLAN

Chapter 3 Master Plan

3-1 Port Facilities in the Target Year

1) The Role and the Corresponding Activities of Each Port

(1) Apia Port

1. Apia Port will become more and more important toward the target year. This port will continue to serve as the lifeline of Western Samoa. And the expected growth of the nations economy depends on the port activities, because to achieve such growth almost all the cargoes will have to pass through Apia.

2. The main items which must be considered for Apia to fulfill its leading role are summarized below.

① Upgrading the efficiency of cargo handling, especially the handling of containers.
② Upgrading the safety of vessel manuevering.
③ Upgrading the safety in the land area, including separation between the cargo area and the passenger area.
④ Effective land usage
⑤ Lifetime of the present feacilities
⑥ Upgrading the efficiency of port management.

(2) Asau Port

3. Asau Port is central to the development of Savaii Island. In Savaii, based on the reforestation program, this port will become an important center of timber export. And almost all the oil products consumed on Savaii also pass through here.

4. So, the following improvements are necessary at Asau Port.

① Upgrading the safety of vessel maneuvering at the entrance and in the basin.

② Securing the timber stock yard

(3) Salelologa and Mulifanua Ports

5. The traffic between the main islands has increased, and this trend will continue because of the development of Savaii. So the role of both these ports as ferry terminals will become more and more important. As these ports are located in the inner areas of coral reefs, they have long entrance channels with some bends and their turning basins are limited.

6. The following improvements are necessary at these ports.

① Upgrading the safety of vessel maneuvering.
② Securing parking space for motor vehicles.

2) Port Facilities under the Master Plan

(1) Apia Port

7. In order to fulfill its role as the leading national port, Apia Port requires the following facilities by the target year.

i) Basins

8. A turning basin and a basin adjacent to the main wharf with sufficient space and depth.

(a) Sufficient space

The turning basin should have a diameter at least twice the maximum length of the vessels that will call at the port. The projected maximum length is 200 meters.

The mooring space beyond the edge of the wharf should be 0.2 times the maximum vessel length.

(b) Water depth

The design depth of the wharf is -11 meters, and judging from the present draft of the vessels that call at the port, the depth should be 11 meters.

ii) Breakwater

9. To ensure calmness at the port, some protective facilities such as a breakwater may be necessary.

10. The calmness of the water greatly influences cargo handling activities. It is said that the critical wave height for cargo handling in a basin in front of a wharf is preferably not more than 50 cm, but the allowable wave height varies depending on the vessel size and the cargo handling situation. Generally, for large vessels greater than 5,000 GRT, cargo handling activities can continue with wave heights up to 70 cm at a reduced handling efficiency.

11. On the other hand, a basin in front of a wharf should secure the necessary calmness on 95% or more of the days each year and each season. The special features at Apia concerning the above items are as follows.

① Rough seas, or high waves, occur mainly in the rainy season, from December to February.
② The share of the vessels smaller than 5,000 GRT is about 65%.
③ The national economy of Western Samoa depends upon the port activities at Apia.

12. Based on these factors, the Master Plan is designed to ensure a maximum wave height in front of the wharf of 50 cm on 95% of the days during the rainy season.

13. We calculated the effect of the proposed breakwater using a computer model. Based on trial and error calculations, we determined that a 100 meter breakwater will ensure sufficient calmness at the wharf. Table 3.1.1 shows the calmness in front of the wharf at present and with the proposed

breakwater (See Fig. 3.2.1).

Table 3.1.1 Calmness in Front of the Wharf

item / kind of wave / wave height	at Present		with the proposed breakwater (Decrease ratio 55%)	
	appearance days (days)	ratio of appearance (%)	appearance days (days)	ratio of appearance (%)
seas — 50 cm or more	19	21	5	6
seas — 70 cm or more	13	14	1	1
swells — 50 cm or more	3	3	0	0
swells — 70 cm or more	0	0	0	0
seas + swells — 50 cm or more	22	24 (76%)	5	6 (95%)
seas + swells — 70 cm or more	13	14	1	1

Note 1) Ratio of appearance is the figure between December to February.
Note 2) The figures in parentheses are the working ratio of handling.

iii) Mooring Facilities

(a) Main Wharf

14. The main wharf is over 20 years old. Judging from the structural life, this wharf can be used until the target year with some repairs for normal cargo handling. Thereafter, new facilities will have to be provided.

(b) New Wharf

15. From the cargo forecast in 2005, about 320 thousand tons of cargo will be handled at the wharf, mostly container cargo totaling 240 thousand tons. Generally at well-equipped container terminals with installed gantry cranes and sufficient terminal area, 1.5 million tons of cargo, or 100 thousand TEUs, are handled. At Apia Port, only 16 thousand TEUs, or 26 thousand TEUs including empties, will be handled in 2005. Then considering the

present berth occupation and the vessel size, only one new wharf will be required for cargo handling, mainly container cargo handling in the target year. And the present wharf will be available for small vessels and for mooring resting vessels.

16. The new wharf shall:

① Function as a container terminal
② Have sufficient length and depth to accommodate all calling vessels described in Chapter 2-4.

17. Then the dimensions of the new wharf should be:

① Length: 200 - 225m
② Depth: -11m
③ Strength: Sufficient for container handling

Ideally, the container yard should be located adjacent to the wharf.

(c) Ferry Berth

18. The present berth is not in good condition for the mooring of the Queen Salamasina. The improvement of the berth should be planned considering the future situation. For the time being the Queen Salamasira will continue her service, and any replacement ferry by the target year will not be much larger than the Queen Salamasina considering the movement between Western Samoa and American Samoa. As the length of the Queen Salamasina is 40 meters, the length of the berth in planned as 50 meters.

(d) Wharf for Small Vessels

19. Certain small vessels, such as tugboats, are based at Apia Port, and they are moored at the inside of the main wharf. But as the mooring area for small vessels is limited to the inside only, after the expansion of the yard, the area for mooring small vessels will be reduced to 50 meters along the wharf. At present the coastline in front of shed No.1 is not used as a wharf, but it should be improved to function as a wharf for small vessels

by the target year.

(e) Mooring Buoys for Tankers

20. At the opposite side of the main wharf there are three mooring buoys and a manifold for tankers. But the vessels which moor at the main wharf use this area as a turning basin. Thus beacons or lights should be installed for safe maneuvering.

21. However, fundamentally it is better to remove the tanker buoys offshore for the following reasons.

① The area will continue to be used as a turning area after the construction of the new wharf (see Fig. 3.2.2)

② The safety of the bay should be ensured in case of an oil spill.

iv) Storage Facilities

(a) Expansion of Yard

22. The present main wharf which is a detached pier type is connected to the yard area by two approach bridges, but only one of these bridges is available for heavy cargo handling at present, and this greatly reduces cargo handling efficiency. Also, there is no marshalling yard available for the loading and unloading of container cargo.

23. The number of port calls of Ro/Ro vessels has been increasing at the port, but proper facilities to accommodate Ro/Ro vessels are not available due to the narrowness of the apron.

24. The Master Plan includes the expansion of the yard between the two approach bridges to increase cargo handling efficiency and to provide a marshalling yard for container cargo.

(b) Container Terminal

25. The container throughput will reach 12,900 TEU in 2005, 2.5 times the current level. The required size of the container terminal in the target year is calculated based on the following factors.

a) Dwelling Containers in the Yard

26. As almost all the containers dwell in the port area at present and this situation will not change so much in the future, the dwelling container factor is estimated as 0.9.

b) Dwell Time

27. According to the stevedoring companies, the average dwell time is 19 days now. The most important related factor is the interval of the liner services. Presently, the liner services between the South Pacific region and the U.S.A., Europe and Japan are mostly monthly. And services within the South Pacific region by PFL are provided every 3 or 4 weeks on each route.

28. The future maritime trade in this region is estimated to increase, and also in Western Samoa the container cargo will increase steadily. Then there will be more liner services by the target year. Thus, we estimate that the average dwell time will be reduced to 15 days by the target year.

c) Calculation

29. The maximum number of containers in the yard at the same time is calculated as follows:

$$N = \frac{12,900 \times 0.9 \times 15 \times 1.1}{365} = 525 \text{ TEU}$$

N = number of dwelling containers at the same time

12,900 = yearly throughput (TEU)

15 = dwelling time (days)

1.1 = peak factor

365 = days per year

d) Layout Plan

30. Fig. 3.1.1 shows a model layout of the container yard assuming that forklifts will be used. The containers will be stacked two high, and many of the containers will be empty. Thus, the required number of slots is 263 slots.

(c) Container Freight Station (CFS)

a) Width

31. The width of the CFS depends on the cargo volume sorted there.

$$W = \frac{3.5 \times C}{V}$$

W = width of CFS

C = LCL cargo per day

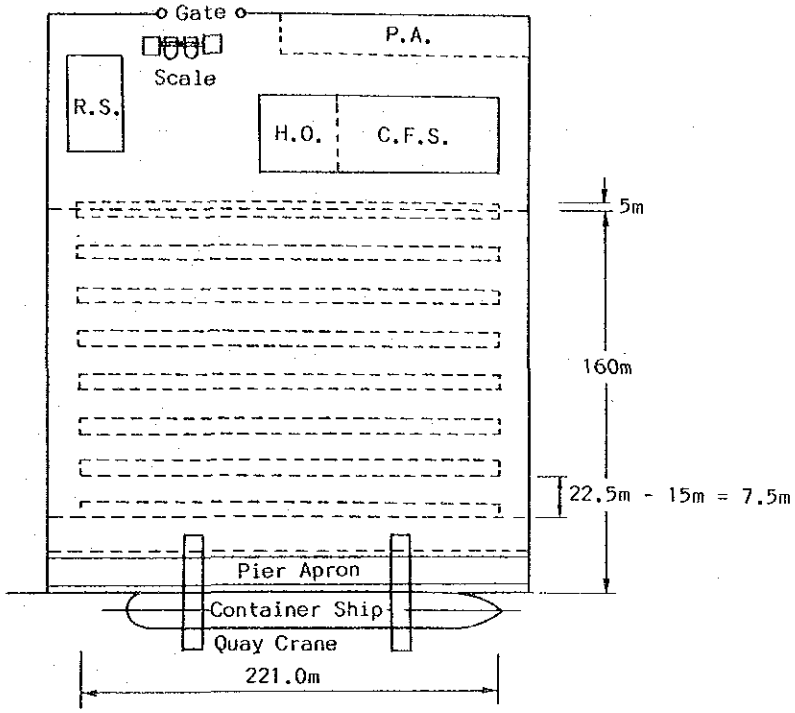
V = cargo sorting capacity per bay per day

3.5 = width of each bay

LCL: There is no data available about the ratio of LCL:FCL at the port. According to the Container Park Study, the ratio of LCL is about 45 percent.
We estimate that the LCL ratio will decrease to 40 percent by the target year.

V: Usually at normal container terminals in developed countries V is estimated at 3.5 TEU.

We estimate that in Western Samoa V will be somewhat less, about 2.5 TEU.



Yard Area = 165 x 250 = 41,250m^2 (= A1)
N_{20} = 34 x 2 x 8 = 544 (N_R = 34 N_P = 510)
Stacking Area = 7.5 x 221 x 8 = 13,260m^2 (=A_3)
Pass = 41,250 - 13,260 = 27,990m^2 (= A_2)
A_1/N_{20} = 75.8 m /TEU
A_3/A_1 = 0.679

Fig. 3.1.1 Model Layout of the Container Terminal (Using Forklifts)

V = 2.5 TEU = 37.5 tons

$$W = \frac{242,400 \times 0.4 \times 3.5}{300 \times 37.5} = 30 \text{ meters}$$

300: Working days per year

b) Depth

32. The depth of the CFS is set at 40 meters considering the efficiency of cargo handling in the CFS.

(d) Maintenance Shop (MS)

33. At a normal container terminal the maintenance shop occupies about 1,000 square meters. But considering the present situation at Apia, such a large shop will not be necessary. The maintenance shop should have sufficient space to repair one or two containers. Then the required space of the maintenance shop is about 200 square meters.

(e) Transit sheds

34. Of the four existing transit sheds, only sheds No.1 and No.3 are actually used for handling port cargoes. But all of the sheds will become superannuated by the target year. So the Master Plan includes two new transit sheds, one for export cargoes and one for import cargoes. Each of the sheds has an area of 2,500 square meters. Together, these two sheds will be able to accommodate the cargo volume in the target year.

(f) Coconut Oil Tanks and Shed

35. There are presently two oil tanks and a shed for the export of coconut oil and coconut meal. But these facilities will have to be replaced by the target year.

v) Connecting Roads

36. For smooth and safe transportation in the port area, it is necessary to consider the port roads in the land layout plan.

vi) Ferry Terminal

37. A new ferry terminal is planned for the following reasons.

① Apia port is the entrance to Western Samoa for ferry passengers.
② The present terminal is superannuated.
③ The export and import procedure for the ferry cargos is not aranged well.
④ It is necessary to separate the passenger area from the cargo area.

(a) Passenger Terminal

38. The required terminal area is calculated as follows.

$A = a \cdot n \cdot f$

A = Area for the passenger terminal
a = Area per capita (=1.2 m^2)
n = The capacity of the ferry (216 persons on the Queen Salamasina)
f = Annual Fluctuation rate (=1.2)

Then

$A = 1.2 \times 216 \times 1.2 = 310\ m^2$

(b) Office Area

39. The required office area is calculated as follows.

$A = a \cdot n$

A = Area for the office
a = Area per capita (= 15m^2)
n = Number of persons in the office (= 10)

Then

$A = 150\ m^2$

In additon to the above space, 50 square meters is required for the meeting and control rooms.

(c) Cargo Terminal

40. All ferry cargoes pass through a customs declaration at the ferry terminal. From the field survey which was held from 7 to 17 hours on March 5th, 160 motor vehicles entered the ferry terminal area to declare imported cargo. The average dwelling time of each vehicle was about one hour, and the average number of persons per vehicle was two or three.

a) Waiting Area

41. Then the following waiting area is required.

$A = a\ (n_1\ N + N_2)$

A: Waiting area (m^2)

a: Space per capita (= 1.2 m^2)

: Concentration rate (=1.6 : daily fluctuation)

N: Number of vehicles waiting for cargo at the same time (=16)

n_1: Number of consignees per vehicle (=2.5)

n_2: Number of consignees on foot waiting for cargo at the same time (=5)

Then

$A = 1.2 \times 1.6 \times (2.5 \times 16 + 5) = 86\ m^2$

But it is possible to use part of the passenger terminal described in (a) as a waiting area.

b) Customs declaration area: 100 m^2 (including customs office)

c) Cargo stock area : 100 m^2

(d) Terminal Space

42. From (a), (b), and (c), the required area of the ferry terminal is 710 square meters.

vii) Port Management Facilities

(a) Main Office

43. The main governmental organizations concerned with port activities are the Ministry of Transport (M.O.T.) and the Customs Department (C.D.). The main office of C.D. is located in the port area. But the main office of M.O.T. is between the port and the city center. The government of Western Samoa intends to provide office space in the port area for the main organizations concerned with port activities. Then in the Master Plan a centralized office zone is provided for the following reasons.

① Simplifying the import and export procedures
② Promotion of communication among the concerned organizations
③ Total control of the port activities

If a port authority is established, its main office will also be located in this centralized office zone.

44. The total floor space of the new office building is calculated as follows. The main office of C.D. has an area of about 600 square meters, and as 40 persons work at the main office of C.D., the floor space per capita is 15 square meters. On the other hand there are 11 persons at the head office of M.O.T. who work in the marine and shipping sections. To improve the port management, the number of workers will have to be increased. If the floor space per capita is the same as that of C.D., the floor space for M.O.T. or the port authority may have to be as much as 300 square meters.

45. The present liquor store has an area of 1,500 square meters, but one-third of this area is sufficient for selling liquor judging from the present activities.

46. Then, the total floor space of the new office building should be 1,500 square meters, including 100 square meters for other governmental organizations.

(b) Pilot Office

47. It will be necessary to replace the pilot office because of the construction of the container terminal. The required floor space is 200 square meters.

viii) Tugboats

48. As the two low-horsepower tugboats are out of order, it is necessary to replace them.

ix) Navigation Aids

(a) Beacons

49. The visibility of the two beacons should be increased.

(b) Lighthouse

50. Along with the construction of the breakwater, it will be necessary to construct a light house at the tip of the breakwater.

x) Marina

51. Annual port calls of yachts at Apia Port total about one hundred, and as many as fifteen (15) yachts remain in Apia at the same time during the dry season now. But there is no special basin provided for the yachts, and their anchoring area is very close to the turning basin of commercial vessels.

52. It is estimated that the number of port calls by yachts will increase by the target year for the following reasons.

① In Pago Pago there is still some concentration of yachts

② In Western Samoa one of the important policies to develop the country is the promotion of tourism.

53. So the Master Plan includes the construction of a marina. The necessary data to decide the capacity of the marina is not available now. However, we estimate that two 30 meter pontoons should be provided for 20 - 30 yachts considering that almost all port calls by yachts are during the dry season, and the water depth should be -4 - -5 meters. A slip should be provided for the repair of yachts. A clubhouse should be constructed nearby. In the Master Plan, a land area of 450 square meters is provided for the clubhouse.

xi) Green Areas

54. The Master Plan includes green area zones for the benefit of passengers, port workers, port users and local residents.

Table 3.1.2 Port Facilities in 2005 at Apia Port

Facility	Function	Dimensions or Contents
i) Basins	(a) Turning basin (b) Mooring basin	Diameter=400m, Depth(D)=-11m D = -11m
ii) Breakwater		Length (L) = 100m
iii) Mooring facilities	(a) Main wharf (b) New wharf	Some repairs L = 200 - 225m D = -11m Strength: Sufficient for Containers
	(c) Ferry berth (d) Wharf for small vessels (e) Mooring buoys	L = 50m Improvement of the coastline (1) Installing lights (2) Removal offshore
iv) Storage facilities	(a) Expansion of yard (b) Container terminal (c) CFS (d) Maintenance shop (e) Transit shed (f) Coconut oil tanks and shed	Behind the main wharf Area 263 slots 30 m x 40 m = 1,200m^2 200 m^2 2,500 m^2 x 2 Replacement
v) Connecting roads		Based on the layout plan
vi) Ferry terminal		710 m^2
vii) Port management facilities	(a) Main office (b) Pilot office	1,500 m^2 200 m^2
viii) Tugboats		Replace (2 boats)
ix) Navigation aids	(a) Beacons (b) Lighthouse	Improve Construction on the new breakwater
x) Marina	(a) Pontoon (b) Clubhouse (c) Basin	60m (20 yachts) 450 m^2 -4m~-5m
xi) Green area		

(2) Asau Port

i) Breakwater

55. At present the breakwater is only extended to the edge of the reef and the entrance zone of the channel is very rough. In the Master Plan it is proposed to extend the breakwater by about 200 meters to facilitate vessel maneuvering at the entrance zone of the channel.

ii) Channel

56. The width and the depth of the existing channel are not sufficient. Considering the design vessel size, the channel should have the following dimensions.

Depth: -7.5 m
Width: 100m

iii) Leading Markers

57. This includes resiting the existing leading markers and adding new ones.

iv) Turning Basin

58. The turning basin should be dredged to a depth of -7.5m

v) Open Storage Yard

59. The required yard area is calculated using the following equation.

$$A = \frac{N}{wR}$$

A: Area of the open storage yard (m^2)
N: Total export volume per year (=20,000 tons)
α: Utilization rate (=0.7)
w: Unit capacity (=3.0 tons/m^2)

R: Turnover (= 4 - 6 times/year)

Then

$$A = \frac{20,000}{0.7 \times 3 \times (4 - 6)} = 1,600 - 2,400 \ m^2$$

Thus, the required area of the storage yard is about 2,000 square meters.

(3) Salelologa Port

60. As for Salelologa port, the Master Plan includes the following items.

i) Turning Basin

61. Cutting the corner of the reef between the turning basin and the basin for mooring, or at least setting up a marker on the corner of the reef.

ii) Parking Lot

62. A parking lot is provided for vehicles waiting for the ferry. The required area is calculated using the following equation.

A = Na

A : Area of the parking lot (m^2)

N : Number of waiting vehicles (20 trucks)

a : Unit space per vehicle ($85 m^2$ per truck)

Then

$A = 20 \times 85 = 1,700 \ m^2$

iii) Navigation Aids

63. The improvement of beacons that do not function well.

(4) Mulifanua Port

64. The Master Plan includes the following items:

① Parking Lot

② Navigation Aids

These are the same as at Salelologa Port.

(5) Aleipata Port

65. As evaluated in Chapter 1-3, this project is still premature in the target year.

(6) Idea of a New Port in Vaiusu Bay

66. The Government of Western Samoa is considering setting up a new port in Vaiusu Bay, and some studies have already been carried out. Judging from our study this project will still be premature in the target year. The reasons are as follows:

① The Port of Apia will be sufficient for the cargo demand in the target year if the improvements noted above are implemented.
② If the industrial plan is achieved by the target year, the problem of the empty containers waiting to be exported will decrease, but not much impact on the overall port activities can be expected.
③ The traffic to and from the port area is not responsibel for significant traffic congestion based on our study.
④ Few merits can be expected from the new port project in comparison with the cost.

67. We present the results of our study on a new port in Appendix 1.

3-2 Layouts of Port Facilities for the Master Plan

68. In this section the layouts of port facilities at each port for the Master Plan are presented based on the previous chapter.

1) Apia Port

(1) Basic Concept

69. The layout of the facilities for the Master Plan is designed considering the following main criterias:

① To upgrade the cargo handling efficiency
② To secure a sufficient area for cargo handling
③ The functional life of most of the existing facilities will end by the target year
④ To improve the safety in the port
⑤ To separate the cargo area and the passenger area
⑥ To improve the accessibility from the gate to the wharf
⑦ To secure an area for future expansion of the port
⑧ Natural Conditions

(2) Main Facilities for the Master Plan

i) Breakwater

70. The breakwater was designed considering the following goals:

① to secure the calmness of the basin;
② not to interfere with the turning basin; and
③ to be able to cope with the possible future expansion of the port.

(a) Calmness

71. As mentioned in 3-1, a 100 meter breakwater will ensure sufficient calmness in front of the present wharf.

(b) Securing the Turning Basin

72. The need to secure a sufficient turning basin must be considered when determining the location of the breakwater, as the size of the turning basin is already limited.

(c) Securing an Area for Future Expansion of the Port

73. Based on the field survey, the structural lifetime of the present wharf will end in the target year. Thus, the possible location of a new wharf must be considered in the layout plan.

ii) New Wharf

74. The ideal location of the new wharf should be determined considering the following factors:

① the calmness of the water area in front of the wharf;
② sufficient length and depth to accommodate the vessels which will utilize the wharf;
③ the construction cost;
④ the physical condition; and
⑤ the connection with the container yard and other facilities behind the wharf.

The potential site for the new wharf is limited to the reef edge considering the physical conditions.

75. The length of the wharf should be 200- 225 meters ideally, but in the plan it is reduced to 190 meters for the following reasons;

① The present wharf is only 185 meters long.
② The estimated maximum vessel size is the same as at present. Then the length of the wharf will only be a little short for passenger vessels, the same as the present situation.
③ The physical conditions and the construction cost suggest that a shorter wharf is more practical.

iii) Storage Facilities

(a) CFS, Transit Sheds

76. The CFS and transit sheds should be located adjacent to the container terminal.

(b) Coconut Oil Tanks and Storage Shed

77. These facilities should be located separate from the container handling area, but they should be located in an area with good connections to the gate and the new wharf.

iv) Ferry Terminal

78. The present location seems to be ideal.

v) Main Office

79. The main office will located at the gate area, which is the best location to oversee port activities.

vi) Marina

80. The marina need not be so deep, so the marina is located at the interior of the bay, which is closest to the downtown area.

vii) Green

81. The green will be the symbol of the port, and will be prepared as an amenity for passengers, port workers port users and local residents. So, the green will be located adjacent to the passenger area.

(3) The Layout of the Master Plan

82. The layout of the Master Plan, based on the above mentioned concepts, is shown in Fig. 3.2.1 and Fig. 3.2.2. Fig. 3.2.3 shows the layout plan of the container terminal, and Fig. 3.2.4 shows the Master Plan and the present coastline.

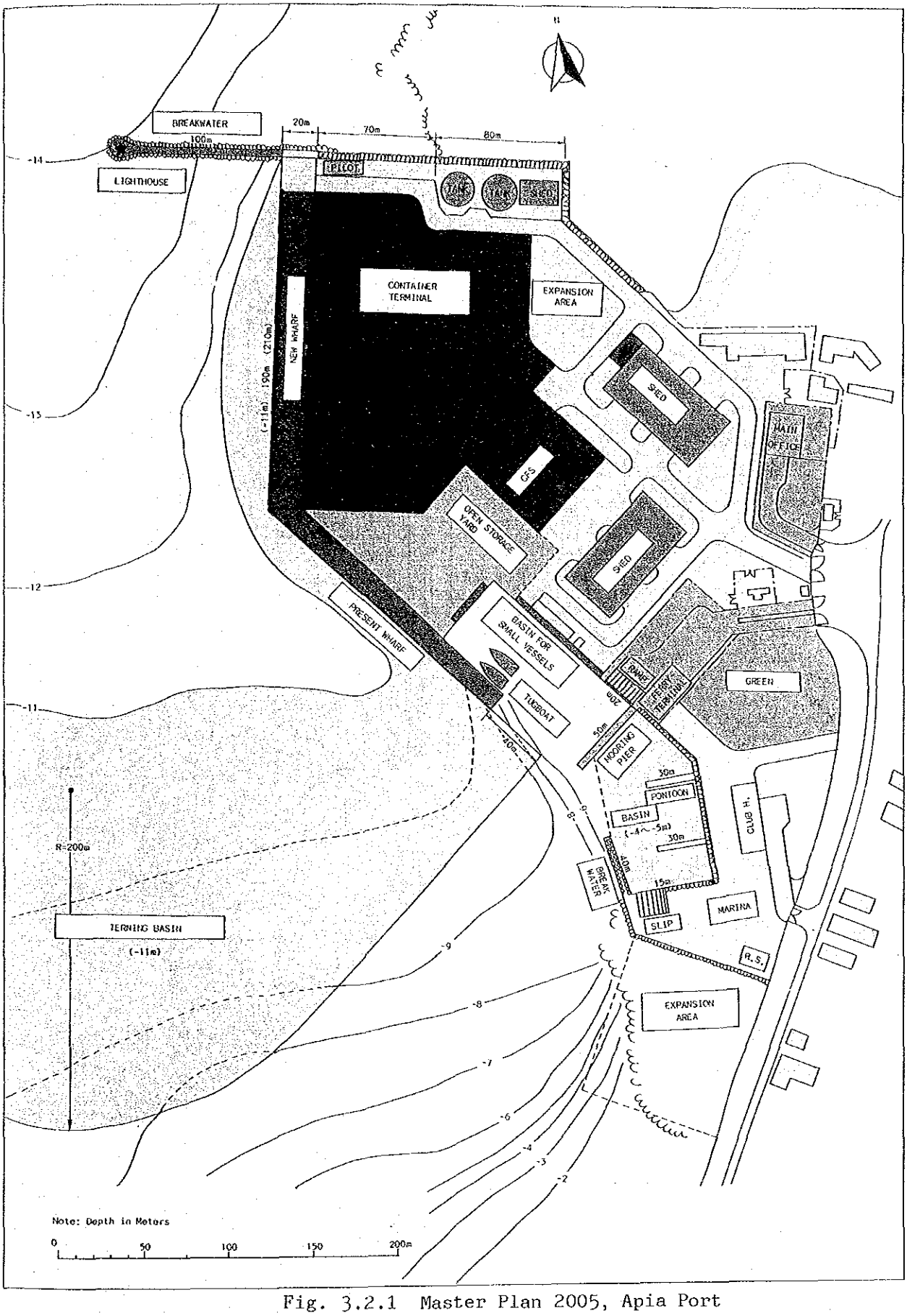


Fig. 3.2.1 Master Plan 2005, Apia Port

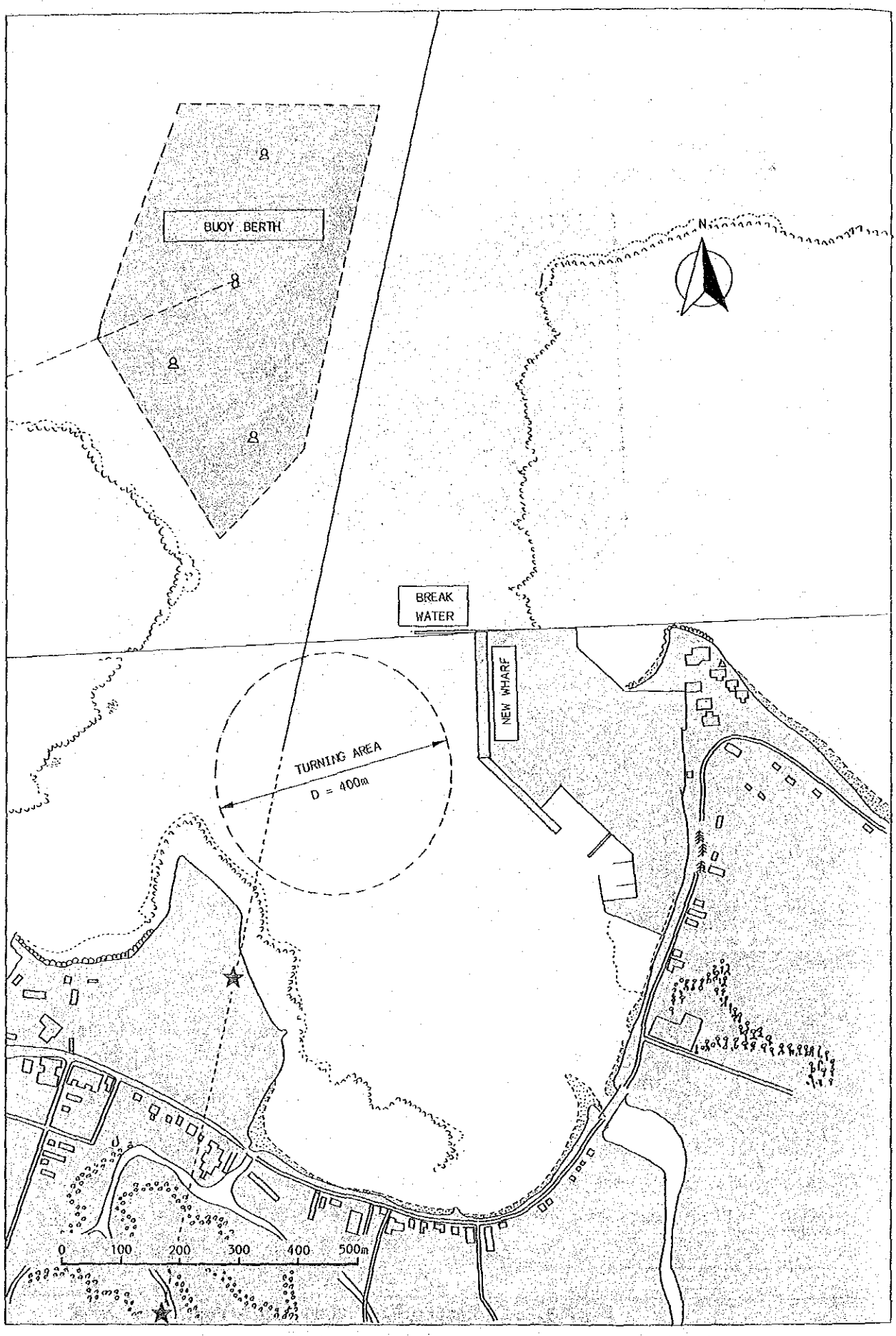


Fig. 3.2.2 Master Plan 2005 (Resiting Mooring Buoys) Apia Port

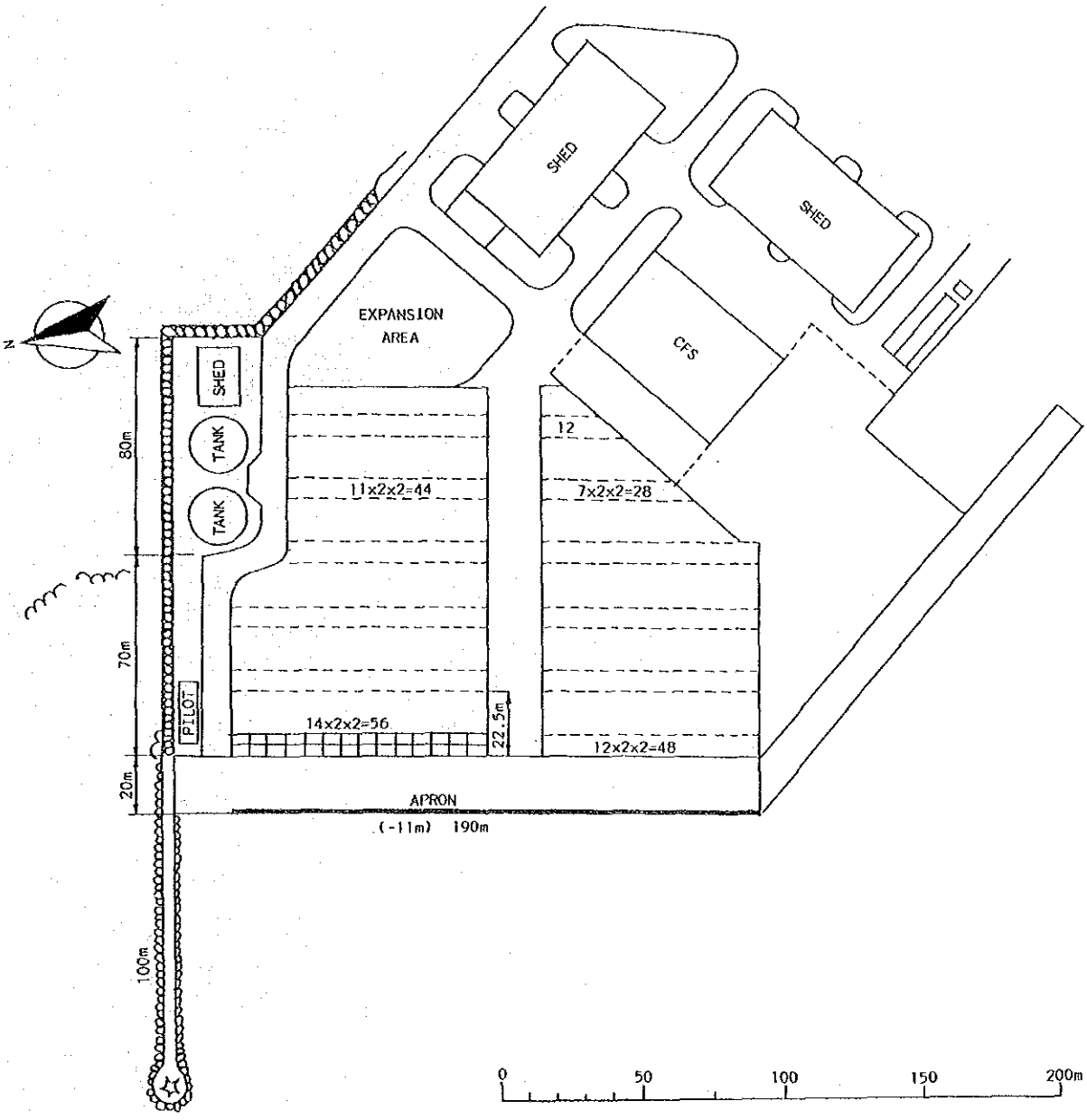


Fig. 3.2.3 Layout of the Container Terminal

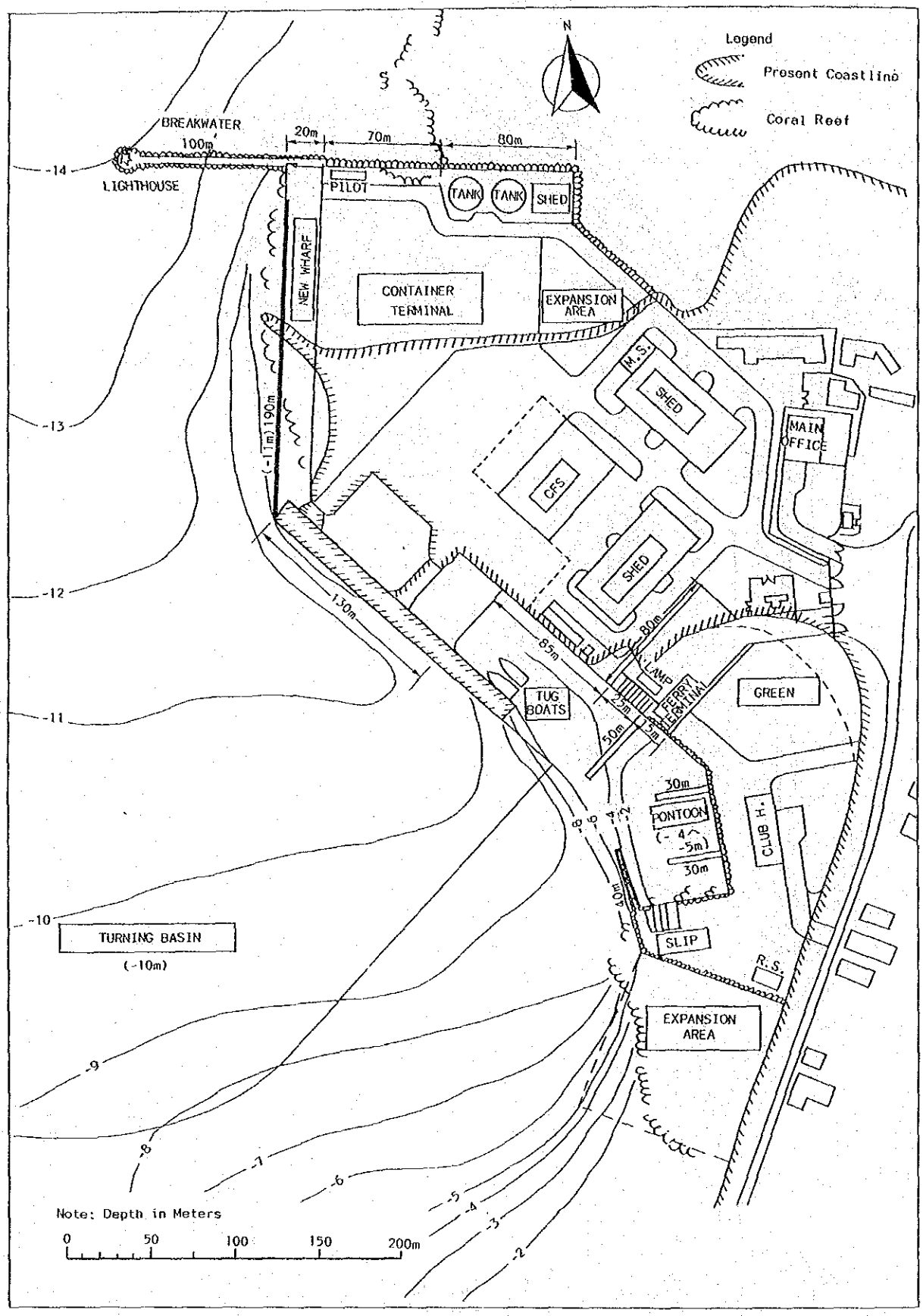


Fig. 3.2.4 Master Plan and Present Coastline, Apia Port

2) Asau Port

(1) Channel

83. The design channel is 100 meters wide and -7.5 meters deep as described Chapter 3-1. The layout of the channel under the Master Plan is designed to improve the present channel. But an alternative location is also considered to the west of the present channel.

84. A further survey will be necessary to determine the execution plan considering soil conditions, calmness, cost and vessel manuevering.

(2) Extension of the Breakwater

i) Direction

85. The direction of the breakwater should be determined by considering the calmness of the channel. And it is also necessary to ensure a sufficient area at the entrance to the channel. Thus it is better that the direction of the breakwater extension be somewhat more northward than the present direction.

ii) Length

86. As the design depth of the channel is -7.5 meters, 200 meters is sufficient to ensure calmness at the channel entrance.

(3) Open Storage Yard

87. Two alternatives are considered under the Master Plan. One is to utilize the present yard area and the other is to reclaim the area behind the wharf and use this area for storage. Further consideration is necessary to determine the excution plan.

(4) Layout of the Master Plan

88. Fig. 3.2.5 and Fig. 3.2.6 show the layout of the Master Plan.

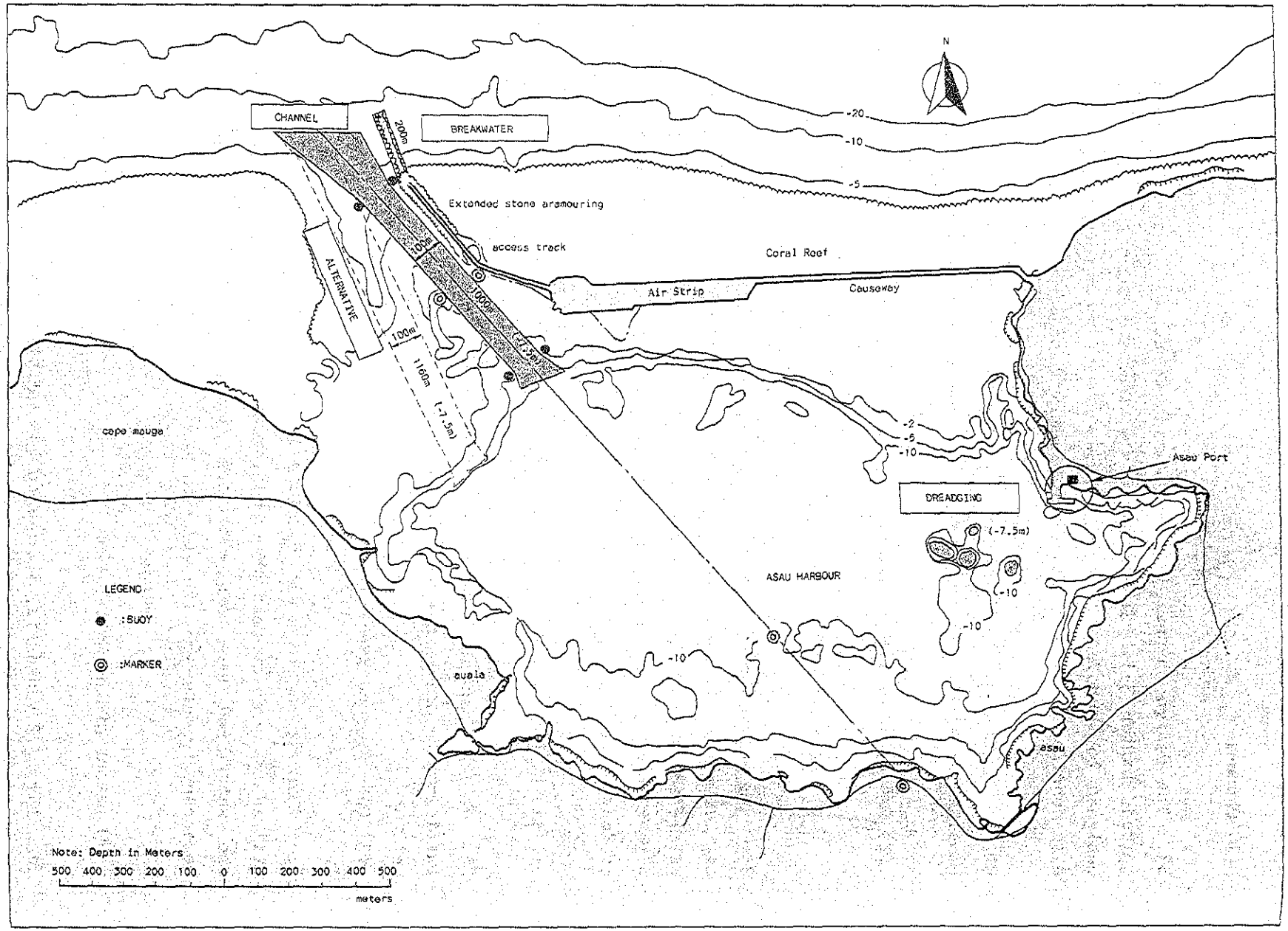


Fig. 3.2.5 Master Plan 2005, Asau Port

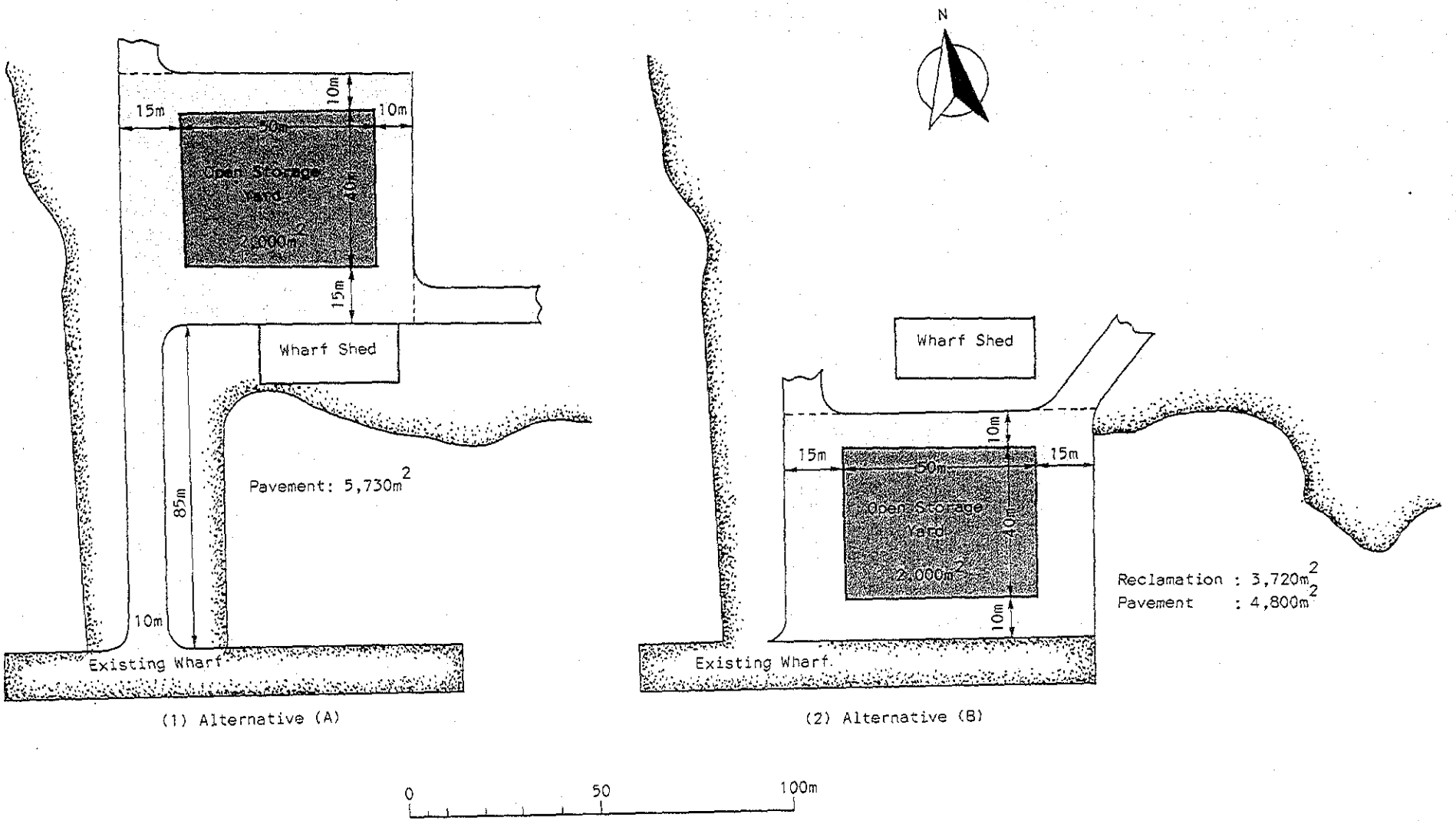


Fig. 3.2.6 Layout of the Open Storage Yard, Asau Port

3) Salelologa and Malifanua Ports

89. The layouts of the parking lots at both ports under the Master Plan are designed considering mainly easy access to the ferry and the present road. Fig. 3.2.7 - 3.2.9 show the Master Plan and related figures at Salelologa Port, and Fig. 3.2.10 - 3.2.11 show the Master Plan and related figures at Mulifanua Port.

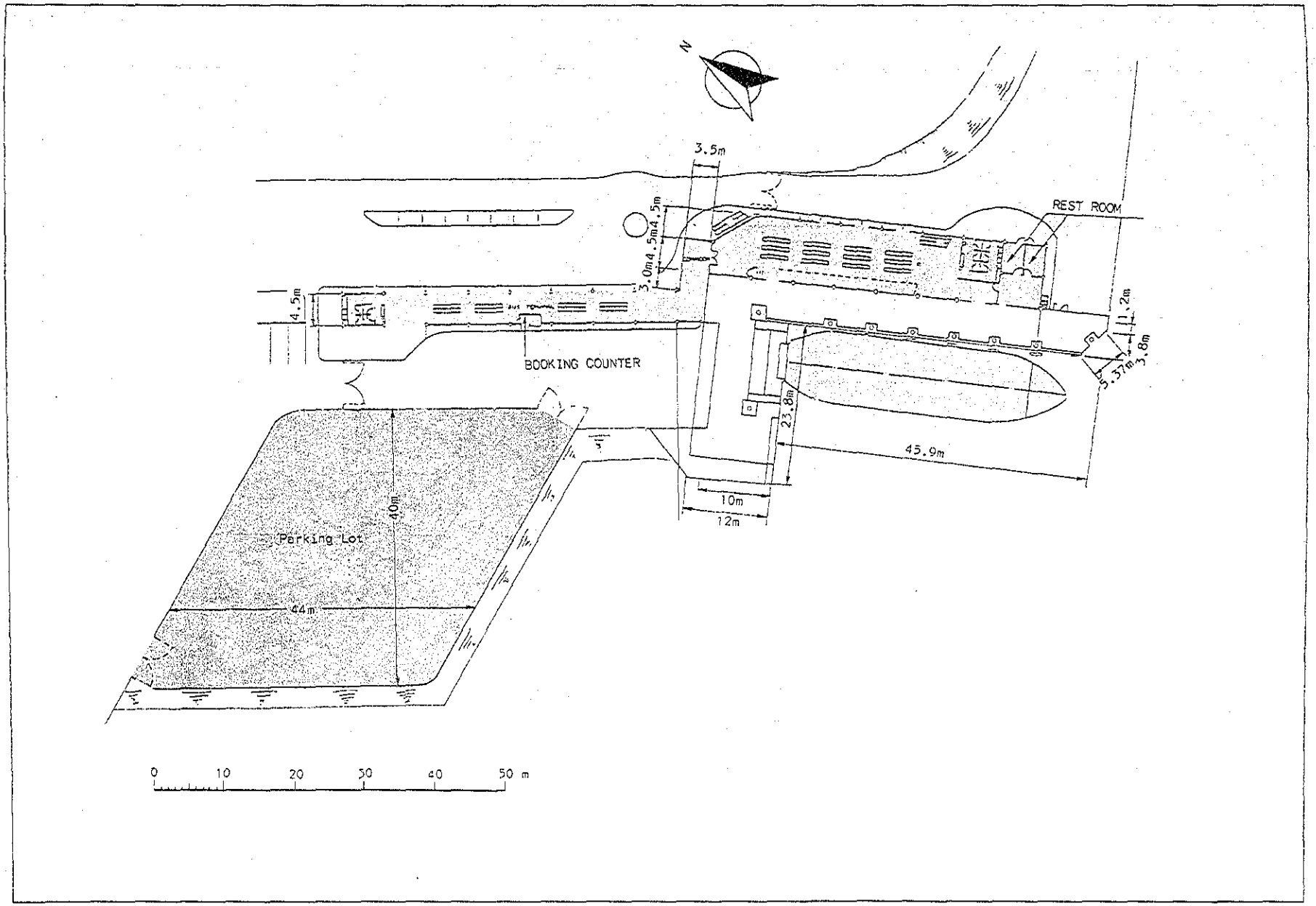


Fig. 3.2.7 Master Plan 2005 (Parking Lot) Salelologa Port

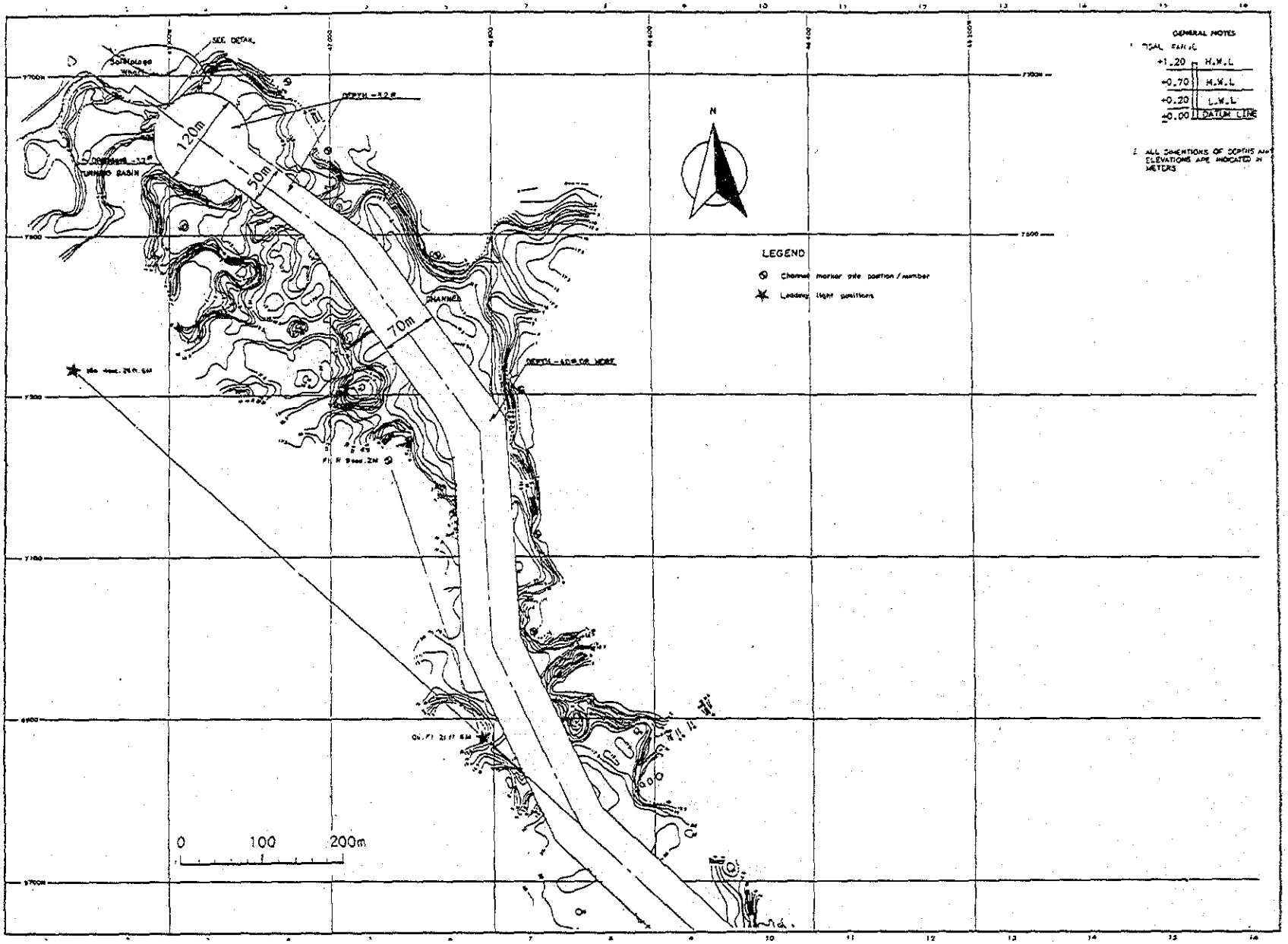


Fig. 3.2.8 Location of Navigation Aid Facilities, Salelologa Port

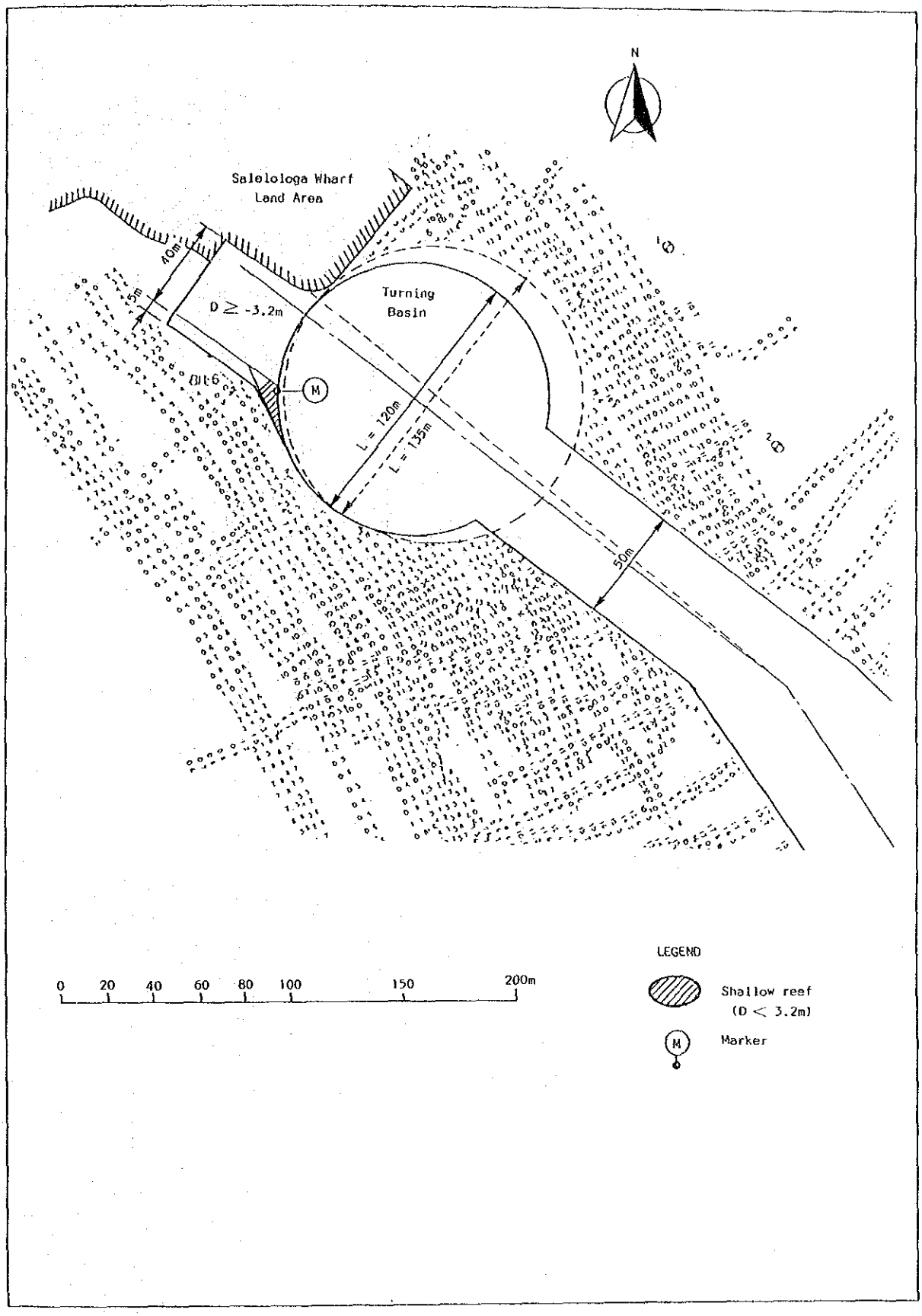


Fig. 3.2.9 Basin in Salelologa Port

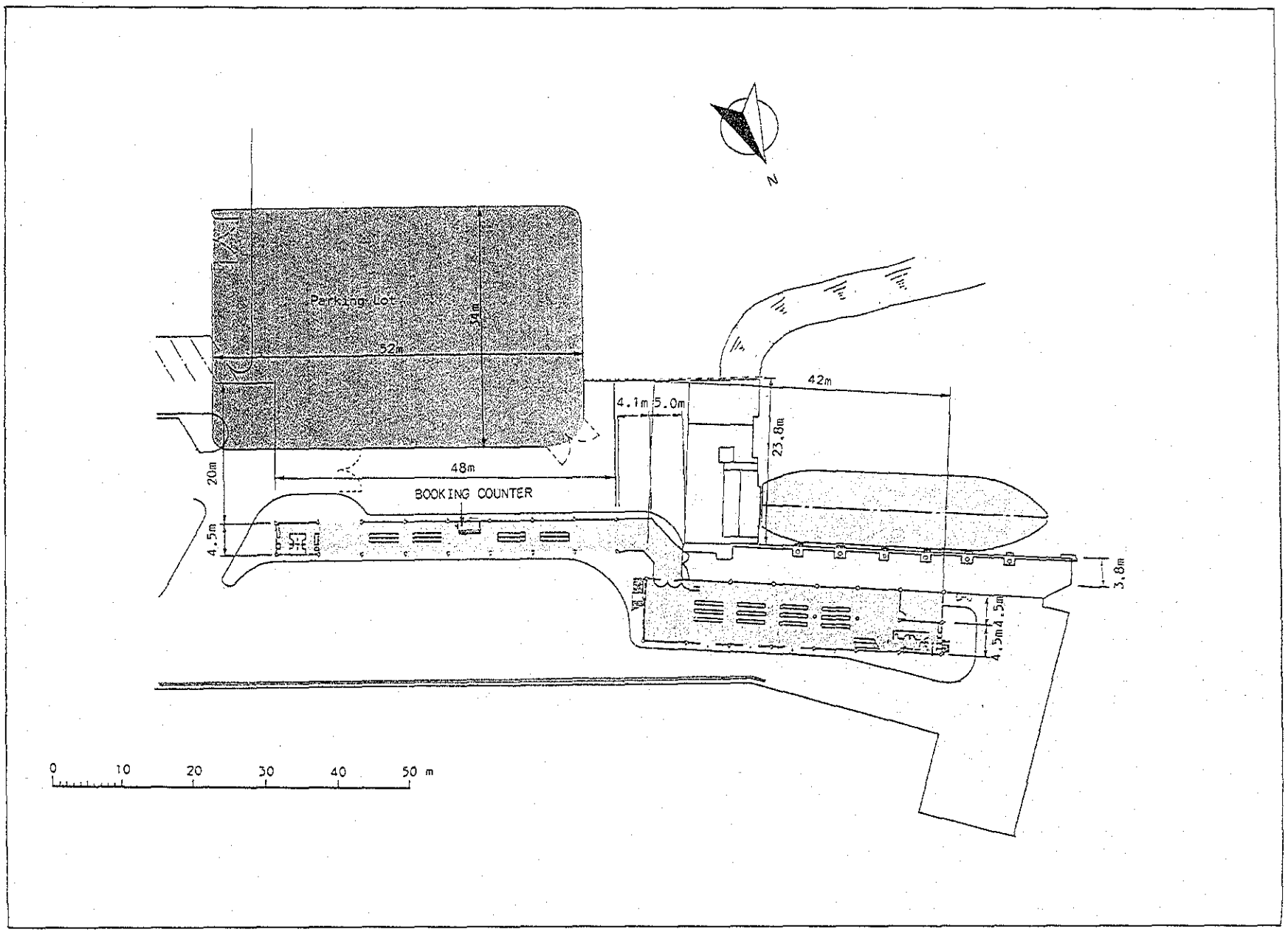


Fig. 3.2.10 Master Plan 2005 (Parking Lot) Mulifanua Port

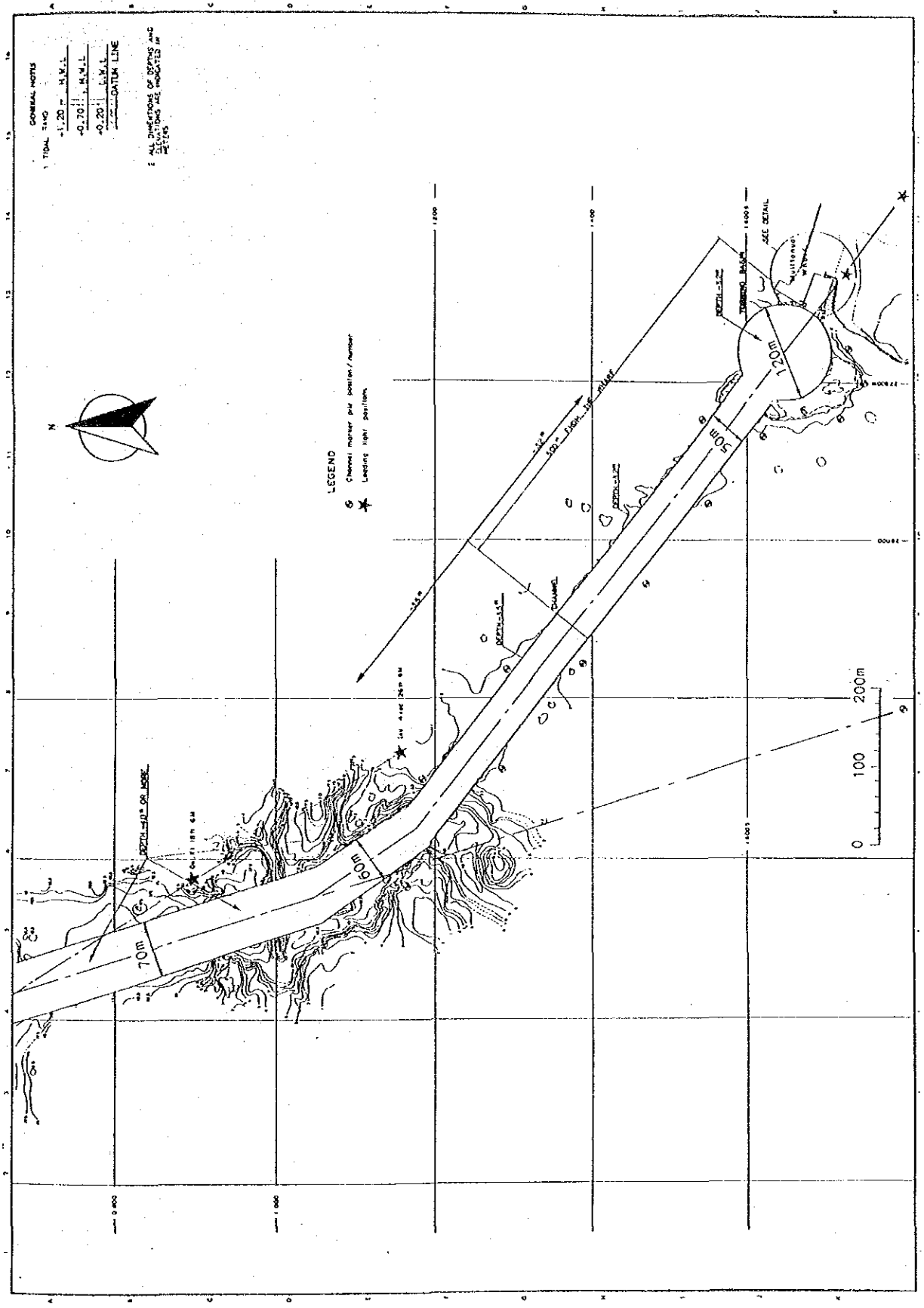


Fig. 3.2.11 Location of Navigation Aid Facilities, Mulifanua Port

3-3 Total Investment

90. The total project cost of the Master Plan for Apia, Asau, Salelologa and Mulifanua Ports is tabulated in Table 3.3.2 - 3.3.4 and is summarized in Table 3.3.1 below.

Table 3.3.1 Total Construction Cost of Master Plan

Name of Harbour		Total Cost (1,000 WS$)
1.	Apia	85,616
2.	Asau (Alternative A)	19,609
3.	Salelologa and Mulifanua	4,358
	G. Total	109,583

91. The major project item for Apia Port under the Master Plan is the construction of the new wharf, and the total project cost is estimated at about 86 million WS$.

92. For Asau Port, the extension of the breakwater and the dredging work of the approach channel are the major items, and the total project cost is estimated at about 20 million WS$.

93. Salelologa and Mulifanua Ports will require a total project cost of about 4 million WS$ mainly for the improvement of the existing ferry terminals.

Table 3.3.2 Project Cost of Master Plan (Apia Port)

No.	Item	Unit	Quantity	Unit Cost WS$	Amount 1,000 WS$
1	Dredging	m^3	110,000	17	1,870
2	Breakwater	m	100	49,700	4,970
3	Wharf Repair	LS	1	496,000	496
4	New Wharf -11m	m	210	122,000	25,620
5	Ferry Terminal	m^2	3,600	880	3,168
6	Small Vessel Wharf	m	100	21,300	2,130
7	Buoy Lighting	LS	1	16,000	16
8	Buoy Resiting	LS	1	250,000	250
9	Container Yard	m^2	6,000	850	5,100
10	Container Terminal	m^2	25,000	130	3,250
11	Beacon Upgranding	PC	2	70,000	140
12	Marina	m^2	10,000	240	2,400
13	Green Area	m^2	5,000	90	450
14	C.F.S.	m^2	1,200	1,700	2,040
15	Maintenance Shop	m^2	200	1,400	280
16	Transit Shed	m^2	5,000	1,100	5,500
17	Main Office	m^2	1,500	2,700	4,050
18	Pilot Office	m^2	200	2,400	480
19	Co. Oil Tank & Shed	LS	1	463,000	463
20	Tug Boat	PC	2	2,740,000	5,480
21	Mobilization	LS	1	6,850,000	6,850
	S. Total				75,003
22	E. Services	LS	(1-19)x0.05		3,134
23	Contingency	LS	(1-13)x0.15		7,479
	S. Total				10,613
	G. Total				85,616

Table 3.3.3 Project Cost of Master Plan (Asau Port)

No.	Item	Unit	Quantity	Unit Cost WS$	Amount 1,000 WS$
	(Alternative A)				
1	Dredging of Channel	m^3	320,000	17	5,440
2	Dredging of Basin	m^3	420	170	71
3	Breakwater Extension	m	200	34,250	6,850
4	Open Storage Yard	m^2	5,730	113	647
5	Navigational Aids	LS	1	290,000	290
6	Mobilizaion	LS	1	3,650,000	3,650
	S. Total				16,949
7	E. Services	LS	(1-5)x0.05		665
8	Contingency	LS	(1-5)x0.15		1,995
	S. Total				2,660
	G. Total				19,609
	(Alternative B)				
1	Dredging of Channel	m^3	700,000	17	11,900
2	Dredging of Basin	m^3	420	170	71
3	Breakwater Extension	m	200	34,250	6,850
4	Open Storage Yard	m^2	4,800	540	2,592
5	Navigational Aids	LS	1	290,000	290
6	Mobilizaion	LS	1	3,650,000	3,650
	S. Total				25,353
7	E. Services	LS	(1-5)x0.05		1,085
8	Contingency	LS	(1-5)x0.15		3,256
	S. Total				4,341
	G. Total				29,694

Table 3.3.4 Project Cost of Master Plan (Salelologa and Mulifanua Ports)

No.	Item	Unit	Quantity	Unit Cost WS$	Amount 1,000 WS$
	(Salelologa Port)				
1	Parking Area	m^2	3,500	320	1,120
2	Dredging	m^3	170	260	44
3	Navigational Aids	LS	1	260,000	260
	S. Total				1,424
	(Mulifanua Port)				
4	Parking Area	m^2	1,700	320	544
5	Navigational Aids	LS	1	180,000	180
6	Mobilization	LS	1	1,780,000	1,780
7	E. Services	LS	(1-5)x0.05		107
8	Contingency	LS	(1-5)x0.15		322
	S. Total				430
	G. Total				4,358

CHAPTER 4
THE FIRST STAGE PLAN

Chapter 4 The First Stage Plan

4-1 Priority Evaluation

1. Before determining the construction schedule, it is necessary to determine the priority of the various port works. Based on the relative priority, urgent works can be identified and a decision can be made as to which works should take place as part of the First Stage Plan.

1) Overview of the Required Works at Each Port

2. Following is a brief summary of the required works at each port.

① Apia Port: There are presently numerous bottlenecks at the port which greatly reduce the cargo handling efficiency and safety.

② Asau Port: The present problems are the channel and markers, but these problems are not so urgent compared with the cost.

③ Mulifanua Port: There are no urgent problems.

④ Salelologa Port: The only problem is the shallowness at the edge of the basin. However, it is not necessary to dredge this area on an urgent basis. Rather, the shallow area should be properly marked.

3. Based on this brief summary, it is clear that the only place where works will have to be carried out on an urgent basis is at Apia Port. Therefore, only the priority of the works at Apia needs be considered to determine which works should be carried out under the First Stage Plan.

2) Evaluation Criteria and Method

4. The relative priority of the works at Apia is determined based on the following criteria:

① Necessary to resolve the present bottlenecks
② Relative demand for each facility.
③ Economic benefit of each facility
④ Ability to upgrade the safety of port activities

5. There are various ways to determine the priority of the port works. Here, each of the port works is first evaluated in terms of each of the criteria presented above. They are ranked ◎ , ○ , △ , and × with ◎ as the highest rank and as the lowest rank.

6. Certain works are then chosen for the First Stage Plan. All the port works selected for the First Stage Plan have at least three marks ◎ and no × marks. The results of the evaluation are summarized in Table 4.1.1.

3) Results of the Evaluation

7. The port works to be carried out under the First Stage Plan and the main benefits of each of these works is summarized below.

① Construction of the breakwater - Improve the calmness of the harbour
② Repair of the main wharf - Increase the structural life of the wharf
③ Improve the ferry terminal - Separate passenger traffic and cargo handling
④ Expansion of the yard - Upgrade the cargo handling efficiency
⑤ Lighting of buoys - Improve navigation safety
⑥ Purchase a new tugboat - Upgrade the safety of vessel maneuvering

8. The entire project divided into the first stage works and the long-term works is summarized in Table 4.1.2. The port works under the First Stage Plan should be completed within 5 years, and all the long-term works should be completed by the target year of the Master Plan, 2005.

Table 4.1.1 Priority Evaluation

	Resolve the present bottlenecks	Demand	Economic benefit	Upgrade safety	First stage works
Dredging the basin	○	○	△	○	
Breakwater	◎	◎	△	◎	○
Repair the wharf	◎	◎	◎	◎	○
New wharf	○	×	△	×	
Ferry terminal	◎	○	◎	◎	○
Wharf for small vessels	△	△	△	○	
Lighting of buoys	◎	◎	○	◎	○
Resite buoys offshore	◎	△	△	◎	
Expansion of yard	◎	◎	○	◎	○
Container terminal	△	△	△	○	
C.F.S., M.S.	△	△	△	○	
New transit sheds	△	△	△	○	
Coconut oil tanks & shed	×	×	△	○	
Main & pilot offices	○	○	×	△	
New tugboat	◎	◎	○	◎	○
Second new tugboat	△	×	×	◎	
Upgrade beacons	○	○	△	○	
Marina	○	△	△	○	
Green	△	△	△	×	

Table 4.1.2 Stage Plan under the Master Plan

Project	First stage	Long term
o Breakwater	○	
o Repair the wharf	○	
o Ferry terminal	○	
o Lighting of buoys	○	
o Expansion of the yard	○	
o Tug boats	○	○
o Dredging the basin		○
o New wharf		○
o Wharf for small vessels		○
o Resite buoys offshore		○
o Container terminal (Including C.F.S. & M.S.)		○
o New transit sheds		○
o Coconut oil tanks & shed		○
o Main & pilot offices		○
o Upgrade beacons		○
o Marina		○
o Green		○

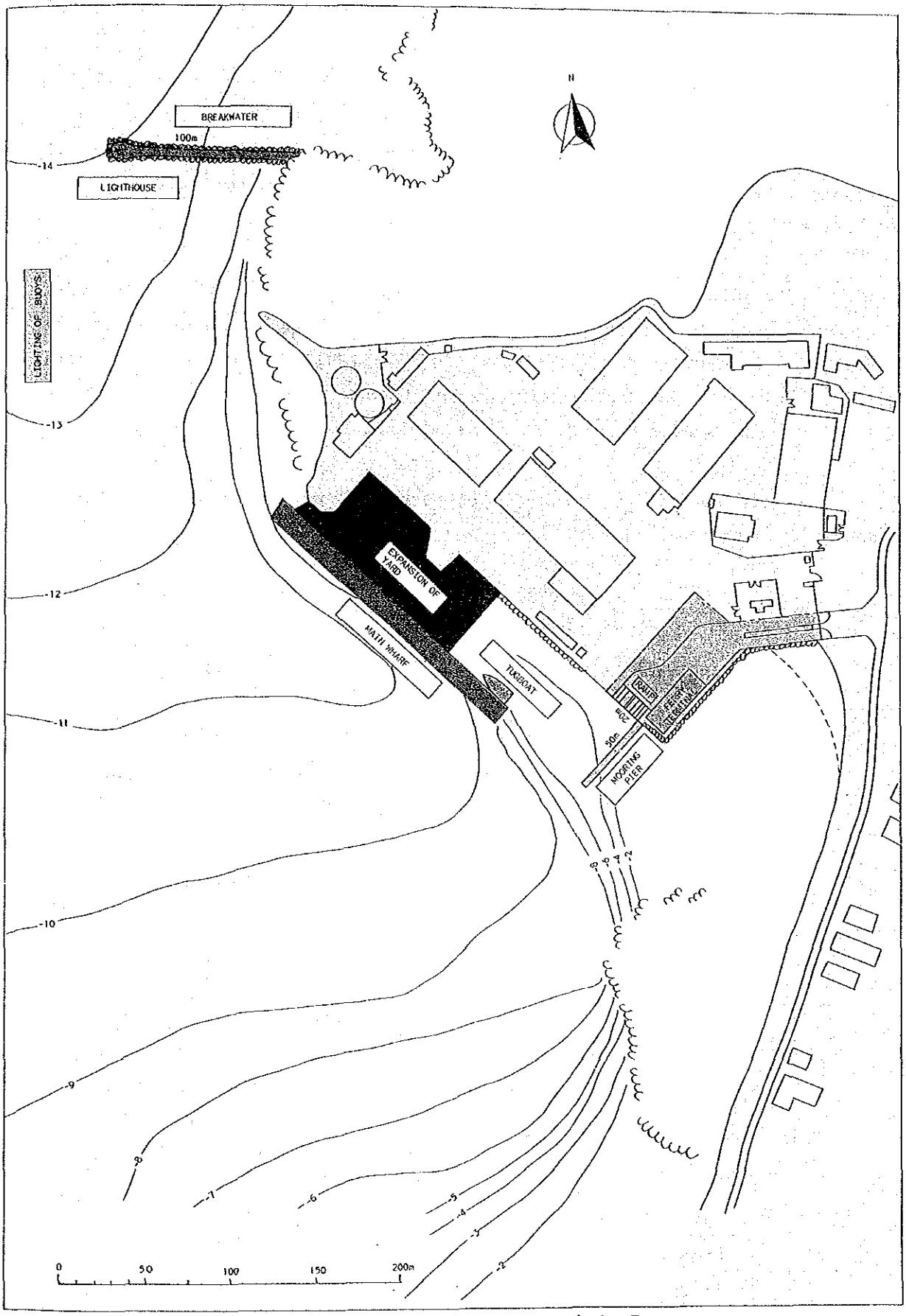


Fig. 4.1.1 First Stage Plan, Apia Port