11.3 Investment Scale and Implementation Plan

The initial investment of the project is shown in the following table. Fig. 11-1 shows the construction schedule.

Table 11-1 Initial Investment Cost

(Units: NZ$)

Site	No.	Area	:	Description of Work	Q'ty	Unit	Costs
1	1	Health Dept.	:	Seawall	300	m	747,000
2	2	Avarua East Coast	:	Seawall/Reclam.	125	m	833,000
	P3	Avarua Harbour	:	East Breakwater	90	m	535,000
	P4		:	West Breakwater	30	m	414,000
	P5		:	East Marina Wharf	155	m	474,000
	P6		:	Repair work of existing wharf	155	m	495,000
	P7		:	Temp. Quay/Jetty		L/S	371,000
	P8		:	Dredging	9,938	m^3	350,000
	9	Avarua Central Coast	:	Add. Works to MOW seawall	130	m	392,000
	10		:	Seawall/Reclam (middle)	220	m	1,703,000
	11		:	Seawall/Reclam (west)	195	m	1,084,000
	P12	Avatiu Harbour	:	East Breakwater	280	m	3,250,000
	P13		:	Inner Breakwater	100	m	57,000
	P14		:	Relamation	13,000	m^3	154,000
	P15		:	Repair of Existing Quay	130	m	218,000
	P16		:	Slipway (TLT)	30	m	51,000
	P17		:	Fisheries Quay	145	m	437,000
	P18		:	Fishery Market Shed	300	m^2	150,000
	P19		:	West Breakwater	290	m	637,000
	P20		:	Utilities		L/S	350,000
	P21		:	Dredging	30,000	m^3	1,400,000
	P22		:	Tugboat & Cargo Handling Equipment		L/S	1,280,000
	23	Airport East	:	Tank yard (Seawall, West)	130	m	433,000
	24		:	Tank yard (Seawall, Mid.)	90	m	322,000
	25		:	Tank yard (Seawall, East)	80	m	305,000
	26		:	Auxiliary side dike	120	m	97,000
	27	Airport West	:	Seawall near MET	80	m	308,000
	28		:	Detached Breakwater	150	m	304,000
	29		:	Seawall at Nikao	115	m	490,000

Summary	:	Direct Costs Total----------	17,641,000
		Coastal Protection	7,018,000
		Port Improvement	10,623,000
With Contingency	:	x 1.205 Total----------	21,257,000
		Coastal Protection	8,457,000
		Port Improvement	12,800,000

Notes 1. Mark "P" means work item for port improvement sector.

2. Contingency means physical contingency and other allowance.

The total initial investment cost is about NZ$ 21.26 million. Total costs for the coastal protection works amount of about NZ$ 8.46 million and the total costs for the port improvement is about NZ$ 12.8 million. The total cost will be paid out over the first three years.

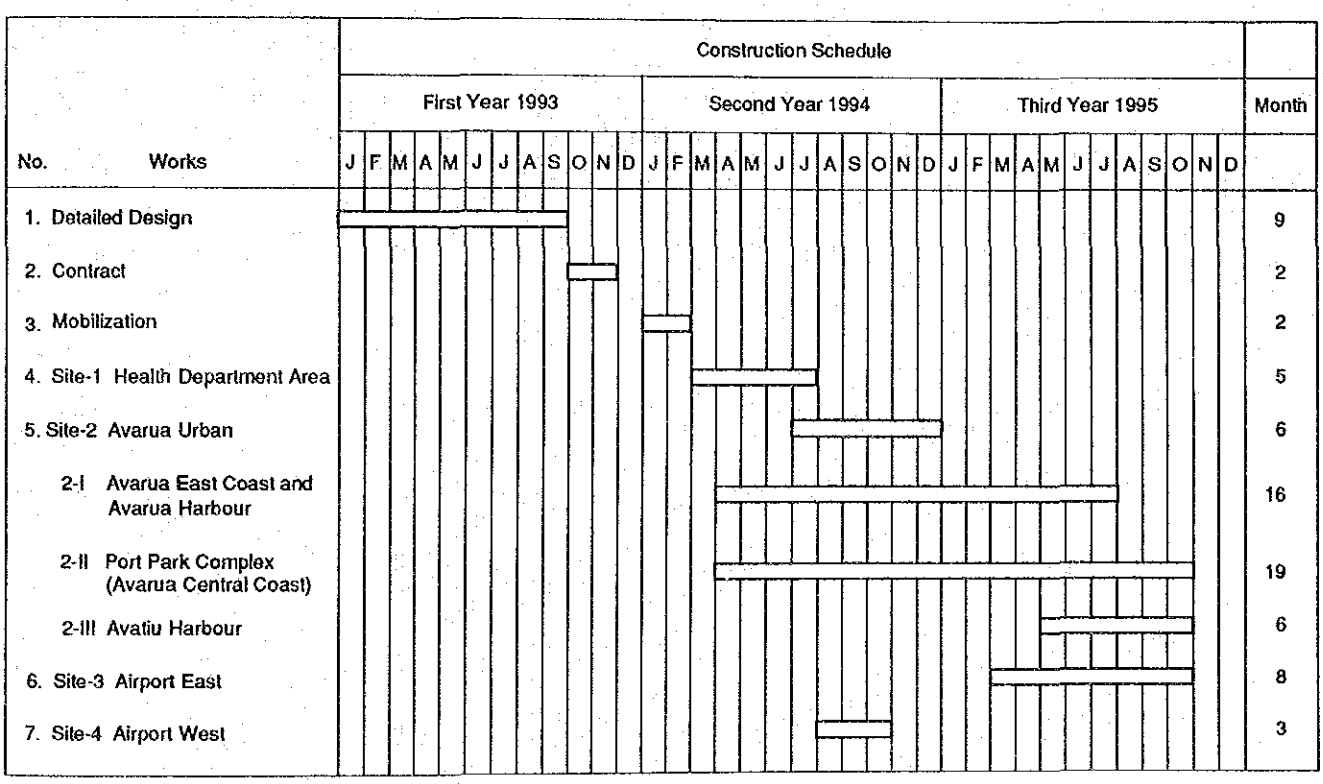
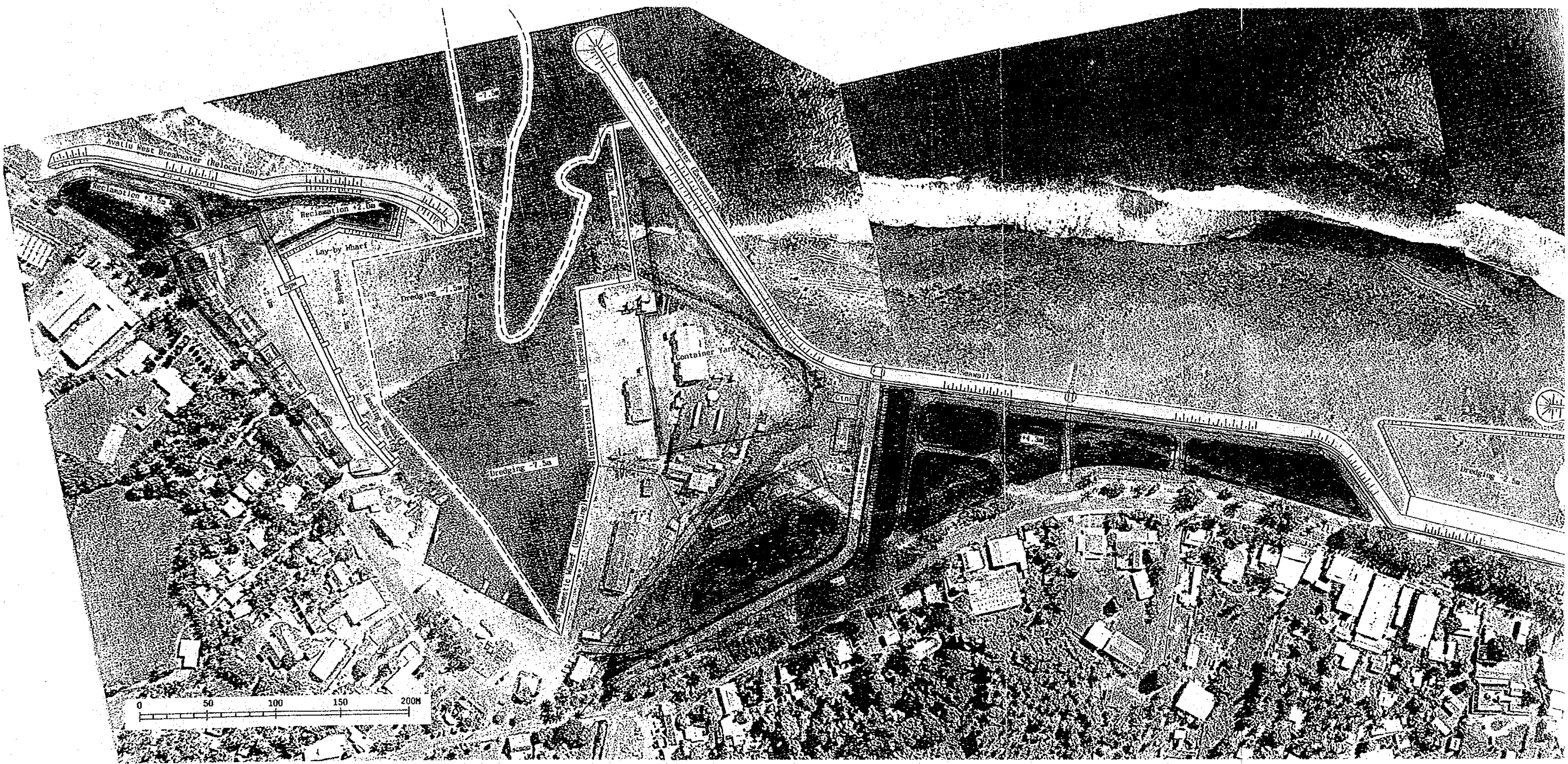


Fig. 11-1 Construction Schedule, Coastal Protection and Port Improvement Cook Islands



Avatiu West Breakwater (Relocation)
Reclamation +3.5m
Reclamation +2.0m
Lay-by Wharf
Spw
Dredging -1.5m
Dredging -7.5m
Shop
Boat Park
Adm
ICC
F Mkt
Car Park
Fish Landing Wharf
-7.5m
Dredging -7.5m
Avatiu East Breakwater (Extension)
Container Yard
International Wharf (Upgrading)
Domestic Wharf (Upgrading)
Shed
Ctnl
Shop
+3.0m
Avatiu Stream
Seawall
0
50
100
150
200M

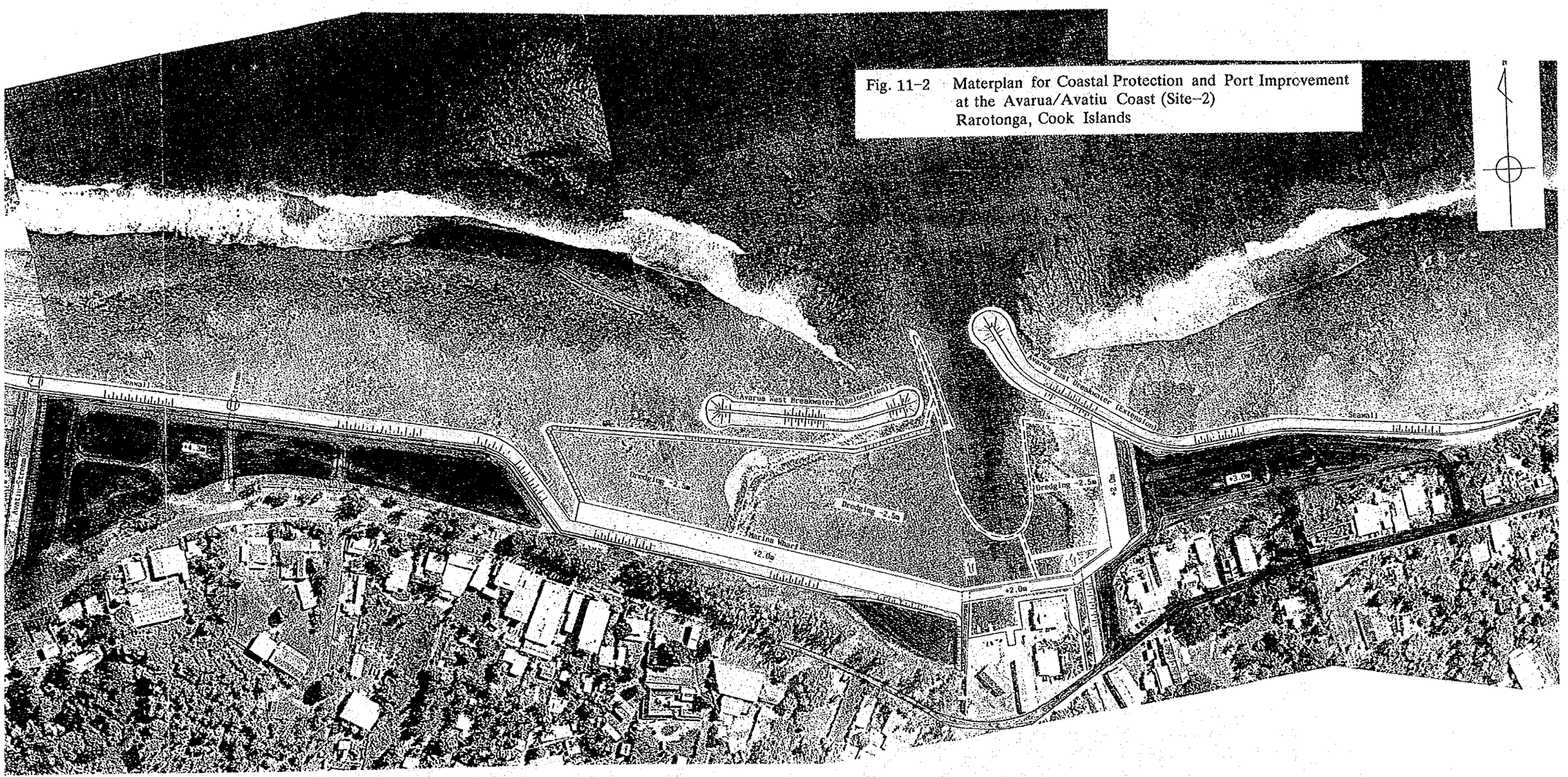


Fig. 11-2 Materplan for Coastal Protection and Port Improvement at the Avarua/Avatiu Coast (Site-2) Rarotonga, Cook Islands

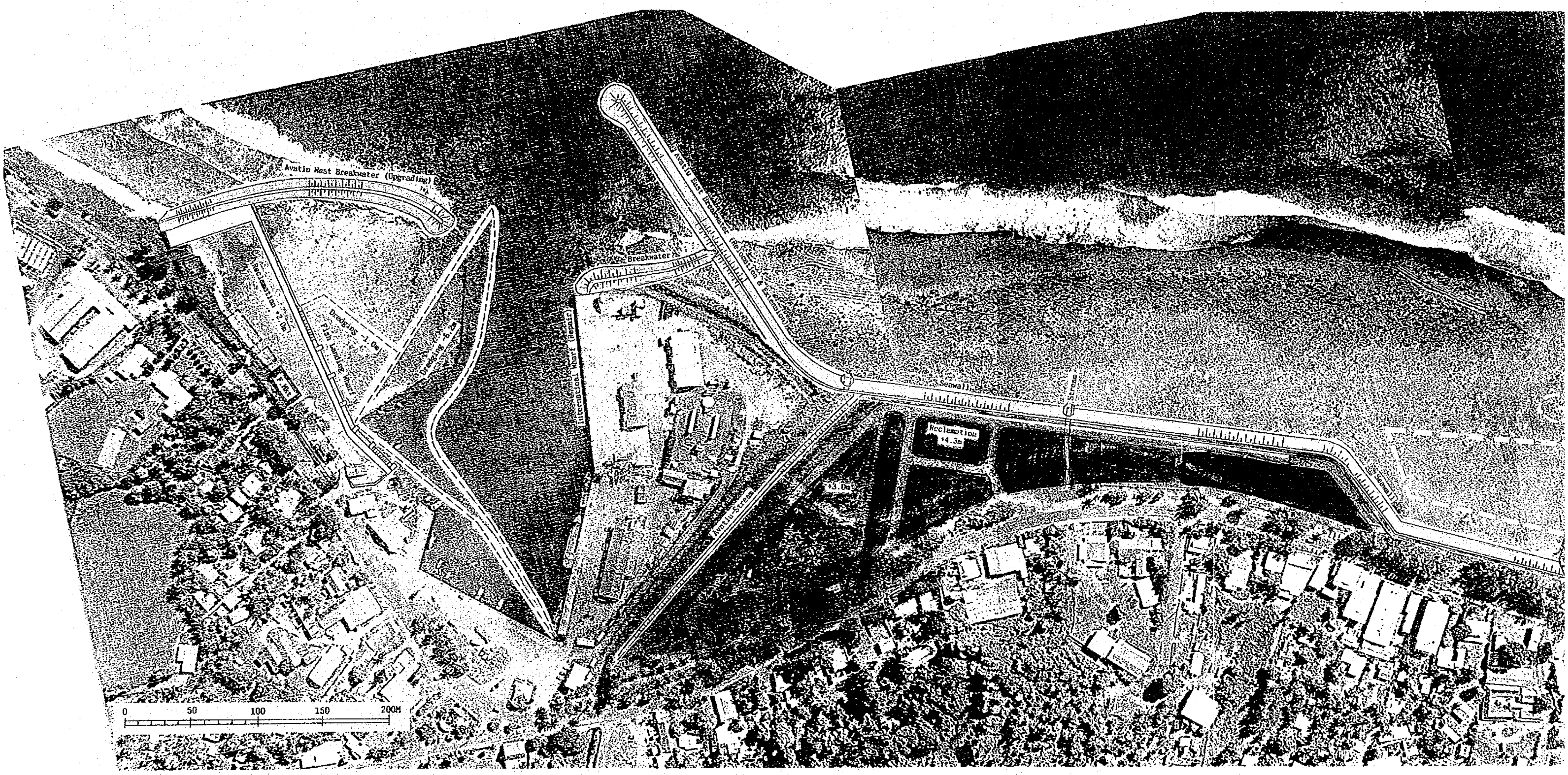

Avatiu West Breakwater (Upgrading)
Reclamation +2.0m
Dredging -1.0m
Fish Landing Wharf
Dredging -6.2m
F.Mkt
Avatiu East Breakwater (Relocation & Extension)
Breakwater
International Wharf (Repair)
Seawall
Reclamation +4.3m
+3.0m
Avatiu Stream
0
50
100
150
200M

Fig. 11-3 Short-Term Development Plan for Coastal Protection and Port Improvement at the Avarua/Avatiu Coast (Site-2) Rarotonga, Cook Islands

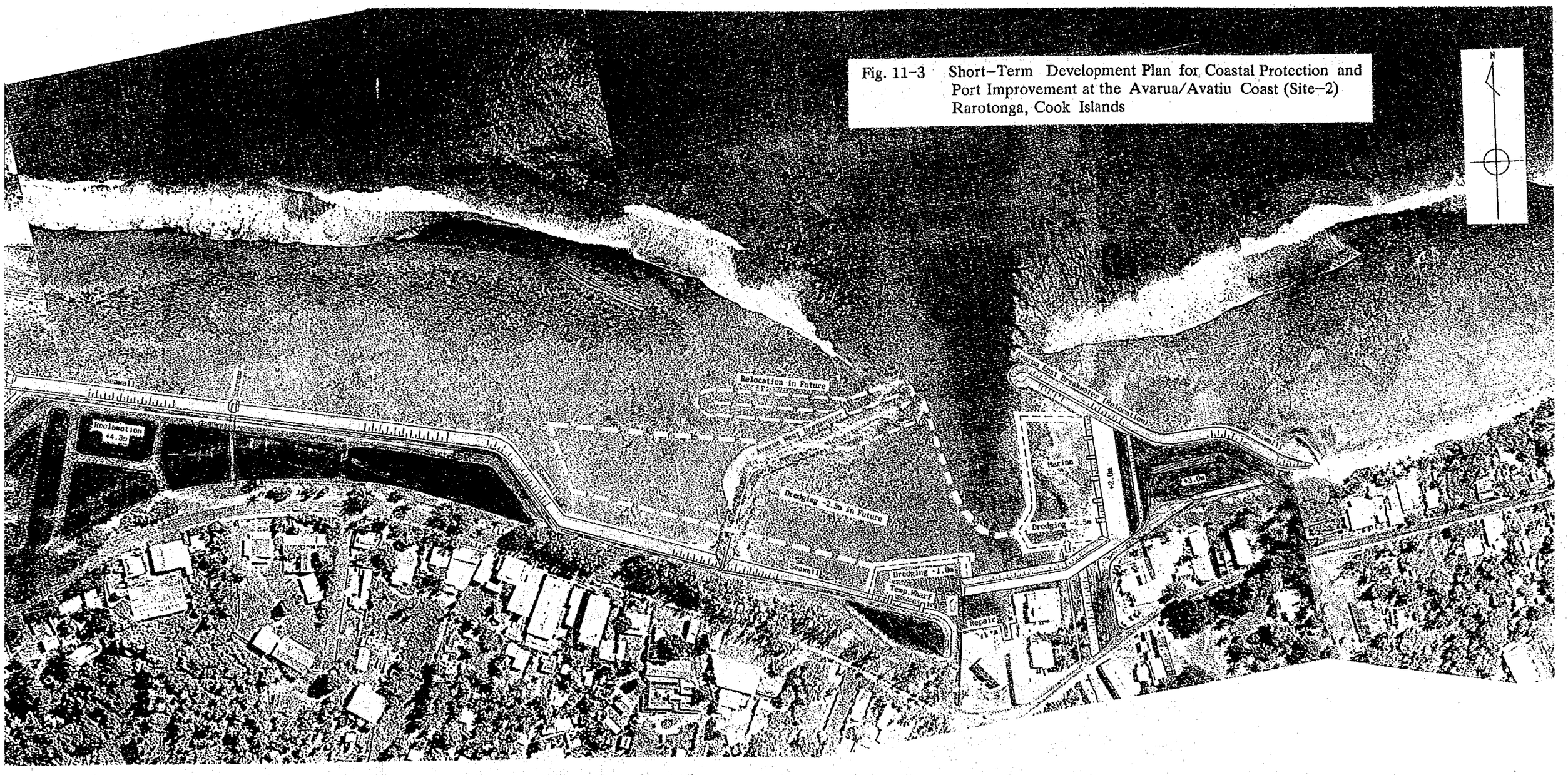


Fig. 11-4 Short-Term Development Plan for Coastal Protection in front of the Health Department (Site-1)

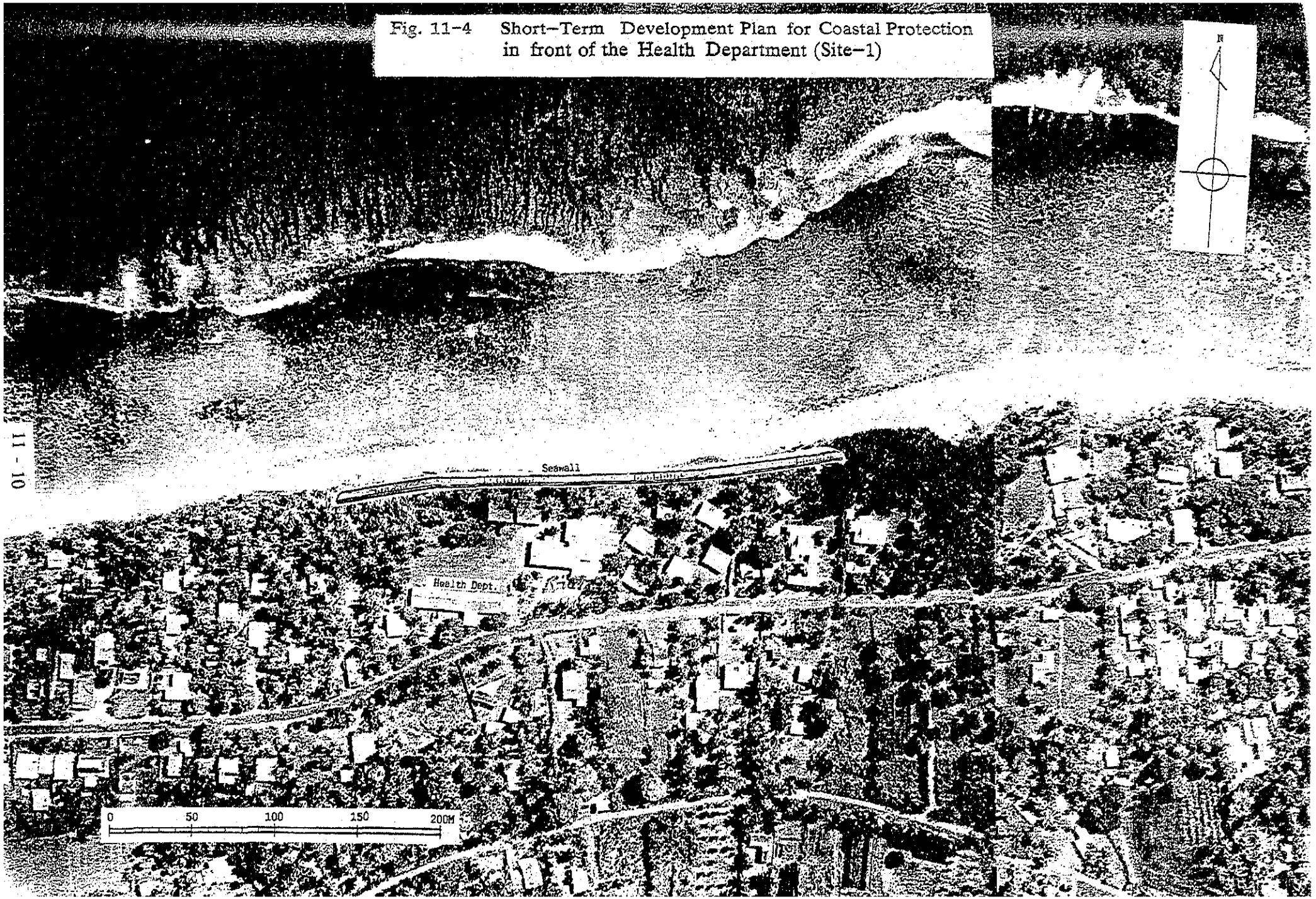


Fig. 11-5 Short-Term Development Plan for Coastal Protection in front of the Petroleum Tanks (Site-3)

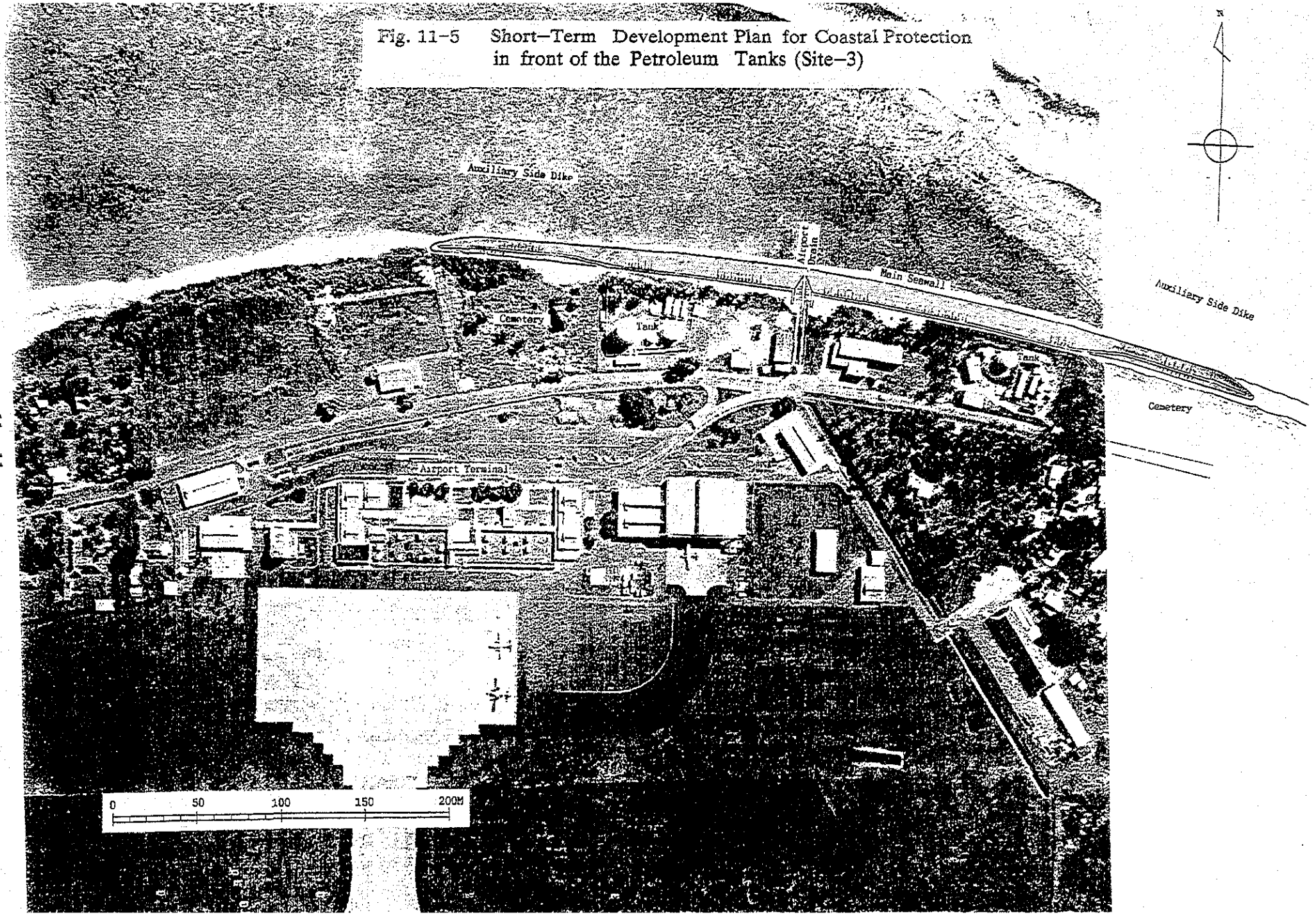
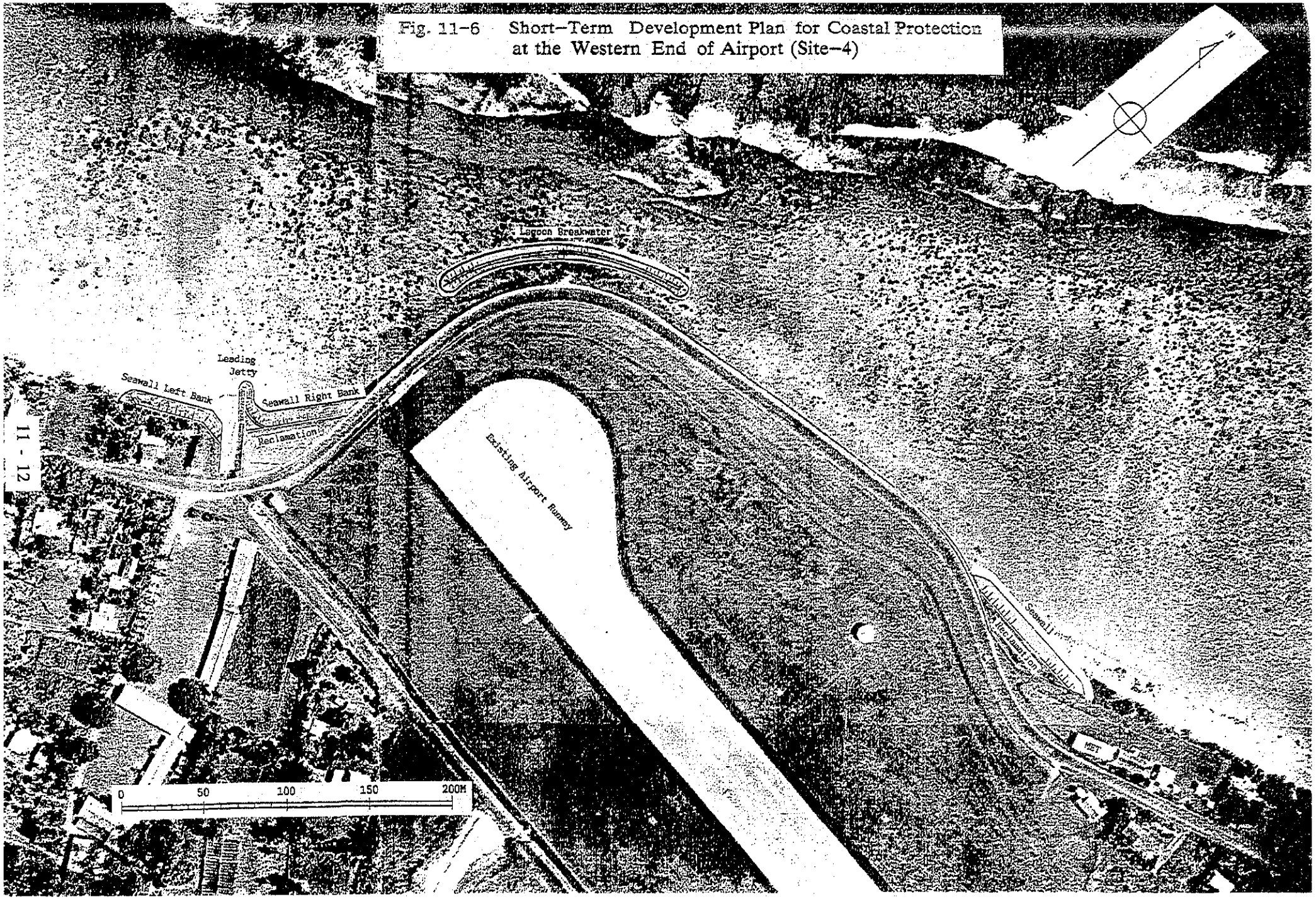


Fig. 11-6 Short-Term Development Plan for Coastal Protection at the Western End of Airport (Site-4)



Chapter 12: Short-term Development Plan: Coastal Protection

Chapter 12 Short-term Development Plan : Coastal Protection

12.1 Formulation of the Short-term Development Plan

12.1.1 Refinement of Plan

Coastal protection work in the proposed Short-term Development Plan is basically the same arrangement as described in the proposed Phased Development Plan. However, the necessary realignment was conducted based on the latest information including the requirements of the Cook Government and the preliminary design of system. The following four sites are to be protected:

Site - 1 Health Department and its Surroundings
Site - 2 Avarua/Avatiu Urbanized Area
Site - 3 Airport East
Site - 4 Airport West

1) Site - 1 Health Department and its Surroundings

The proposed length of the coastal protection here is 300 meters. This is 100 meters longer than the original layout in Chapter 10. The new arrangement can cover the government offices and public facilities including the Health Department, Department of Education, the Office of Secretary and the Conservation Department. To prevent this site from such damage as caused by Cyclone Val/Wasa in late 1991 and Cyclone Gene in March 1992 makes this extension necessary.

The proposed defense line is about two meters behind the existing concrete seawall that is located near the beach top. Thus, the existing wide sandy beach will remain as it is for use by local swimmers. The backfilling work on the existing moderate slope using excavated coral fragments will be made behind the proposed seawall for the creation of elevated flat land. The foreshore area should continue to be accessible by local swimmers.

2) Site - 2 Avarua/Avatiu Urbanized Area, Avarua Harbour East

The investment scale for protection work here will be made for a limited area for cost reduction purposes. The proposed coastal protection work beyond the existing East Breakwater will cover 160 meters of the coastal area. This is one half the coverage shown in the original layout in Chapter 10.

Proposed defense line is in advancing area about 50 m seawards in order to create new buffer zone. Along the western faceline, a 160 meter long dike wall will be constructed for retaining reclaimed earth. The outlet of Takuvaine (Avarua) stream will be located at the southern end of this dike. Among this dike, northern 85 m wall will be marina wharf together with five berthing jetties.

3) Site - 2 Avarua/Avatiu Urbanized Area, Avarua Harbour

The necessary coastal protection work should be conducted. However, the fundamental renewal of the port will not be performed during the Short-term Development Stage. While, the proposed alignment of major facilities is based on the Port Improvement Master Plan preventing work from double investment. As shown in Chapter 13, the East breakwater will be replaced to the new location of the Master Plan. However, the West breakwater will remain as it is until the Master Plan Stage to save costs.

The coastal protection work proposed here includes the realignment of the existing seawall line. Immediately westward of the existing Vaikapuangi Stream outlet, new reclamation work retained by a rock reprapping wall will be constructed. The proposed 120 meter long retaining wall will be constructed on the same faceline as the protection work at the West breakwater by MOW.

4) Site - 2 Avarua/Avatiu Urbanized Area, Port Park Complex

The coastal protection work proposed here has the same alignment as the original layout in Chapter 10.

Proposed faceline within 130 m Avarua West breakwater westwards is same alignment with the existing seawall executed by MOW in 1991. While remaining 350 m seawall to the Avatiu East breakwater will advance

seawards in 40 m to 130 m in order to create cyclone buffer zone. This zone will be constructed by land reclamation and aims at mitigating cyclone disaster to Avarua urbanized area where the most concentrated investments in the island are made by both private sector and public sector.

Under normal climatic condition, this new land will provide space for public use such as car parking area, bus terminal, green park, etc. About 40 % of this land faced to Avatiu Harbour will be the future port expansion site in the Master Plan stage. Construction cost of seawall will be minimal due to reuse of the existing seawall armour rock.

5) Site - 3 Airport East

The proposed coastal protection length is 350 meters. This is 150 meters longer than the original layout. The new arrangement will cover the two existing Fuel Storage Facilities, JUHI and TRIAD, the laundry factory located between them and cemeteries.

The proposed seawall faceline is located about five meters seaward of the existing fuel storage seawall.

6) Site - 4 Airport West

The proposed coastal protection length is 360 meters. This is 160 meters longer than the original layout. The new arrangement will cover not only the existing northwest corner of the runway, it will take in the airport west-end seawall and the seawall near MET.

Chapter 13: Short-term Development Plan: Port Improvement

Chapter 13 Short-term Development Plan : Port Improvement

13.1 Objective of Short-term Development Plan

According to the traffic demand forecast, growth of traffic up to 1997 is moderate, thus the primary objective is to ensure the safety of port users and vessels. Another important objective is to build the fisheries sector in Avatiu Harbour as recommended in the Master Plan. Alignment of the east breakwater in Avarua Harbour will also be modified, not only from the coastal protection view point, but also in anticipation of large marina construction in the future.

13.2 Required Port Facilities

1) Avatiu Harbour

The existing deep-sea wharves for both international and domestic cargo will be utilized. 60% of the pleasure boats simultaneously staying in the harbours will be moored at the south side wharf in Avatiu Harbour. The others are as follows.

Facility	Quantity
CFS	330 m^3
Container Yard	10,500 m^3

The width of the basin will be expanded to 140 m in case of using a tug boat taking into consideration the safe turning of large vessels.

The landing wharf (30 m long), the lay-by wharf (160 m long) and the market hall (200 m^3) will be constructed at Avatiu Harbour as per the policy of the Master Plan. And relocation of LPG tanks is desirable.

2) Avarua Harbour

60% of the pleasure boats simultaneously staying in the harbours will be moored at the south side wharf in Avatiu Harbour. The remainder of the yachts with a draft of less than 1.5 m will be moored at Avarua Harbour. Also the existing damaged facilities will be reconstructed.

3) Breakwater

The length of the east breakwater in Avatiu Harbour is 280 m. The length of the existing breakwater in Avarua Harbour is relocated and extended for maintaining a calm inner basin for small boats. This breakwater will be a part of the retained seawall in the area behind the east side of Avarua Harbour.

4) Equipment

The following equipment will be required in the Short-term Development Plan.

Equipment		Quantity
Tug Boat		1 no.
Buoy		1 no.
Trailer		1 no.
Forklift	20 ton	2 nos.
	5.0 ton	1 no.
	2.5 ton	1 no.

13.3 Port Operation and Management

The following is recommended to ensure safe and smooth operation.

1) Breakwater

Ship's stopping distance should be lengthened and the basin should be protected as much as possible by means of extending the breakwater. Also the cross section of the breakwater should be larger than before.

2) Cargo Handling Yard

The truck movements and travel distances of the handling equipment should be minimized and its movements should be restricted to the designated paved areas. Concrete pavement should be used.

3) Organization

The establishment of a port authority is recommended to reduce overhead, enhance and rationalize port operation and management.

13.4 Modified Development Plan of Avarua Harbour

Development of Avarua Harbour will be carried out in the Master Plan while no development plan other than for facilities which are damaged and hazardous to users will be executed in the Short-term Development Plan. Agreement between Government of the Cook Islands and the Study Team was reached at the second field survey (submission of the Interim Report). However, Government of the Cook Islands strongly requested that development of Avarua Harbour should be included in the Short-term Development Plan during the explanation mission of the Draft Final Report. After discussion between Government of the Cook Islands and the Study Team, it was concluded that the development of Avarua Harbour would be performed in the Short-term Plan provided that the Plan would be feasible in the economic analysis.

In the examination of the Final Report, taking into consideration the demand for marina in the target year 1997 and its construction cost, total project costs and benefits in the Short-term Plant, it was determined that appropriate facility would be arranged in Avarua Harbour to accommodate some of the pleasure boats calling at Rarotonga Island.