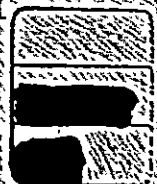


**MASTER PLAN FOR DEVELOPMENT  
OF  
PORTS IN ETHIOPIA  
(ASSAB & MASSAWA)**

**February 1974**

**OVERSEAS TECHNICAL COOPERATION AGENCY**



**MASTER PLAN FOR DEVELOPMENT  
OF  
PORTS IN ETHIOPIA  
(ASSAB & MASSAWA)**

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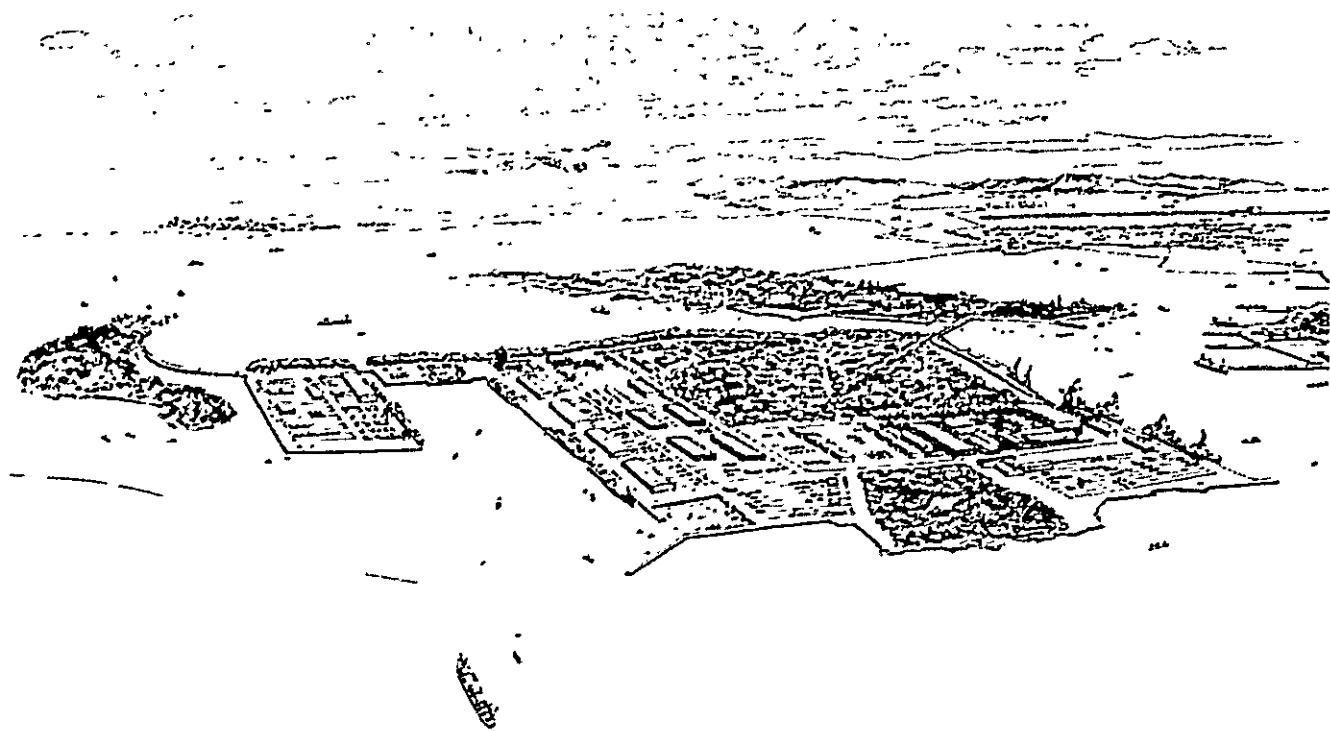


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February 1974

**OVERSEAS TECHNICAL COOPERATION AGENCY**

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Artist's Vision of the Port of Massawa Completed, Bird's eye view



## P R E A F A C E

The Government of Japan has complied with the request of the Imperial Ethiopian Government to prepare the development and improvement plan for two Ethiopian Ports, Assab and Massawa and entrusted the actual work to the Overseas Technical Co-operation Agency.

This Agency, recognizing the importance of the development of the said two ports for the development of the national economy of Ethiopia, has organized specialists teams headed by Mr. S. Kittaka and dispatched them in August 1972 and in February 1973 respectively. The first team had prepared its interim report and submitted it to the Ethiopian Government.

Meanwhile further studies, collection of necessary information and consulting with the Ethiopian authorities have been conducted. The second team continued the study while they exchanged views and opinions with the Ethiopian authorities concerned.

After all these extensive studies we have drawn up this report in a form of master plan for the development of two Ethiopian Ports. This master plan covers not only technical matters but also economical aspect of the port projects.

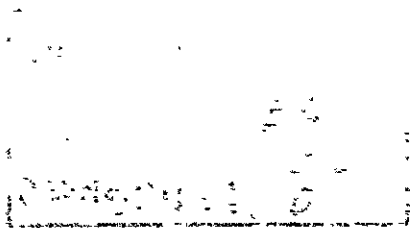
It is our great pleasure if this master plan would help the Ethiopian Government in preparing her port development plan and at the same time it would contribute much to promotion of friendly relations and closer economic co-operation between Japan and Ethiopia.

We express our sincere thanks to our Embassy in Addis Ababa, as well as Japanese firms in Ethiopia, our Ministries of Foreign Affairs, Transport and other governmental authorities for their kind assistance given to our study teams in executing their missions.

Yours sincerely,



Keiichi Tatsuke  
Director General  
Overseas Technical Co-operation Agency



As mentioned above four Japanese Study Teams have been dispatched in connection with the subject project to Ethiopia. Members of the respective study teams are mentioned hereunder.

**The First Team:**

**Team Leader:** Mr. Shunji Kittaka  
**Members:** Messrs. Yoshizawa, Kudo, Okuyama, Nambu, Fuseya and Imai

**The Second Team:**

**Team Leader:** Mr. S. Kittaka  
**Members:** Messrs. Kudo, Izumi and Imai

**The Third Team:**

**Team Leader:** Mr. S. Kittaka  
**Members:** Messrs. Shioda, Someya and Kamiya

**The Fourth Team:**

Mr. Kudo, Mr. Ishiwata

The Fourth Team was dispatched to draw up the final Master Plan for the two ports.

The schedule of this fourth team was as follows.

25th October 1973	Leaving Tokyo
26th October 1973	Arrival in Addis Ababa
27th October/11th November	Talks with Ethiopian authorities and private industries to collect further information and data. Please refer to the attachment.
13rd November/20th November	Site survey in Assab and Massawa in co-operation with Port Offices
21st November/13rd December	Preparation of report (Draft)
14th December	Visited H. E. Ato Nagash and submitted a draft of the report
15th December/16th December	Visited the Addis Ababa-Assab Highway now under construction
17th December	Explanation of the draft of the report at the Steering Committee, Planning Commission. Heard the Ethiopian views and opinions.
18th December	Leaving Addis Ababa for Japan
21st December	Arrival in Tokyo

**ATTACHMENT**

(Schedule of the Fourth Study Team)

Date	Names of Organizations Visited or Contacted	
	Name of Organization	Name and His Position
30th Oct. (Tue.)	ETHIOPIA AMALGAMATED Ltd.	Mr. GEBREYES BEGNA General Manager
31st Oct. (Wed.)	AGIP	Mr. MARCO MANZONI General Manager
1st Nov. (Thu.)	Assab Oil Refinery	Mr. KEBEDE AKALE WELDE Managing Director
3rd Nov. (Sat.)	CUSTOM HEAD OFFICE	FITAURARI BERHE HADERA Assistant Minister Deputy Head of Custom
5th Nov. (Mon.)	MINISTRY OF AGRICULTURE Planning and Programming Department	Dr. KEN EUBANK (U. S. Aid) Mr. KETEMA DESTA Head, Economic Research
	MINISTRY OF MINES	Mr. GIRMA ZAWDE Assistant Minister Dr. JOHN S. TOOMS U. N. Project Manager
6th Nov. (Tue.)	ROAD TRANSPORT ADMINISTRATION Planning and Programming Department	Mr. SERKE BERHAN TESHBERU Acting Head of Research
	IMPERIAL HIGHWAY AUTHORITY Planning and Programming Division	Mr. KASSAHUM ZELLEKE
7th Nov. (Wed.)	LIVESTOCK AND MEAT BOARD	Eng. MIODRAG TUCOVIC Head, Planning, Research and Information Department
	MINISTRY OF AGRICULTURE (2nd visit)	
9th Nov. (Fri.)	AGRICULTURAL INPUT AND MARKETING SERVICE SH. C. PLANNING COMMISSION OFFICE Steering Committee	Mr. TESFA TADESSE  Mr. YUSUF AHMED Mr. T. MARINOS *1
10th Nov. (Sat.)	MINISTRY OF COMMERCE, INDUSTRY AND TOURISM PLANNING COMMISSION OFFICE	Dr. DEBEBE WORKU Mr. KETEM DEST Mr. TOME
12th Nov. (Mon.)	AID BANK	Mr. WONDLOSSEN SAHALE Chief Engineer
12th Nov. (Mon.)	TECHNICAL AGENCY Library	Chief, Librarian
14th Nov. (Wed.)	Massawa PORT OFFICE	Mr. Port Manager *2
17th Nov. (Sat.)	Assab PORT OFFICE	Mr. SEYOUM T. WORK Port Manager *2
19th Nov. (Mon.)	Djibouti PORT OFFICE	Mr. General Manager  Mr. Traffic Manager

\*1 Following members attended from Marine Department.

Mr. AYELE MAKONNEN, Mr. MEBRAHTU G. KIDAN, Mr. BISLAT HABTE MICHAEL,  
Mr. MICHAEL MUSIE

\*2 At both ports, related officers such as Planning Officer, Traffic Officer, Engineering Officer &  
Port pilot attended the meeting.

Mr. Kefichi Tatsuke, Director General  
Overseas Technical Cooperation Agency  
Tokyo, Japan

Dear Sir:

We have the pleasure to submit herewith the Master Plan for Development of Ethiopian Ports. This Master Plan is the results of the studies conducted by the specialists teams dispatched several times to Ethiopia since September 1972.

We believe that this Master Plan will be a guide for the future development of two Ethiopian Ports, Assab and Massawa the plan of which the Imperial Ethiopian Government has requested our Government to prepare.

In submitting this Master Plan we must express our sincere thanks to the Imperial Government of Ethiopia and all the concerned agencies and institutions of Ethiopia, especially, the Marine Department and the Planning Commission for their kind assistance to and co-operation with us in executing our mission during our stay in Ethiopia. Our thanks shall be expressed to the Japanese Embassy in Addis Ababa and the Japanese firms there for their kind assistance as well.

Yours sincerely,

S. Kittaka  
Leader  
The Japanese Survey Team  
for Ethiopian Port Projects

February 1st, 1974  
Tokyo, Japan

For preparation of this master plan the following procedures have been taken in the past three years.

1. The request of the Imperial Ethiopian Government and the action taken by the Government of Japan in compliance with the request.

September 1971	Official request from the Imperial Ethiopian Government to the Government of Japan for assistance in preparing a long range development plan for her two ports.
March 1972	Official request from the Imperial Ethiopian Government for dispatch of Japanese specialists for port and harbour.
April 1972/May 1972	Official acceptance by our Government decided. H. E. Ato Nagash Garadew, Vice Minister, Head of Marine Department of Imperial Ethiopian Government visited Japan and consulted with the Japanese Government on detail off the request.
August 1972	H. E. Ato Enderkachew Makkonen, Minister of Communications, Tele-Communications and Post and H. E. Ato Nagash Garadew visited Japan and requested the earliest dispatch of the study team.

2. Dispatch of the Japanese specialists teams to Ethiopia

12th August/9th September 1972	The First Study Team was dispatched to Ethiopia
October 1972	Interim Report titled "Interim Report on Port Development of Ethiopia, Assab and Massawa" was submitted to the Ethiopian Government.
November 1972	In reviewing the first study the necessity of dispatching the second study team and changes in executing the program of study team was realized.
24th February/9th March 1973	The Second Study Team was dispatched. The revision of the interim report submitted. In consultation with the Ethiopian authorities assessment in cargo volume and other basic data was changed.
May 1973	Japanese Government decided to continue her assistance in preparing the detailed master plan in the new fiscal year 1973/74.
16th June/21st July 1973	The Third Team was dispatched, mission was to assist Ethiopian Government to draw up the plan for port development to be contained in the Fourth Five Year Plan of Ethiopia. Draft of the plan was submitted to the Ethiopian Government.
19th October/21st December 1973	The Fourth Team was dispatched. The team prepared a long term master plan for two ports and a draft was submitted to the Ethiopian Government.
December 1973	The final report on the Five Year Plan was submitted to the Ethiopian Government.

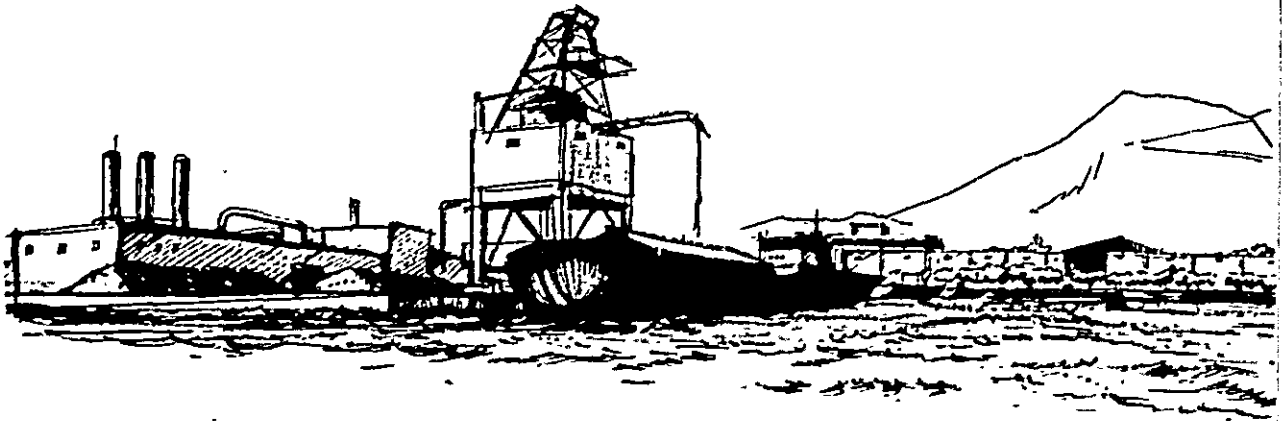
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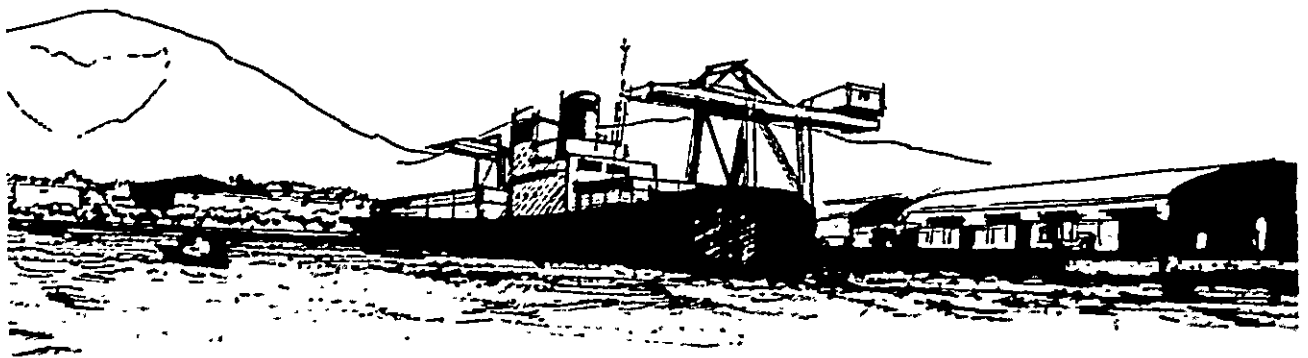
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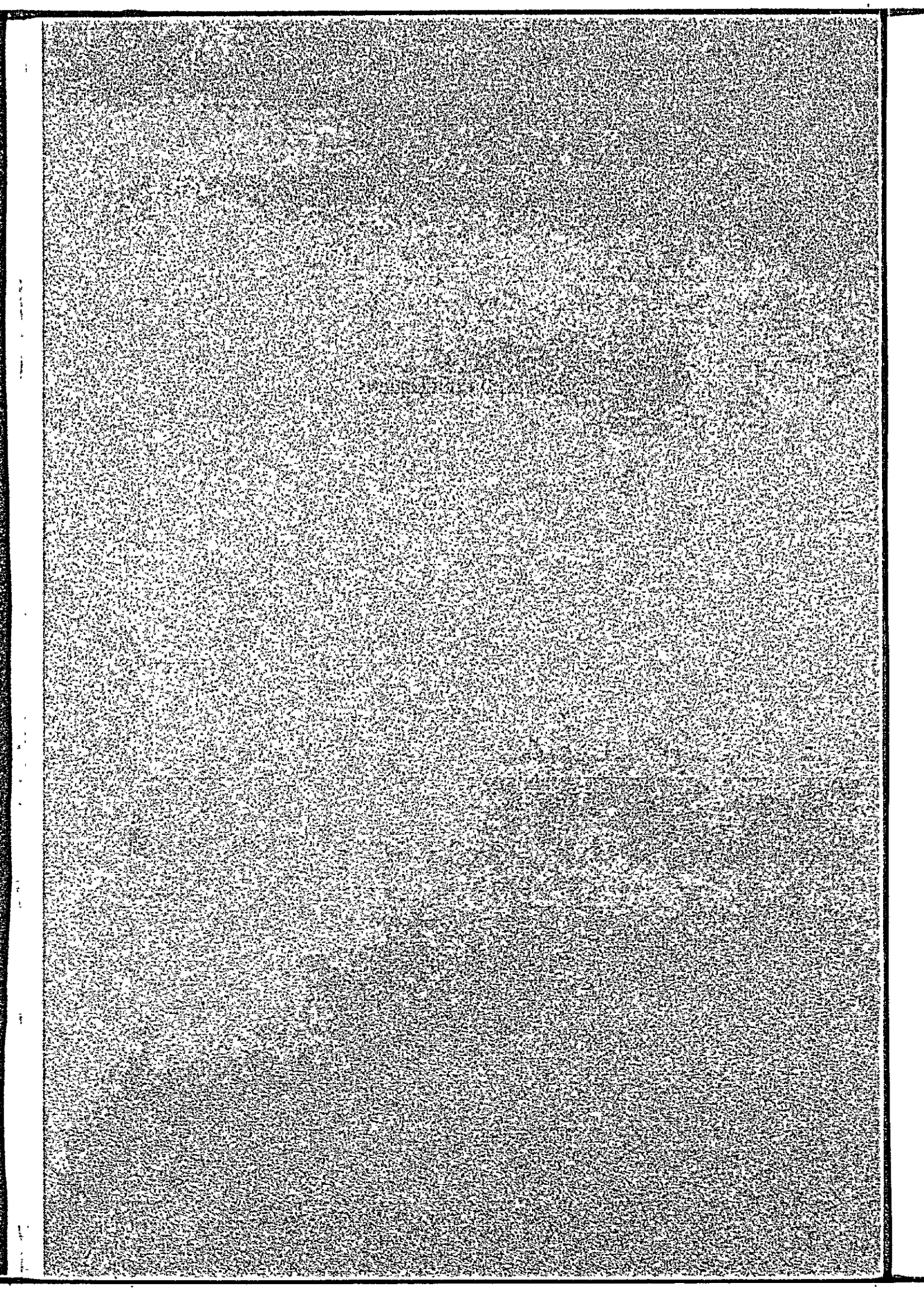




The Port of Assab seen from the Port Entrance, Artist's Vision



**I. SUMMARY AND CONCLUSIONS**



## I. SUMMARY AND CONCLUSIONS

### (1) Introduction

The Japanese Survey Teams for Port Projects in Ethiopia have been despatched in compliance with the request of the Imperial Ethiopian Government to prepare a master plan for development of two Ethiopian Ports, Assab and Massawa. Objects of the survey are accordingly to make up a long term master plan in a range of 15-20 years for improvement and development of Ethiopian ports, to estimate construction scales for each stage of development programme and to point out necessary improvements with advices and recommendations in line with the master plan.

Methodology we adopted for the survey is as mentioned hereunder:

#### Step - 1 Frame Work

- (i) By macroscopic analysis, export and import in the national total are estimated throughout the planning period.
- (ii) Sectoral studies on the major commodities both for export and import are made and adjusted by the results of macroscopic analysis.
- (iii) Then the estimated volumes of export and import are allocated to the hinterlands of each port.
- (iv) Capacity of the existing port facilities is estimated through the analysis of port statistics. In this approach, theory of waiting lines is adopted.
- (v) Needs of additional capacities are calculated from the results of previous analyses.

#### Step - 2 Physical Plan

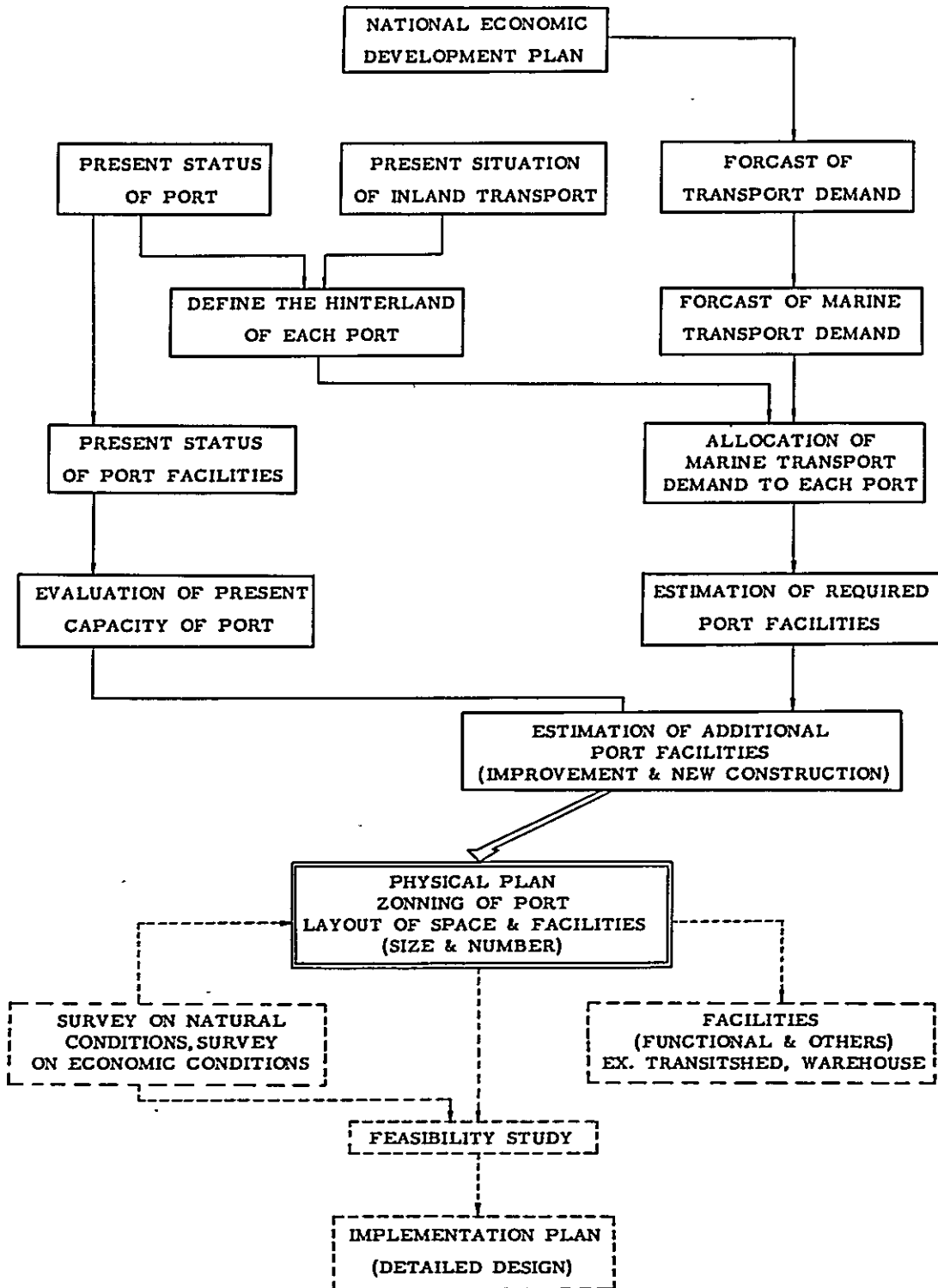
- (i) Within the frame work, the most probable course of development of each port is imaged up, considering natural conditions, the existing functions of the port and development of the town itself etc.
- (ii) Then the zoning of port area has been made. Separate zones are assigned for each major category of projected transport demand.
- (iii) A number of facilities, their sizes and locations are decided by the engineering studies.
- (iv) All of these studies are summarized in the physical plan, then adjusted for the selected intermediate target years.

#### Step - 3 Recommendations

In the course of our survey, there have been many important facts which will much effect the execution of the master plan. Recommendations are made not only for necessary actions to be undertaken but also for such facts for better understanding.

A flow-chart of planning process is shown in Fig. I - 1.

Fig. I - 1



This master plan will be a guide for the development of two Ethiopian Ports, Assab and Massawa throughout the planning period of 20 years. It is quite obvious that various changes in economy, social conditions and technology etc. would necessitate due adjustments during the long period and adequate adjustments should be fed back to this master plan in time so as to make this plan a real guide for the development of two ports in Ethiopia.

We must mention further that the scope of this study which was carried out by the request of the Imperial Ethiopian Government has not included detailed survey of natural conditions such as boring and sounding of the proposed sites. Accordingly the estimation of construction cost in this master plan should be understood as a first order approximation and the precise construction cost should be estimated in the course of the feasibility study which shall be conducted as a follow-up to this study.

(2) Conclusion

(2) - 1 Transport Demands

The estimated cargo volumes in 1994 G.C., the target year of our master plan and intermediate target years of 1979 G.C. and 1984 G.C. are as follows: -

1. Projected Transport Demand At The Target Year

(Unit: 1,000 M/T)

Year(G.C.)		Massawa	Assab	Total
1979	Total	467.1	1,715.6	2,182.7
	Export	346.3	339.5	685.8
	Import	120.8	1,376.1	1,496.9
1984	Total	598.9	2,534.6	3,133.5
	Export	445.6	465.9	911.5
	Import	153.3	2,068.7	2,222.0
1994	Total	1,024.4	5,062.5	6,086.9
	Export	670.8	713.5	1,384.3
	Import	353.6	4,349.0	4,702.6

Note: Home trade, Import and Export of refined oil are not included in the table.

(2) - 2 Outline of Port Developments

We conclude the direction of development of the ports shall be as follows, taking into consideration various determining factors such as natural conditions, the present situation of the town, the existing port facilities, the nature of necessary traffic demand in future.

Massawa

The new commercial harbour including container feeder berths and bulk cargo berths shall be constructed in the sea area extending from South of Massawa Island as far as Sheikh Said Island (the area connecting the existing commercial port compound with this new port area should become a part of thus enlarged port area).

This development plan gives the benefit that by expanding the port area in this direction closely connected with the existing commercial port compound, the administration and management for

the public berths of commercial harbour as a whole shall be effectuated as one unit: On the other hand, we conclude the industrial port which will be, in future, constructed in Khor Dakliyat Bay, shall be reserved for a future industrial development.

**Assab**

A desirable direction of development of the port of Assab is concluded as follows: -

The commercial harbour area including a container berth and bulk cargo berths shall be extended from the existing port compound to the south. The new port area shall be extended from the existing port area to the south up to the refinery. The newly extended port area shall be allocated, from the north to the south, as the expansion of general cargo berths, to container berth, bulk cargo berths and the industrial port. As the development of Assab port goes, it will become necessary to remove the existing buoys for oil tanker which shall be replaced by the fixed pier to a certain point outside the entrance channel to the port.

**(2) - 3 Scale of Construction**

The following table shows the necessary number of berths per each category of the port cargo, against the estimated cargo volumes in 1994, 1984 and 1979 years in G.C. respectively.

**Number of Berth to be Constructed**

**1994 G. C.**

**Massawa**

General Cargo Berth	15,000 D/W	5 berth	(-10 <sup>m</sup> x 185 <sup>m</sup> )
" (Home Trade)	2,000 D/W	2 berth	(-5.5 <sup>m</sup> x 90 <sup>m</sup> )
Bulk Cargo Berth	15,000 D/W	1 berth	(-10 <sup>m</sup> x 185 <sup>m</sup> )
Container (Feeder) Berth	2,000 D/W	1 berth	(-5.5 <sup>m</sup> x 110 <sup>m</sup> )

**Assab**

General Cargo Berth	15,000 D/W	5 berth	(-10 <sup>m</sup> x 185 <sup>m</sup> )
" " "	2,000 D/W	2 berth	(-5.5 <sup>m</sup> x 90 <sup>m</sup> )
Bulk Cargo Berth	40,000 D/W	1 berth	(-12 <sup>m</sup> x 240 <sup>m</sup> )
" " "	15,000 D/W	2 berth	(-10 <sup>m</sup> x 185 <sup>m</sup> )
Container Berth	70,000 D/W	1 berth	(-12 <sup>m</sup> x 300 <sup>m</sup> )

**1984 G. C.**

**Massawa**

General Cargo Berth	15,000 D/W	4 berth	(-10 <sup>m</sup> x 185 <sup>m</sup> )
---------------------	------------	---------	----------------------------------------

**Assab**

General Cargo Berth	15,000 D/W	3 berth	(-10 <sup>m</sup> x 185 <sup>m</sup> )
Bulk Cargo Berth	2,000 D/W	1 berth	(-5.5 <sup>m</sup> x 90 <sup>m</sup> )
	15,000 D/W	1 berth	(-10 <sup>m</sup> x 185 <sup>m</sup> )

**1979 G. C.**

**Massawa**

General Cargo Berth	15,000 D/W	1 berth	(-10 <sup>m</sup> x 185 <sup>m</sup> )
---------------------	------------	---------	----------------------------------------

**Assab**

General Cargo Berth	15,000 D/W	1 berth	(-10 <sup>m</sup> x 185 <sup>m</sup> )
Bulk Cargo Berth	15,000 D/W	1 berth	(-10 <sup>m</sup> x 185 <sup>m</sup> )



### (3) Recommendations and Comments

#### (3) - 1 Integration between Port Development and City Planning

In view of the nature of the both of Assab and Massawa being the port city or of the fact that a future of the both cities entirely depend upon its development as the port, the both port development and city plannings should be closely integrated and co-ordinated each other or the port development plan should have a priority on the municipality plan, so that the both plannings can assure and help overall development of the port city.

##### a. Assab

In the light of Assab being steadily developing and growing into one of the most important ports in Ethiopia, we recommend the port authorities should reserve widely the surrounding area under its custody for future expansion and development, which reserved land would be utilized not only for its own use but also for the rent to future industries and transportations which may be necessary to be located close to the port.

##### b. Massawa

The reservation of all necessary land for future expansion and development of Massawa port is more urgently necessary and seriously important than in Assab, in view of the narrowness of the land of Massawa Island and the mode in which private people are apt to own a new reclaimed land.

To make sure the expansion of the port area to the southern sea shore of Massawa Island as proposed, we recommend the port authorities should:

- i) expedite the acquisition of the whole land area behind the existing port compound to the sea side.
- ii) take a legal action to refrain private person or industry from reclaiming whole southern sea side line of Massawa Island and preserve such area under the port custody.
- iii) acquire all reclaimed land already owned by private persons even under compensation by the port.

#### (3) - 2 Desirable System of Port Management

It will be generally admitted with a view of the ports being at present in a developing stage, that immediate shift of the existing system of the port management into the self-supporting autonomous organization where all revenues and expenditures relative to the port operation are balanced, might be difficult. However, as a tentative system, it might be possible and desirous to manage the port under the system in which individual port runs self-supportingly as far as current revenues and expenditures are concerned, while undergoing a subsidy from the central government for investments to infra-structural development schemes costing above a certain limit of amount.

This tentative management system will give two advantages; one is that as such semi-autonomous organization, the port authorities can proceed to implement and execute a big scale port development project in consistence with a national and global development plan of the central Government, and the other is to give an incentive for realization of autonomous and efficient operation and management of the port by allowing the port such wide-range authorities and responsibilities of the administration and management, as a disposal of budget under a certain limited amount at the port's own discretion in order to encounter emergent needs and

so on, under the control of Marine Department Head Office.

(3) - 3 Improvement of the Port Operation

(3) - 3 - 1) Prevention of the damage of the cargoes

As asserted in the body of the report, the competition of Assab port with Djibouti will be determined,— once the both ports stand in an equal position on inland road transportation after completion of Awash-Tendaho Highway and linking highway connecting Djibouti to this highway,— by economics, efficiency and dependability of cargo handlings and port operation in general of these ports. According to our survey on the spot, it seems to us that the damages of cargoes in open storages in Assab appear bigger than those in Djibouti. Judging from the damages even in Djibouti being still too high as compared with those in the international 1st class port, there is much room to improve and prevent such damages in the port of Assab. We should stress that one of the integral conditions to overcome this competition is to serve for the cargo owners an efficient and safer operation and cargo handling so that shipping agents, forwarders can have more reliability upon the port of Assab. An improvement of cargo operation and management under this consideration can be executed without expending much money. To this end, we would suggest (1) clarification of responsibility of cargo storage (including the responsibility of compensation of damages) (2) strengthening of training of port labourers and inducement of merit system to them and (3) improvement of cargo handling systems and so forth. These improvement methods will apply also to the port of Massawa. In this conjunction, the shifting system of the gang of longshoreman which is going to be adopted to the Assab port against so called existing Red Sea System is to be positively introduced. Once it succeeded in Assab, it should be adopted also in Massawa.

(3) - 3 - 2) Introduction of Pallet System to cargo handling in the port

The introduction of "Pallet System" has been scrutinized in Marine Department for the years as an improvement method of cargo handling at the port. As the both Assab and Massawa ports have a number of fork lifts and trucks, the background and condition to be able to realize faster and more efficient port operation without causing much cargo damages by introduction of this Pallet System is becoming ripe. We consider it also possible and desirous to make port operation more efficient by operating small electrical fork lifts in the ship's hold, in an agreement with the shipping ports.

Under this Pallet System, the port office can prepare, at the initial stage, only the pallets to be used only in the port area, without expending much money. Some fitting works for the port facilities becomes necessary in Massawa like levelling works so that the entrances of warehouses are to be levelled the roads.

An urgent pavement of open storage area and marking thereof to indicate the plots and operating routes are also one of the urgent measures to be taken without losing time and money for the both ports, in order to improve the port operation safely, efficiently and dependently.

(3) - 3 - 3) Improvement of environment of port labourers

Another important consideration by the port management is the improvement of the environment for staffs and labourers of the port, which is the mother bed to create an efficient working. In particular, the environment surrounding the port of Assab is not favourable,

geographically remote, short of amusements, and climatically severer than Massawa. In order to develop the port, the municipality, the source of labour should be developed all together and the port authorities should positively participate in the improvement of environment of the port city to ensure the proper functioning as the port.

(3) - 4 Improvement of Inland Transportation

(3) - 4 - 1) Road Transport

i) General

Indications are that a future inland transportation of the port cargoes tends to rely upon the road transport more than the rail and there will merge more needs, to cope with such growing trend of inland transport by lorry, for establishments of the terminal stations, rationalization of various truck companies and the administrative control of traffic flow of import and export cargoes.

In general, the present road capacity and conditions are envisaged to be capable, except a very limited section, for future traffic demand for the period to cover our plan, even considering rapidly increasing ratio of the traffic volume during such period and further even under the situation when the container transport system be introduced into Ethiopia as described later, provided if appropriate counter-measures for fitting the conditions to this new system be undertaken.

ii) Establishment of truck terminal station

As reported in the transport section, Section II-(2), there are a lot of small scale truck companies in Ethiopia. In order to enhance the efficiency and rationalization of road transportation as a whole, we recommend that one of the important inland transport administrations is to unite and amalgamate these small scale truck companies and in parallel with this measure, the port authorities should construct the big terminal centre in or near the port compound which will be accommodated with storage facilities utilized by truck companies under a low rated rent or fee. Djibouti has been moving to this policy.

iii) Rationalization of a long distance road transportation

As one of the counter measures for rationalization of a long distance road transportation, we suggest that several inland terminal stations with the bonded area are to be set up on the highway where the lorry driver, trailer and chassis etc. are to be changed whereby an inefficiency caused by a long distance road transport can be avoided.

iv) Control of imbalanced road transportation

Another measure is to improve an efficiency in bound-to port and bound-to hinterland traffic flow; as we see in transport between Addis Ababa and Assab where export cargo usually exceeds that of import, the remarkable loss in rotation efficiency of trucks due to this imbalance. An adequate administrative measure should be taken to adjust the import-export traffic flow.

**(3) - 4 - 2) Railway Transportation**

We consider that Northern Ethiopian Railway will lose its *raison d'etre* from purely economical point of view, as the means of inland transportation connecting Massawa port with its hinterland. Taking the above into consideration we presume there will be no necessity of introducing the railway into the proposed new expansion of the port.

With regard to the Franco-Ethiopian Railway, the inland transportation by the existing railway as far as the section between Addis Ababa and Dire Dawa is concerned, will be mostly shifted to the road transport upon completion of the Awash-Tendaho Highway and possibly the traffic between Djibouti and Addis Ababa to the projected new road. We presume, however, the railway will be playing an important role for the traffic between Djibouti and Dire Dawa as before.

**(3) - 5 Comments on the possibilities for Ethiopian ports as the International Transshipment and Bunkering Ports**

As described in Section III-(3) Djibouti, the port of Djibouti has invested considerable amount of money to grow as a bunkering port leaving extra capacity to be utilized for future increased demand. It enjoys a fairly good reputation among the surrounding countries. Taking into consideration the competitiveness with such facilities, we presume it not economic for Ethiopia to make an investment for bunkering facilities either in Assab or Massawa in competition at the present stage. If the oil exploration now underway proves successful and Ethiopia becomes an oil-producing country in future, this issue will come out in the foreground from a quite different standpoint, namely for the disposal of this new natural resources of Ethiopia.

As regards the possibility to become an international transshipment port, we consider such possibility will be slim, in view of the fact that these ports are geographically situated in not so advantageous position. Apart from such possibility to become an international transshipment port for conventional ships, in case of future possibility for such a port for container vessels, the situation may be something different. We envisage that once Suez Canal is re-opened, the Red Sea will be a highway of ocean-going container vessels and such situation may eventually offer an opportunity of establishment of at least one container port along the Red Sea, through which the container cargoes will be distributed to various ports of the surrounding countries on the Red Sea. There is a possibility either Assab or Massawa may become such port, particularly in view that these ports are located comparatively near the highway of ocean-going container vessels going through the Red Sea. We consider, however, such realization will depend upon how the authorities concerned try to make preparatory countermeasures and arrangements in good timing.

**(3) - 6 Re-opening of the Suez Canal and Containerization in Ethiopia**

It is easily anticipated that the Red Sea will become again the most brisk highway of the ocean-going vessels, if the Suez Canal is re-opened. One of the direct repercussions caused by the re-opening to foreign trade and marine transportation of Ethiopia will be an increase in marine freight for European countries. As our forecast of cargo traffic demand (future trend of foreign trade) of Ethiopia has been rather over-estimated, such estimated figures shall be read as they are, even though the Suez Canal be re-opened.

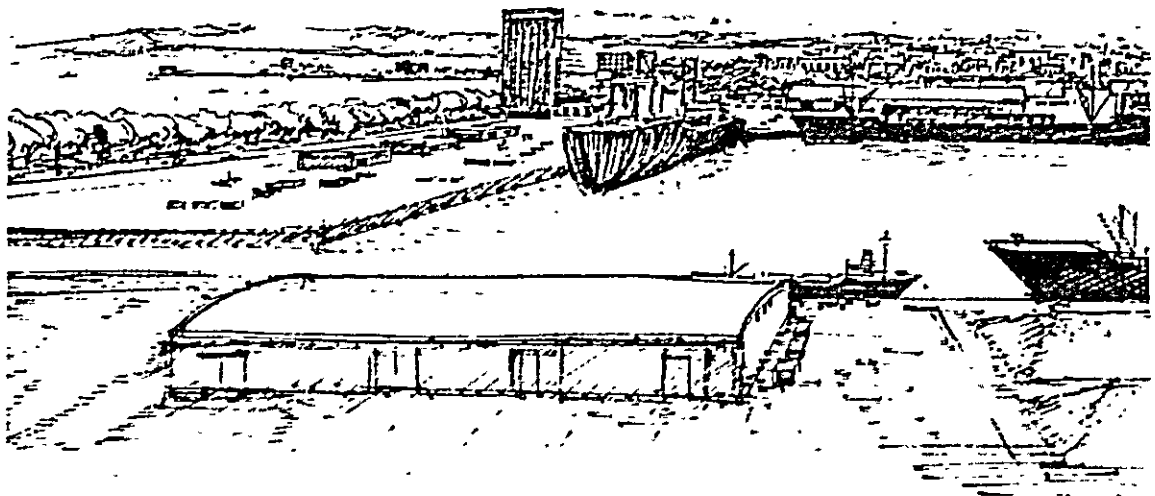
As a result of disclosure of the Suez Canal, the number of ocean-going vessels going through the Red Sea will no doubt remarkably increase, giving a chance of calling to the ports along the Red Sea. Therefore, if a certain amount of high-valued cargoes bearable to high

freight of the container vessel are gathered at the port, some of the container shipping companies may offer a short time calling to collect such cargoes. Among export goods from Ethiopia, meats and meat products, and hides and skins will be commodities capable to utilize such opportunity. The geographical reason that Assab is located very close to the gateway of the Red Sea will give much advantage to be such a port, the container port for surrounding ports of the Red Sea.

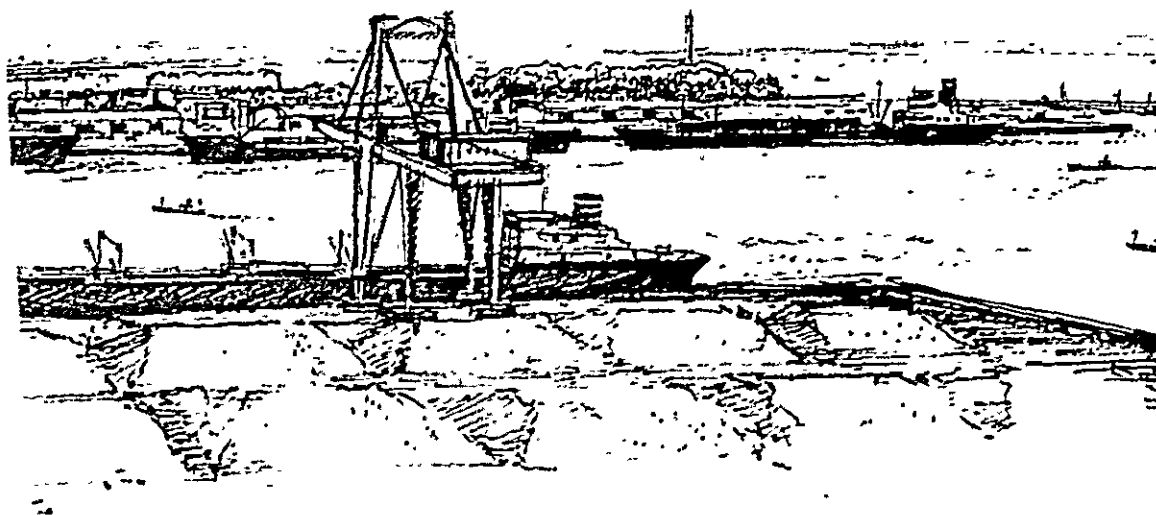
Once your Government decided to containerize the port Assab, earlier action of pre- and consolidated investment should, in close touch with the world-wide trend, be made ahead of the surrounding countries and consistent measures and Governmental control of cargo flow aiming at an accumulation to the port of Assab of suitable commodities such as meat and meat products should be taken in parallel.

(3) - 7 Introduction of bulk handling facilities in Ethiopian ports

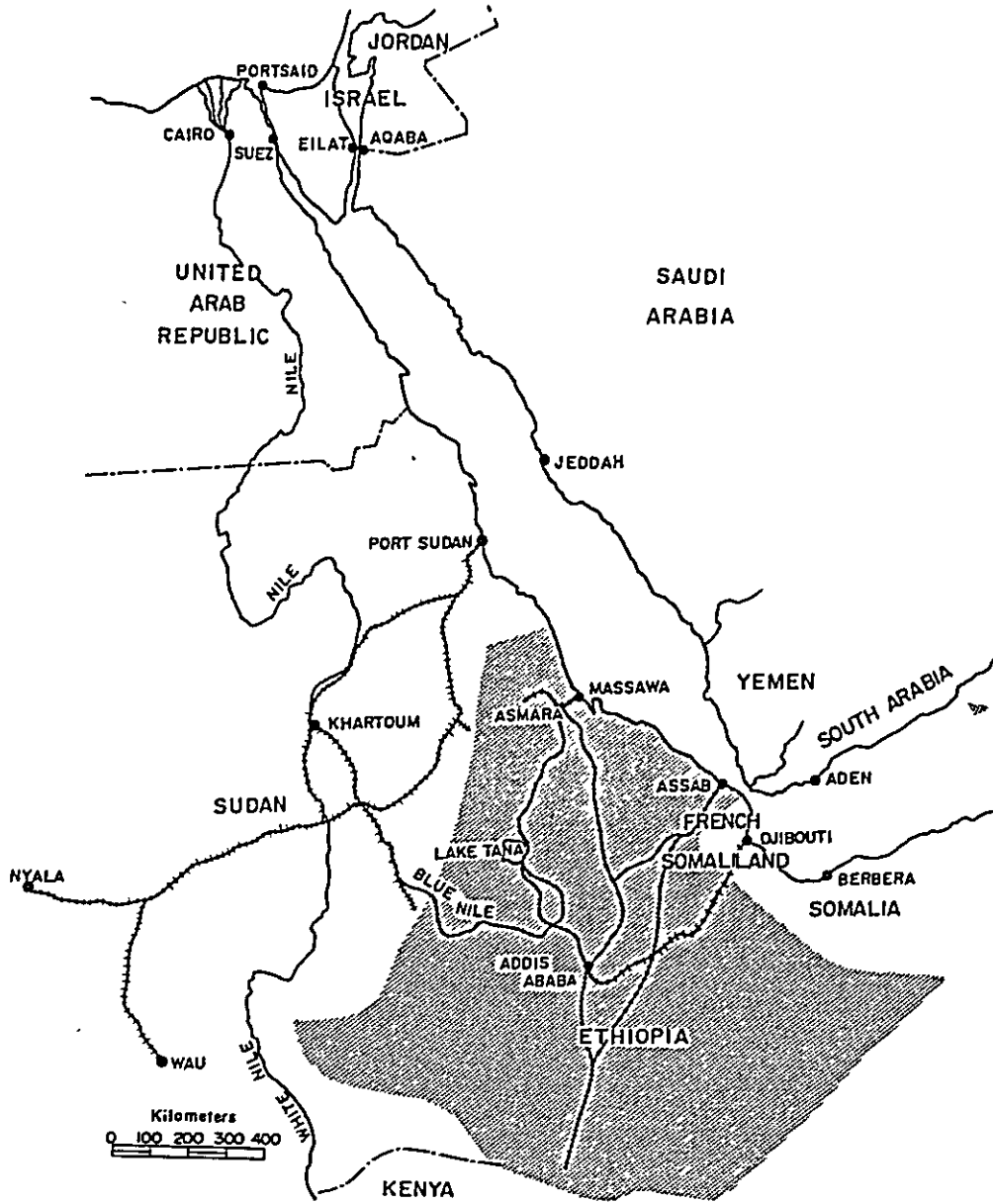
As assumed in Section IV and V, a rapid increase of import of fertilizer is expected in future. As fertilizer is a bulky cargo, it is necessary to have bulk cargo facilities in a discharging port, which will be Assab from transport economy and in the light of consuming area being closer to the port of Assab. The import of fertilizer will be replaced by the import of phosphate rock and sulphur, the materials of a newly built fertilizer plant in 1984 G.C. or afterwards. As regards export cargo, pulses, oilseeds and so on will be bulky if these export grains and seeds are gathered. In order to systemize the bulk transport facilities for export goods, it is necessary to uniform the quality of export goods and gather the goods into one particular port. As regards export of copper and associated minerals, we presume under the present mineral exploitation schedule that the export will reach such a quantity, at the last stage of our planning period, as necessary to consider a bulk handling system. Should its production become larger ahead of the existing development program, such time may come earlier.



The Port of Massawa seen from the Sheikh Said Island, Artist's Vision



# LOCATION MAP



RAILWAYS -----  
 HIGHWAYS —————

SOURCE: Stinford Research Institute.



## II. BACKGROUND

## II. BACKGROUND

### (1) Economic Development of Ethiopia, Import and Export

Ethiopia has an area of 1.2 million square kilometer with a population of some 25 million (1972 estimate). The most important sector of the economy is agriculture and 90 % of the population is engaged in this sector. Industrialization in the country is of recent years, but it has achieved a pretty rapid development in the oil-refinery, cement, textile and food industries. The prospection for crude oil and natural gas now going on in Ogaden and Sidamo areas will bring a new driving power to the economy, if it is found feasible and is exploited. Otherwise, the present pattern of economic structure will not be changed drastically within the planning period, though industrialization, especially in the field of import substitute industries, will be continued.

The Imperial Ethiopian Government is guiding the economic development of the country by successive five year development plans. The 3rd economic development plan which has been extended for one year has come to its final stage at present. The targets shown in the plan have not been achieved satisfactorily. Ethiopia's per capita income of about 75 U.S. dollars, according to UN statistics, should be understood with the background that 40 % of the total economy is depending on barter economy and so-called subsistence economy.

The major items of export are coffee, oilseeds, pulses and hides and skins. Export of coffee is the most important item and earns more than half of total export earning. But it suffers from fluctuation of price which is controlled by the world market. Oilseeds and pulses are said to be the most hopeful exporting items in the near future, though the present situation is not so optimistic. Meat and meat products, bananas and sugar are also increasing their shares in total export.

Export of salt is large in quantity but there are many competitors in the world market. Quality of products, distance to market and high transportation cost, affect the export volume very much so the rapid growth of this item could not be expected in the planning period.

Table II - 1 Economic Indices (1969 - 1972 G. C.)

Amount (million US\$)		1969	1970	1971	1972
		1,711.2	1,836.0	1,874.1	1,949.0
Growth rate		7.3 %		2.1 %	4.0 %
Population (in million)		24.2	24.63	25.25	25.89
Per capita GDP (US\$)		71.2	73.5	74.2	75.3
External trade (mill. US\$)	Export	122.3	122.3	123.8	168.4
	Import	-	171.6	184.8	189.4
	Total	-	293.9	308.6	357.8

Source: ECA Secretariat and compiled by the Survey Team.

FIG. II-1 IMPERIAL ETHIOPIAN GOVERNMENT  
Imperial Highway Authority  
Traffic Counting Stations

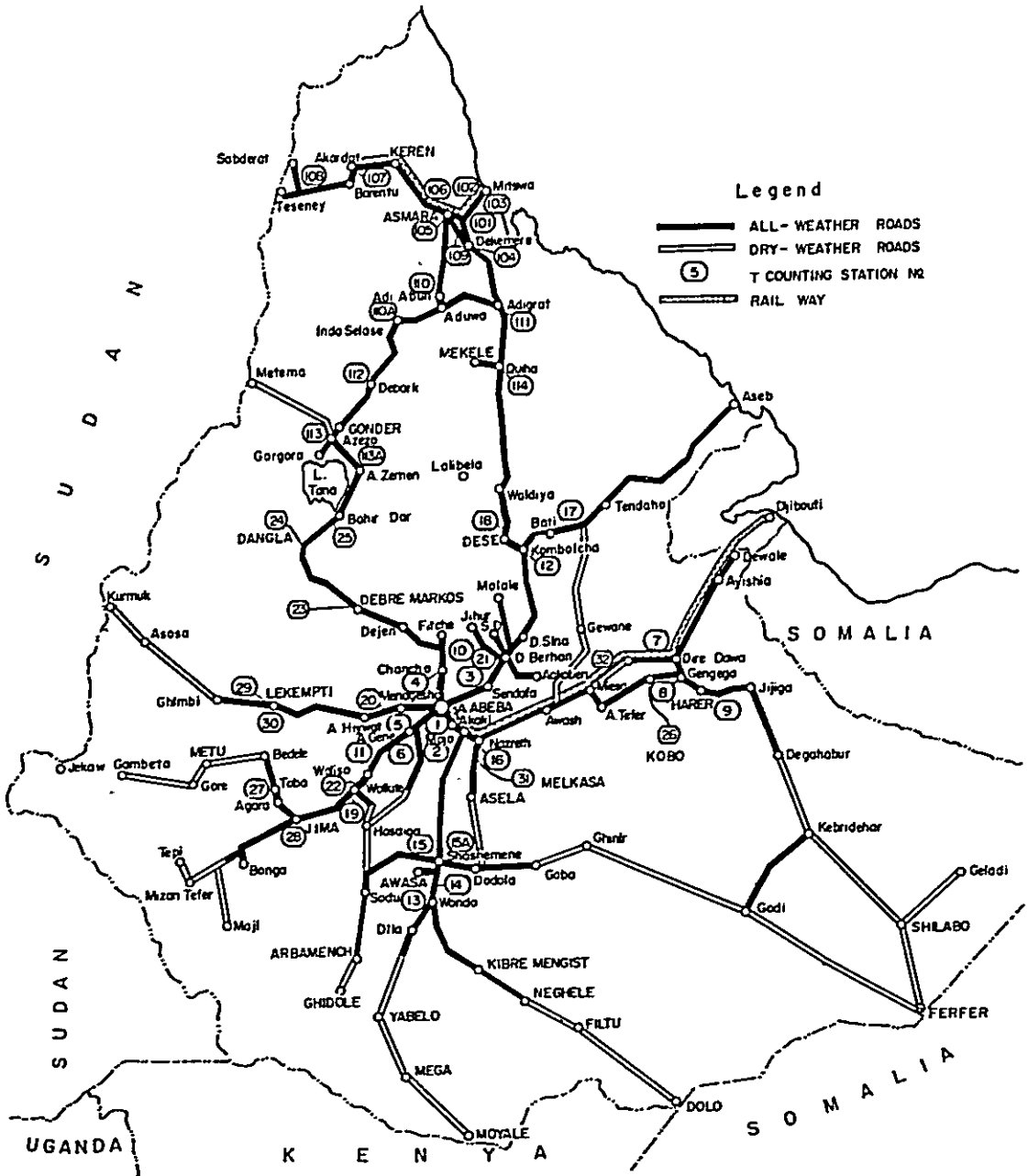


Table II - 2: Gross Domestic Product by Industrial Origin at Current Factor Cost

(Eth. \$ million)

	1963	1964	1965	1966	1967	1968	1969
<u>Agriculture</u>	1,550.3	1,723.0	1,953.9	2,014.6	1,902.6	2,004.9	2,119.5
Agriculture	1,470.2	1,641.5	1,871.6	1,929.0	1,811.2	1,900.0	2,011.8
Forestry	74.9	76.9	77.7	79.5	85.7	88.9	92.7
Hunting	2.1	1.0	1.3	1.6	1.5	1.3	1.2
Fishing	3.1	3.6	3.3	4.5	4.2	3.0	3.0
<u>Industries</u>	329.0	369.7	410.7	458.7	545.7	574.1	633.8
Mining & quarrying	4.2	5.4	9.4	11.6	12.1	11.2	9.1
Manufacturing	61.2	76.1	94.5	108.2	149.4	176.6	211.5
Handicraft & small scale industry	103.5	118.1	126.8	136.8	148.7	157.3	177.2
Building & Construction	148.6	156.5	165.8	187.2	217.6	208.5	214.3
Electricity & water	11.5	13.6	14.2	14.9	17.9	20.5	21.7
<u>Wholesale and Retail Trade</u>	162.9	204.4	236.0	256.1	246.2	286.0	319.8
<u>Transport &amp; Communication</u>	84.3	99.8	116.4	124.1	125.7	139.8	142.8
<u>Other Services</u>							
Banking, Insurance & Real estate	25.2	28.0	33.8	39.0	40.0	43.7	49.5
Public Administration & defence	114.2	124.7	155.8	165.8	178.8	191.2	203.9
Ownership of dwellings	106.5	110.1	113.9	123.5	131.5	138.6	147.4
Educational services	25.0	40.0	45.5	53.2	60.4	64.7	70.0
Medical & Health services	16.5	18.8	20.7	21.9	23.3	24.5	24.8
Domestic services	52.3	53.0	54.2	55.2	56.6	57.6	58.6
Others	33.1	40.0	48.0	57.6	64.5	80.9	90.6
<b>TOTAL</b>	<b>2,550.3</b>	<b>2,811.5</b>	<b>3,188.0</b>	<b>3,369.7</b>	<b>3,375.3</b>	<b>3,606.0</b>	<b>3,860.7</b>

Source: Central Statistical Office.

Table II - 3: Value of Imports and Exports by Commodity Group Section

(Eth. \$ '000)

Commodity Group Section	1968	1969	1970	1971
<b>Imports</b>				
Food and live animals	19,129	19,688	31,447	28,525
Beverages and tobacco	5,673	5,492	5,441	5,881
Crude materials, inedible, except fuels	21,348	16,539	12,268	16,038
Mineral fuels, lubricants and related materials	27,033	28,185	33,577	44,297
Animal and vegetable oils and fats	2,103	2,541	2,537	2,241
Chemical elements and compounds	40,957	43,508	50,067	55,832
Manufactured goods, classified chiefly by material	95,458	86,470	109,159	113,949
Machinery and transport equipment	177,094	133,448	146,975	164,217
Miscellaneous manufactured articles	37,608	43,564	36,570	35,083
Commodities not classified according to kind	6,131	8,867	1,127	3,580
<b>TOTAL</b>	<b>432,534</b>	<b>388,302</b>	<b>429,168</b>	<b>469,543</b>
<b>Exports</b>				
Food and live animals	199,664	221,283	223,082	229,826
Beverages and tobacco	41	2	8	4
Crude materials, inedible, except fuels	54,329	63,729	61,548	68,146
Mineral fuels, lubricants and related materials	1,744	3,241	3,525	4,884
Animal and vegetable oils and fats	2,176	2,131	1,483	1,411
Chemical elements and compounds	101	76	1,616	1,765
Manufactured goods, classified chiefly by material	2,021	1,427	2,384	2,641
Machinery and transport equipment	5,294	57	3	2
Miscellaneous manufactured articles	218	219	537	459
Commodities not classified according to kind	437	430	418	450
<b>TOTAL</b>	<b>266,025</b>	<b>292,606</b>	<b>294,604</b>	<b>309,588</b>

Source: Customs Head Office, Ministry of Finance.

In so far as mining products, other than crude oil and natural gases, are concerned, exploitation is also undergoing enthusiastically. Among these, copper and potash are going to be major export items within a few years.

Machinery and transport equipment is the largest item of import in value. Motor vehicles and parts, telecommunication equipment, industrial machinery and electric machinery are the major components of this group. Metals and metal products, chemical products, rubber tyres and tubes, crude oil and petroleum products are the other main import items.

Food stuff and textiles are losing their shares in total import by the development of import substitute industries. Import of rubber tyres and tubes will be replaced by import of rubber.

The use of chemical fertilizers in agriculture is of recent origin and the Government is pursuing it very closely and is encouraging it. This will induce the rapid increase of fertilizer import and construction of a chemical fertilizer plant will be on the program within one decade or two.

Origin of import and destination of export of external trade is summarized by region and shown in Table II-4 and II-5 below.

Table II - 4: Import by Country of Origin

(in '000 Eth. \$ and in percentage)

	1962	1968	1970	1971	1972(G.C)
Grand Total	(257.035)	(388.302)	(429.080)	(469.555)	(453.602)
Total (%)	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
Africa	2.10	1.80	3.02	2.31	3.36
America	18.4	10.43	8.83	9.43	9.64
U. S. A.	(18.05)	(10.24)	(8.36)	(9.25)	(9.17)
Asia	30.88	27.48	30.28	31.16	30.90
Iran	(3.25)	(5.07)	(6.05)	(6.56)	(5.89)
Japan	(13.90)	(10.85)	(14.83)	(14.75)	(15.19)
Europe	48.12	59.71	55.67	54.66	55.67
W. Germany	(9.12)	(14.33)	(13.72)	(11.05)	(10.68)
Italy	(15.77)	(15.41)	(16.93)	(16.14)	(16.37)
United Kingdom	(7.07)	(10.05)	(7.47)	(9.38)	(9.45)
Oceania	0.09	0.23	2.00	2.01	0.42
Unspecified	0.67	0.34	0.20	0.43	0.01

Source: Customs Head Office and the Survey Team.

Table II - 5: Export by Country of Destination

(in '000 Eth. \$ and in percentage)

	1962	1968	1970	1971	1972(G.C)
Grand Total	(196.196)	(292.606)	(294.622)	(309.955)	(376.955)
Total (%)	100.0 %	100.0 %	100.0 %	100.0 %	100.0 %
Africa	6.78	8.72	6.21	7.59	7.71
Fr. Terr. of Affars & Issas	(3.49)	(6.44)	(5.22)	(6.25)	(5.90)
America	39.55	42.82	50.43	44.39	36.14
U.S.A.	(39.53)	(42.81)	(50.40)	(44.36)	(35.85)
Asia	18.38	17.96	18.67	20.18	23.13
Saudi Arabia	(4.31)	(5.88)	(5.41)	(6.28)	(5.95)
Japan	(1.97)	(4.82)	(5.61)	(5.99)	(6.32)
Europe	34.71	30.38	24.57	27.76	32.86
W. Germany	(3.02)	(9.25)	(6.72)	(7.74)	(7.10)
Italy	(9.84)	(7.18)	(6.20)	(5.23)	(8.31)
Oceania	0.23	0.02	0.01	-	0.11
Unspecified	0.35	0.10	0.11	-	0.11

Source: Customs Head Office and the Survey Team.

(2) The Transport Sector (in relation to export and import)

The domestic cargo transport of Ethiopia has been largely dependent on land transport. Owing to her topographical conditions, share of domestic marine transport in the whole domestic cargo movement is not high. Refined oil which is shipped from Assab to the ports of Red Sea area becomes the most important item among the domestic marine transport in this country.

Two railway lines are in service at present, namely Franco-Ethiopian Railway which is connecting Addis Ababa to Djibouti of the French Territory of Afars and Issas via Dire Dawa, and the Northern Ethiopian Railway operating between Massawa and Agordat via Asmara. The basic statistics for the two railways is shown in Table II-6 and II-7 below.

Table II - 6: Traffic on the Agordat - Massawa Railway

	Thousands		'000 Metric Tons				Commercial Traffic Ton Kilometers ( '000)
	Passengers carried	Passenger Kilometers	Total	Import	Export	Internal	
	Passenger Traffic		Freight Carried				
1951 (E. C.)	196	11,245	126.7	67.9	34.7	24.1	15,629
1952	218	11,845	153.9	46.5	64.2	43.2	18,130
1953	316	14,717	152.4	46.7	54.4	51.3	17,598
1954	384	18,553	178.0	58.6	68.9	50.5	19,850
1955	397	20,008	184.3	58.0	91.9	34.4	10,939
1956	411	20,073	192.2	52.0	100.0	40.2	11,895
1957	440	22,064	208.3	70.2	98.6	39.3	24,417
1958	449	23,958	209.7	77.3	87.4	44.9	24,223
1959	310	17,833	183.4	53.2	75.5	54.7	20,851
1960	268	15,044	163.2	48.3	61.5	53.4	19,264
1961	238	12,776	151.2	42.2	69.3	39.7	18,286
1962	248	13,858	160.6	47.9	57.5	55.2	19,082
1963	114	6,528	166.2	50.9	71.7	43.6	19,345
1964	1	47	146.6	35.8	74.2	36.6	17,415



Table II - 7: Operations of the Franco - Ethiopian Railway

Year *	1961 (E. C.)	1962	1963
Length of track (Kms)	781	781	781
Rolling stock (Numbers)			
Steam locomotives and locotracors	10	10	10
Diesel-electric locomotives	23	23	25
Passenger cars	47	47	47
Freight cars	548	672	676
Autorails	3	3	3
Employee (Numbers)			
Ethiopian	1,855	1,864	1,877
Foreign	38	34	27
TOTAL	1,893	1,898	1,904
Revenue Train-kilometers ('000)	1,707	2,468	2,562
Passengers carried ('000)			
1st and 2nd class	31	37	34
3rd class	380	420	362
TOTAL	411	457	396
Passenger-kilometers (million)	83.0	92.0	80.1
Average kms per passenger	202.0	202.0	202.5
Freight carried ('000 Tons)	356.0	412.0	447.0
Imports	159.0	176.0	236.0
Exports	92.0	119.0	94.0
Internal traffic	105.0	117.0	117.0
Commercial traffic tonkilometers	190.0	220.0	243.1
Average kms per ton of commercial traffic	533.7	536.0	543.0
<u>Revenue</u> ('000 Eth. \$)			
Passenger	1,994	2,264	2,016
Freight	10,941	12,249	14,787
Other	538	416	613
Total Revenue	13,473	14,929	17,416
<u>Expenditure</u> ('000 Eth. \$)			
Personnel	8,034	8,255	8,656
Material and other	5,400	4,352	6,879
Total operating expenses	13,434	12,607	15,535
Provision for works and renewal of equipment	710	1,394	1,881
Total expenditure	14,144	14,001	17,416

\* Year ending 7 July

Source: Franco-Ethiopian Railway

Road distance in kilometer is shown in Fig. II-2 and an outline of road transport is summarized in Table II-8 (next page). Most of the truck companies are small in size and prices are set by bargaining. Official tariff is set only for cargoes from Assab to Addis Ababa. Shortage of trucks and raising of prices are annual events during the coffee export season. This is caused by the over accumulation of trucks in the coffee production areas during the coffee picking season.

FIG. II-2 ROAD DISTANCE BETWEEN PRINCIPAL TOWNS (Km)

Source: Road Map of Ethiopia

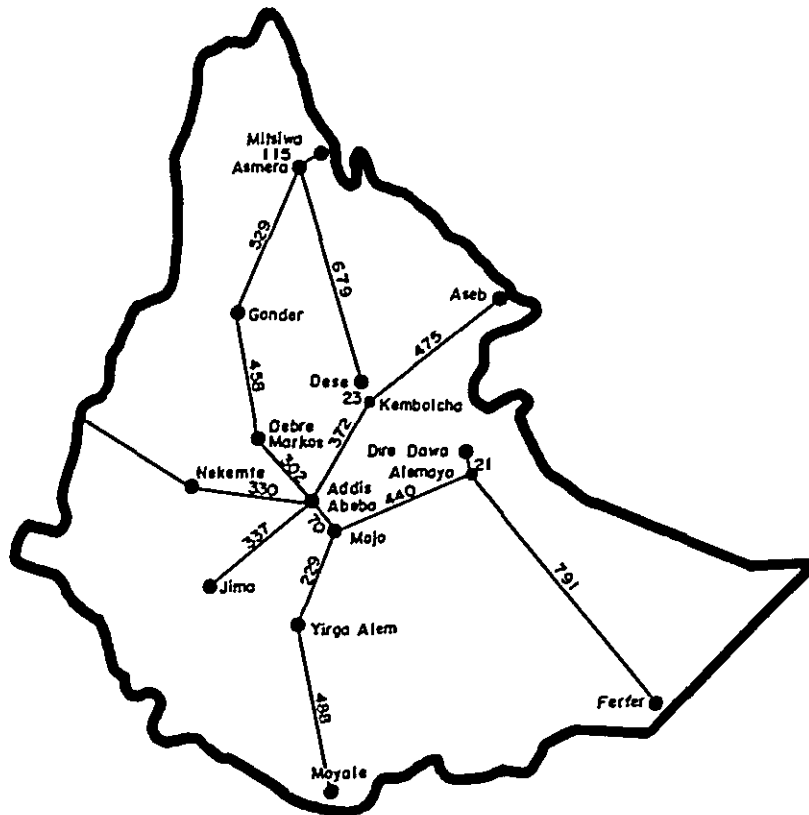


Table II - 8: Commercial Road Transport Estimated Volume and Value of Services (F. Y. 1964)

(In current prices)

Type of Vehicles	Number of Vehicles	Average Dist. (kms) per vch/year	Average Veh/km/year (thousands)	Average payload per vehicle	Pass/kms Or Ton/kms (millions)	Ave. charge per pass/km or ton/km (Eth. f)	Gross value of services ('000 Eth.\$)
<b>I. Inter-urban Services</b>							
1. Micro-buses	1,870	42,000	78,540.0	16.5 psgrs	1,295.9	3.0	38,877.0
2. Large buses	570	56,000	31,920.0	52 "	1,659.8	1.9	31,536.2
3. Pick-up trucks	770	16,000	12,320.0	0.75 tons	9.2	29.0	2,668.0
4. Large single trucks	2,800	43,500	121,800.0	6.8 "	828.2	9.0	74,538.0
5. Trucks with trailers	1,770	55,000	97,350.0	17 "	1,655.0	6.2	102,610.0
- Total Passenger Services	2,440	-	110,460.0	-	2,955.7	-	70,413.0
- Total Freight Services	5,340	-	231,470.0	-	2,492.4	-	179,816.0
					Total I		250,229.2
<b>II. Urban (city) Services</b>							
1. Micro-buses	16	38,000	608.0	18 psgrs	10.9	2.0	218.0
2. City buses	187	57,000	10,659.0	65 "	692.8	1.5	10,392.0
3. Taxi cars	2,300	52,500	120,750.0	3.2 "	386.4	8.5	32,844.0
4. Pick-up trucks +	270	12,000	3,240.0	0.35 tons	1.1	35.0	385.0
5. Large-trucks +	130	6,500	845.0	4.25 "	3.6	20.0	720.0
- Total Passenger Services	2,503	-	132,017.0	-	1,090.1	-	43,454.0
- Total Freight Services	400	-	4,085.0	-	4.7	-	1,105.0

+ Rough estimates probably under-estimated

Source: PCO expert

In general, highway and railway are in a competitive situation but, as far as Franco-Ethiopian Railway is concerned, the situation is far from competitive. Lack of a highway in this region gives the railway almost an exclusive position for cargo transport to and from Djibouti. Export and import of Ethiopia had been dependent upon the ports of Massawa and Djibouti until 1963. Construction of Assab port and the development of highway systems between the port and the hinterland has changed the situation. The hinterland of Djibouti port, except Harar area, and the hinterland of Assab port are overlapping each other.

When the Awash-Tendaho Highway will be completed by 1975, transport by truck to and from Assab will be in a favourable position against railway transport to and from Djibouti. The significant part of the benefit from the huge investment on this highway construction will be yielded by making full use of Assab port.

But, the construction of a highway connecting the port of Djibouti with the above-mentioned highway will be commenced by 1976. This would make the two ports on equal-footing again.

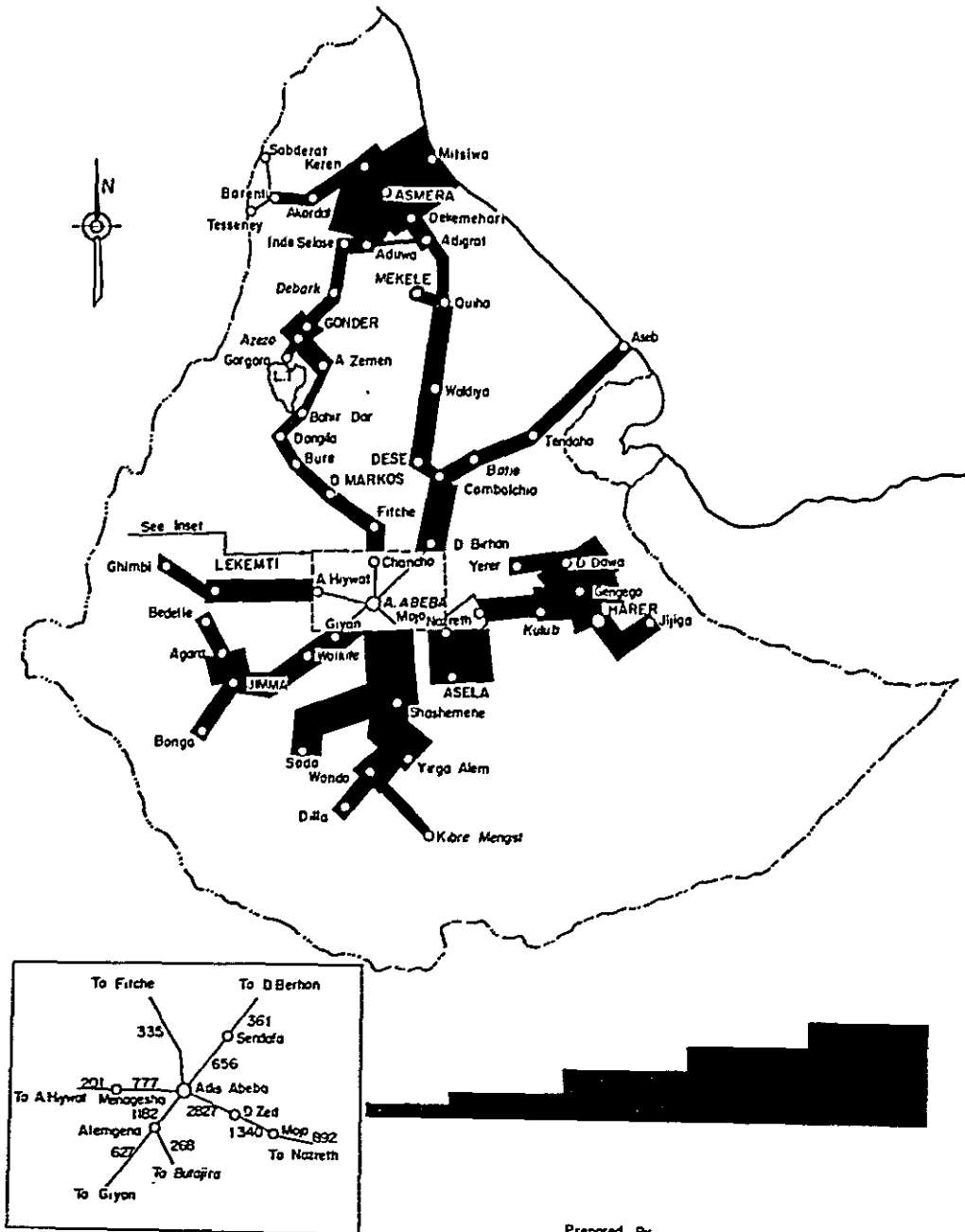
One of the most serious problems in cargo transport between Assab and the hinterland is a remarkable imbalance between export and import. Because of this one-sided transport demand, trucks are idly waiting for cargoes at Assab. Average waiting time of trucks during the month of November 1972 is far beyond one week. This should be solved urgently. In the long run, shifting the import cargoes from Djibouti will be the best solution.

The Northern Ethiopian Railway is now serving by single track between Massawa port and Agordat, its gauge is 950 mm and the difference of altitude between Massawa and Asmara is about 1500 m. This fundamental handicap together with its obsolete rolling stocks make the capacity of this railway very limited.

From the purely economical view point, this railway has lost its significance as to cargo transport between Massawa port and the hinterland.

If the plan to extend this railway across the border and connect to the Sudanese railway becomes concrete, the situation may have another aspect.

FIG. II-3 IMPERIAL HIGHWAY AUTHORITY  
Average Annual 24 Hours  
Rural Traffic Movement  
In Ethiopia, 1972



Prepared By  
Planning & Programming Division

FEB 1973

### III. PRESENT STATUS OF SEA PORTS



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#### (1) Port of Assab

The Port of Assab is located on the Red Sea nearest to the main trade route in comparison with another three principal ports in this area, Massawa, Djibouti and Aden.

At present, only-one good road connects Assab with high plateau areas. A new highway, between Tendaho and Awash, is under construction and will be completed by the end of 1973. This can shorten travel time between Assab and inland major cities, such as Addis Ababa to a greater extent.

Assab is about 860 Km. , from Addis Ababa, the National Capital City, and about 1,185 Kms. , from Asmara, the provincial capital city of Eritrea. The population is estimated at 22,000 people.

Although small in size, and isolated, the town, however, has importance out of proportion to its size and population. Other than being one of the two important National Ports on the Red Sea Coast, it has a 600,000 tons annual Petroleum Refinery.

The reconstruction of Assab Port was begun in 1957 to handle large size vessels. Yugoslavia had executed this work, and principal port facilities now in use were completed by 1961.

#### (1) - 1 Facilities

As shown in Figure III-1, Port of Assab consists of a commercial harbour, a oil harbour and a salt loading terminal. Commercial harbour, the center of the port, equipped with 6 deep see berths which can accomodate up to 10,000 G/T ocean going vessels, and 4 shallow berths for coaster.

Numbers and sizes of warehouses, open storages and a cold storage are listed on Table III-1. As cargohandling facilities, one derrick crane of 30 ton (lifting capacity) and mobile cranes are installed.

Forklift trucks and lorries are the another important cargohandling equipment in the port.

Oil harbour serves as intake of crude oil and outlet of some of refined oil for Assab Oil Refinery. A salt loading terminal owned by a private salt firm is located in south-eastern part outside of the port.

The port is adopting compulsory pilot system and operating for 24 hours. Two tug boats with 600 HP each are assisting ships manouvering in port. Bunkering of fuels together with fresh water supply are available from the quay.

Fig. III-2 below shows the chart of the port of Assab, indicating the management system of the port.



FIG. III-1 PORT OF ASSAB

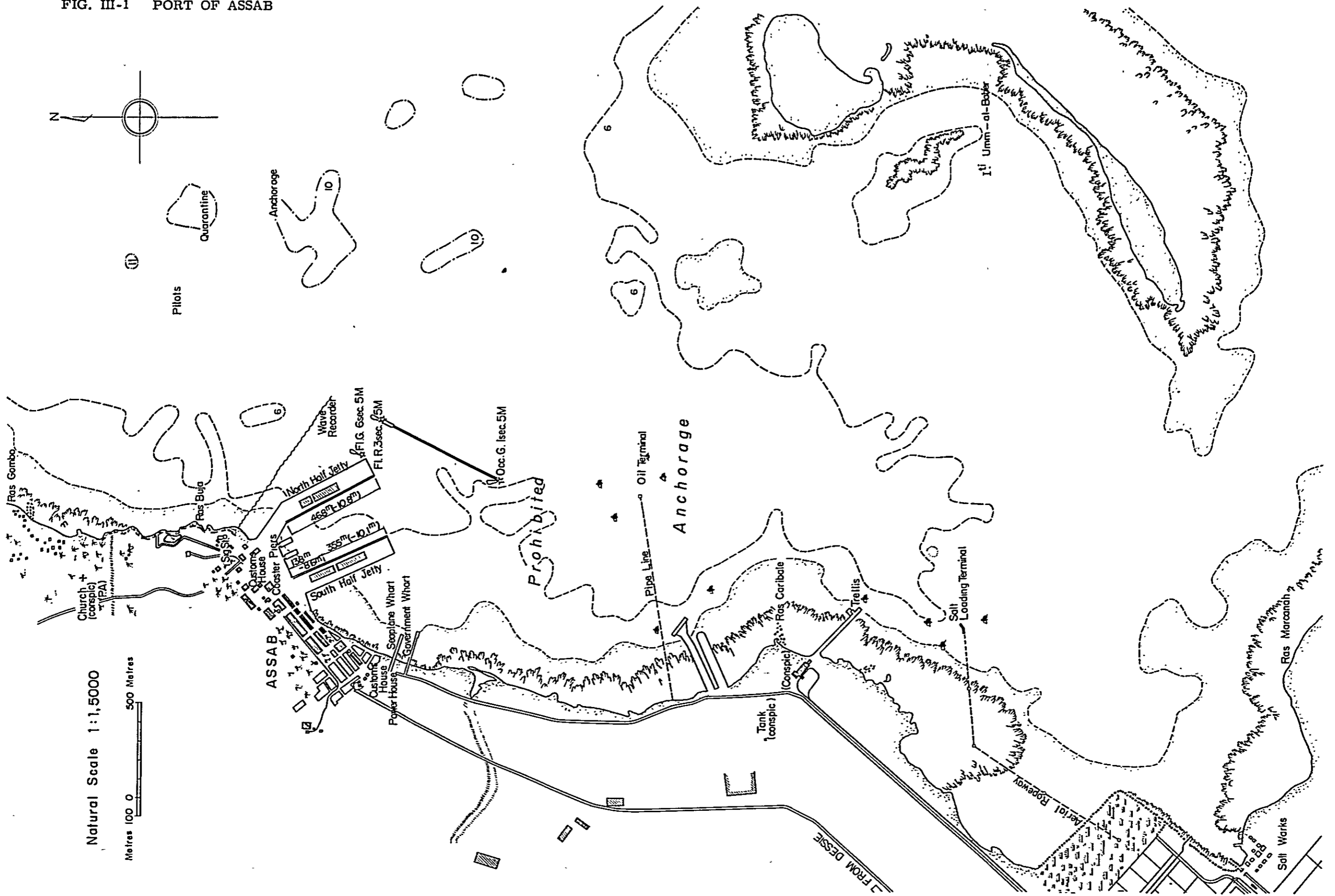




Table III - 1 Existing Port Facilities (Port of Assab)

**Commercial Harbour**

**Berth**

	Name of Berth	Length	Depth
The North Half Jetty	1	468 m	10.8 m
	2	468 m	10.8 m
	3		
The South Half Jetty	8	49 m	5.7 m
	9	138 m	8.6 m
	10	335 m	10.1 m
	11		
Coaster Piers	4	78 m	7.8 m
	5	"	"
	6	"	"
	7	"	"

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Warehouse:	6	15,000 m <sup>2</sup> (Capacity 52,300 m <sup>3</sup> )
Stacking Area:		Capacity 50,500 m <sup>3</sup>
Cold Storage:	1	Capacity 13,200 m <sup>3</sup>
Towage:	2	Tug boats, Each capacity 600 HP
Cargo Handling:		Derrick Crane (30T), Mobile crane (20T) Fork Lifts (1.5 - 3T).

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**Oil Harbour**

	Depth
Shell Jetty	9.9 m
Coastal Tanker Jetty	8.1 m
Refinery Terminal	10.8 m
Salt Loading Terminal	
Dolphin & Buoys	9.9 m

(1) - 2 The Utilization

The annual calling vessels to the port are approximately 700, of which comparatively small scale ships are occupying a larger share. The coaster transporting refined oil from Assab is approximately 15 % of the total.

Table III-2 and Table III-3 below shows the cargoes handled in the past 5 years and in 1964 E. C. respectively, indicating that in 1964 E. C., loading cargo is 714,900 tons and discharging cargo 517,400 tons, totalling 1,232,300 tons, the share of petroleum being big, approximately 75 % both in loading and discharging. The loading of refined oil is in total 300,000 tons approximately; 180,000 tons to Djibouti and 120,000 tons to Massawa, finally destined to Northern and Southern Ethiopia via these ports. The discharging of oil is mostly the crude oil to be refined in Assab Refinery and the balance being fuel oil which is not produced in the Refinery. Other export general cargo, coffee, pulse etc. is 158,800 tons while import general cargo, machinery and chemical products etc, is approximately 88,800 tons, showing much trade imbalance which affects adversely the economics of inland transportation in this port.

Table III - 2 Imports and Exports through Assab

(Metric Tons)

E. C.	Imports*	Exports
1960	433,321	407,301
1961	556,768	444,409
1962	628,383	511,656
1963	688,637	491,852
1964	714,856	517,427

\* Imports include crude oil.

\*\* Both of Imports and Exports include Home Trade and Transshipment.

Table III - 3 Major Commodities Imported and Exported through Assab (1964 E. C.)

(Thousands Metric Tons)

Import	Chemical	7.0
	Fuel, Diesel, Gas Oil & Lubricant	10.1
	Machinery & Heavy Equipment	5.1
	Merchandise General	4.7
	Steel & Iron Bar	6.2
	Wheat, Flour & Other Grains	13.0
	Others	52.7
	Sub Total (Excluding Crude Oil)	98.8
	Crude Oil	612.8
	Total	711.1
Home Trade	2.5	
Transshipment	1.3	
Grand Total	714.9	
Export	Coffee	49.3
	Cotton & Seeds	22.3
	Haricot Beans	12.4
	Hides	5.4
	Horse Beans	10.7
	Lentils	15.6
	Linseeds	15.9
	Niger Seeds	9.0
	Others	18.4
	Sub Total (Excluding Fuel and Salt)	158.8
	Fuel Oil	179.0
	Salt	59.6
	Total	397.4
Home Trade	120.1	
(Including Fuel)	(118.6)	
Grand Total	517.4	

(Source: Port Office of Assab)

Table III-4 below indicates the days during which the lorry carried export cargo from Addis Ababa waits in Assab to take import cargo destined to Addis Ababa and approximately 73 % of the lorries are waiting 1 to 5 days, average 2.4 days.

Table III - 4 Trucks Stay at Assab Port

Date of Arrival	No. of Trucks	Length of Stay (days)						Remarks
		0	1	2	3	4	5	
1963. 11. 15	14	14	0	0	0	0	0	Not Available
12. 14	45	11	34	0	0	0	0	
1964. 1. 12	18	18	0	0	0	0	0	
2. 10	6	1	1	4	0	0	0	
3. 8	21	21	0	0	0	0	0	
4. 13	24	-	-	-	-	-	-	
5. 11	9	0	0	0	0	9	0	
6. 9	23	0	0	0	0	23	0	
7. 14	21	0	5	13	0	3	0	
8. 8	24	0	21	1	0	2	0	
9. 12	20	0	0	0	0	11	9	
10. 10	17	0	0	17	0	0	0	
<b>Total</b>	<b>242</b>	<b>65</b>	<b>61</b>	<b>35</b>	<b>0</b>	<b>48</b>	<b>9</b>	

Source: Branch Office of Road Administration at Assab

Note: Average Number of Arrival per Day: 18 Trucks/Day  
 Total Waiting Time: 368 Trucks/Day  
 Average Waiting Time (for all): 1.6 Day  
 Average Waiting Time (for in waiting line): 24 Days

The utilization ratio of the commercial berths, except the coaster, is approximately 37 %, with an average of cargo handling volume per berth being 40,000 tons and less utilization of North Half Jetty, giving more utilization capacity for the both Jetties. The utilization ratio of salt and oil jetties indicates less figure of approximately 15 %, leaving much room for increased utilization in future.

The following Table III-5 and Table III-6 shows occupation time of the vessels and cargo handling volume per berth respectively.

Table III - 5 Berth Occupation of Assab Port (1964 E. C.)

	Length (m)	Depth (m)	No. of Ships	Total Hours Occupied	Average Hr. Occupied	Occupied (%)
No. 1	156	10.8	59	2,156	36.5	24.6
No. 2	"	"	80	2,733	34.1	31.2
No. 3	"	"	74	3,765	50.9	43.0
No. 8	49	5.7	42	4,101	97.6	46.8
No. 9	138	8.6	82	3,444	42.0	39.3
No. 10	167	10.1	101	3,655	36.2	41.7
No. 11	168	10.1	74	3,203	43.3	36.6
No. 4 - 7	3 <sup>B</sup>	7.8	76	15,360	202.1	58.4
Refinery Terminal	1 <sup>B</sup>	9.9	28	2,436	87.0	27.8
Coastal Tanker Jetty	1 <sup>B</sup>	8.1	59	1,579	26.8	18.0
Shell Berth	1 <sup>B</sup>	10.8	2	50	25.0	5.7
Salt Berth	1 <sup>B</sup>	9.9	9	1,023	113.7	11.7

Source: Assab Port Office

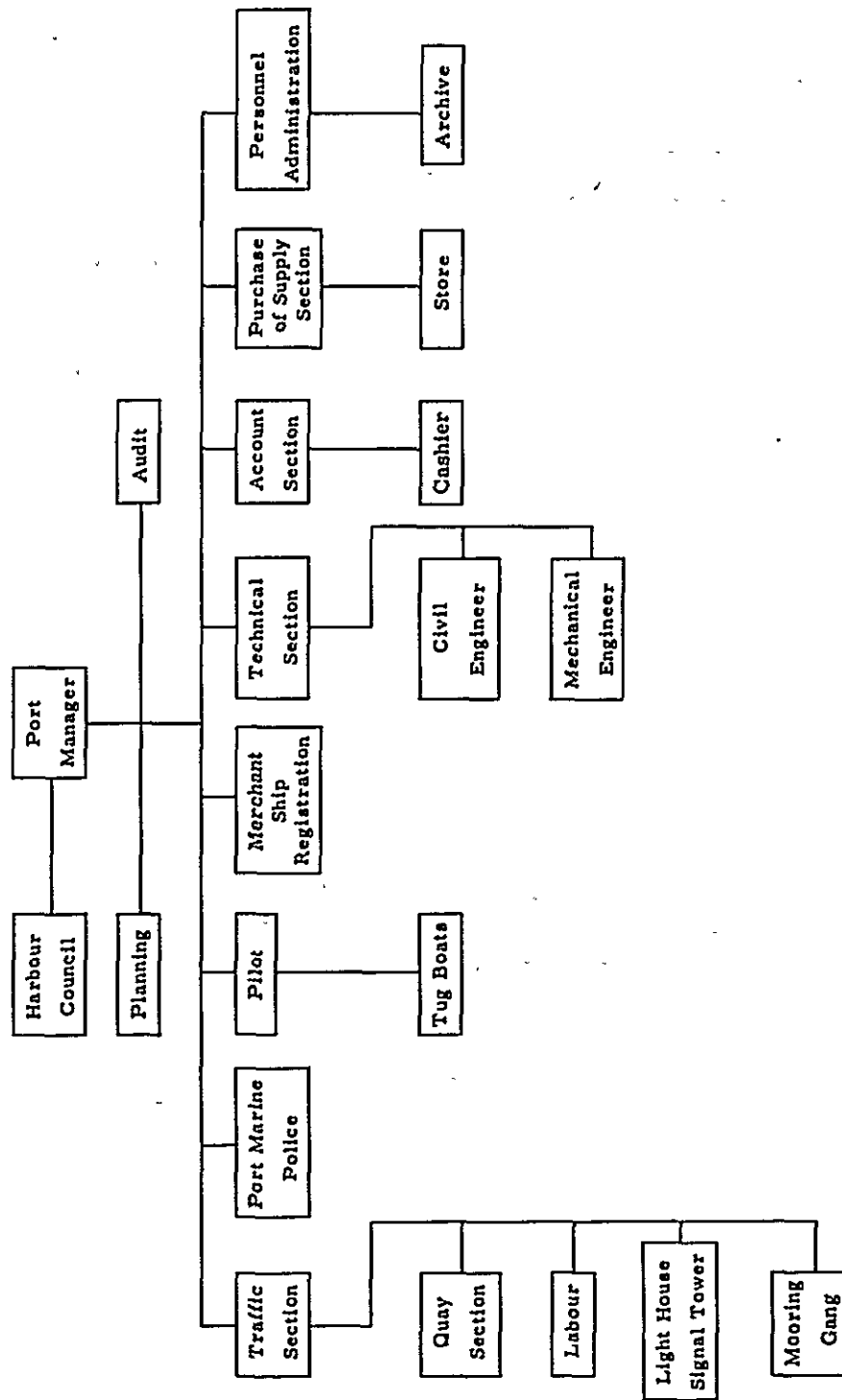
Table III - 6 Berth Utilizations of Assab Port (1964 E. C.)

(Metric Tons)

Name of Berth	No. of Berth	Tons Discharged	Tons loaded	Total tons dry	OIL	Total
No. 1	10,000 <sup>D/W</sup> x1 <sup>B</sup>	7,445	150,770	16,161	142,036	158,187
No. 2	10,000 <sup>D/W</sup> x1 <sup>B</sup>	11,355	42,907	51,562	-	51,562
No. 3	10,000 <sup>D/W</sup> x1 <sup>B</sup>	31,461	6,091	37,552	-	37,552
No. 8	700 <sup>D/W</sup> x1 <sup>B</sup>	2,940	8,675	11,615	-	11,615
No. 9	5,000 <sup>D/W</sup> x1 <sup>B</sup>	14,652	48,282	62,934	-	62,934
No. 10	10,000 <sup>D/W</sup> x1 <sup>B</sup>	20,358	36,823	57,181	-	57,181
No. 11	10,000 <sup>D/W</sup> x1 <sup>B</sup>	7,172	17,409	24,581	-	24,581
No. 4-7	Coaster x3 <sup>B</sup>	624	5,506	6,240	-	6,240
Refinery Terminal	15,000 <sup>D/W</sup> x1 <sup>B</sup>	589,520	-	-	589,520	589,520
Coastal Tanker Jetty	6,000 <sup>D/W</sup> x1 <sup>B</sup>	4,788	158,661	-	163,449	163,449
Shell Berth	15,000 <sup>D/W</sup> x1 <sup>B</sup>	3,329	-	-	3,329	3,329
Salt Berth	15,000 <sup>D/W</sup> x1 <sup>B</sup>	-	69,670	69,670	-	69,670



Fig. III - 2 ORGANIZATION CHART (PORT OF ASSAB)



(2) Port of Massawa

The Port of Massawa is serving for the northern Ethiopia, and its hinterland occupies about one-third of the Empire.

The railway, 950 mm gauge and 306 km long, extends from Massawa to Agordat via Asmara, the capital city of Eritrea Province. Also good paved highways connect Massawa with Asmara and other principal cities in high plateau areas, up to Addis Ababa, 1,166 km distant by road.

(2) - 1 The Present situation of port facilities

The existing port facilities are the commercial harbour where the general cargoes are mainly handled, specialized berths through which salt, cement and refined oil are handled and the American Jetty which has been now so damaged that it cannot be utilized.

The commercial harbour has 5 big berths and No. 1 berth where 2 small ships can be concurrently along side. Along these berths, there is a railway-yard and 6 units of quay cranes are accommodated which are usually serving loading and unloading of the general cargoes onto and from the ocean-going vessels. Facing these berths, warehouses, transit-sheds and open storages are accommodated and functioning as the storage. In the stacking area in-between, a number of mobile-cranes and fork-lifts are operating.

The specialized berths are one each for salt and cement and 2 oil terminals all of which are purposely designed and properly operating for such particular cargoes.

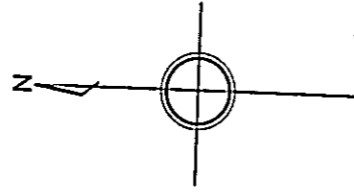
The American Jetty has been now so devastated that it cannot be commercially utilized except as the tentative anchoring and a repairing or rehabilitation is urgently required.

The following Fig. III-3 indicates the plan of Massawa port and Table III-7 the existing facilities of the port.

(2) - 2 The Utilization of the port

The number of the annual calling vessels to the port is around 689 in average, of which the small scale ships of less than 1,000 G/T largely occupy approximately 40 %. Approximate 400 big size vessels above 1,000 G/T are calling per year, of which about 10 % are the ocean-going vessels of more than 10,000 G/T which seem slightly to be increasing. The following Table III-8 is the list of calling vessels indicating the number of each vessel divided in the order of the ship's tonnage;

FIG. III-3 PORT OF MASSAWA



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Table III - 7 Existing Port Facilities (Port of Massawa)

Commercial Harbour

<u>Berth</u>	<u>Name of Berth</u>	<u>Length</u>	<u>Depth</u>
	1.	176 m.	5.0 m.
	2.	150 m.	7.4 m.
	3.	137 m.	8.6 m.
	4.	137 m.	8.4 m.
	5.	137 m.	8.1 m.
	6.	170 m.	9.0 m.
Warehouse:	6 Capacity	75,921 m <sup>3</sup>	
Open Shed:	2	2,616 m <sup>3</sup>	
Stacking Area:		33,555 m <sup>3</sup>	
Towage:	3 Tug Boats	2 x 350 H. P. and 1 x 1,000 H. P.	
Cargo Handling:	6 Quay Cranes (5T, in tandem 9T),		
	7 Folk Lifts	5 Mobile Cranes	
			Depth
Salt Berth			Max. 9.6 m.
Oil Terminals			
Agip Terminal			8.6 m.
Mobil Terminal			9.0 m.
Cement Berth			Max. 5.4 m.
American Jetty			Max. 5.4 m.

Table III - 8 Distribution of Gross Tonnage of Calling Vessels at Massawa Port

Rank of G/T	1970		1971		1972(G. C.)	
	Number	%	Number	%	Number	%
0 - 500	185	26.4	195	27.3	193	28.1
500 - 1,000	115	16.4	90	12.7	100	14.5
1,000 - 2,000	43	6.3	59	8.3	49	7.1
2,000 - 3,000	60	8.6	80	11.3	70	10.1
3,000 - 4,000	21	3.0	18	2.5	18	2.6
4,000 - 5,000	22	3.1	29	4.1	31	4.5
5,000 - 6,000	58	8.3	53	7.5	39	5.7
6,000 - 7,000	47	6.7	37	5.2	16	2.3
7,000 - 8,000	40	5.7	63	8.9	53	7.7
8,000 - 9,000	34	4.9	26	3.7	38	5.5
9,000 - 10,000	43	6.1	33	4.7	42	6.1
10,000 - 15,000	32	4.5	24	3.8	36	5.8
15,000 -	1		3		4	
Total	701	100	710	100	689	100

Source: Massawa Port Office

The cargo volume of the port totals 474,700 ton in 1964 E. C., for loading 210,300 ton and unloading 264,400 ton and there indicates no big difference in the past 5 years. The main out going items are cement, salt, oil seeds, fruits and vegetables and the big in-coming items are consummables like foods and refined oil from Assab which occupy around 40 % of the total import. This figure suggests that the port of Massawa is importantly functioning as the terminal deposit for distribution of the refined oil to North Ethiopia as well as the port of foreign trade.

The following Table III-9, III-10 show the cargo handling volume in recent 5 years and in 1964 E. C. by item:

Table III - 9 Imports and Exports through Massawa

(Metric Tons)		
E. C.	Imports	Exports
1960	207,882	210,144
1961	256,547	240,656
1962	283,116	181,870
1963	290,195	259,565
1964	264,374	210,277

Table III - 10 Major Commodities Imported and Exported through Massawa (1964 E. C.)

(1,000 Metric Tons)			
Import	Chemical Products	6.1	
	Fuel & Lubricants	32.5	
	Steam Coal	8.9	
	Steel and Iron Materials	12.4	
	Others	79.8	
	Total	139.7	
	Home Trade	123.3	
	Transshipment	1.3	
	Grand Total	264.4	
Export	Fruits & Vegetables	19.7	
	Lentils	6.7	
	Meat Products	5.7	
	Niger Seeds (Nehug)	12.6	
	Sesame Seeds	42.1	
	Yellow Graham	6.8	
	Others	26.0	
		Sub Total (Excluding Cement & Salt)	119.5
		Cement	17.8
		Salt	66.9
		Total	204.2
	Home Trade	5.9	
	Transshipment	0.1	
	Grand Total	210.3	

(Source: Port Office of Massawa)

The following Table III-11, Table III-12 show the utilization of the berths.

The Utilization ratio of the commercial harbour is approximately 52% in average which proves the berths are reasonably utilized without causing the vessel to wait off the port.

An annual average cargo handling volume per berth, except No. 1 for small ship, is around 40,000 ton, slightly below the standard utilization figure.

This low utilization ratio is to be contributed to more small ships are calling and the cargo-handling volume per vessel being comparatively small.

The utilization ratio of the refined oil berth still remains around 10 % leaving much room for more utilization.

Fig. III-4 is the chart of the port office indicating the management of the port.

Table III - 11 Berth Occupation of Massawa Port (1964 E. C.)

	Length	Depth	No. of ships	Total Hr. Occupied	Average Hr. Occupied	Berth Occupation	Remarks
	(m)	(m)		(Hr)	(Hr)	(%)	
No. 1	176	5.0	136	10,746	79.0	62.5	2 Berths
No. 2	150	7.4	101	7,179	71.0	81.9	
No. 3	137	8.6	135	5,582	41.3	63.7	
No. 4	137	8.4	96	5,784	60.2	66.0	
No. 5	137	8.1	107	4,498	42.9	52.4	
No. 6	170	9.0	67	3,353	50.0	38.3	
Agip Oil Terminal	(Berth) 1	8.6	31	1,067	34.4	12.3	
Mobil Oil Terminal	1	9.0	30	1,143	38.1	13.1	
Salt Berth	1	5.4	9	467	52.9	5.3	
Cement Berth	1	5.4	1	89	89.0	1.0	

Source: Massawa Port Office

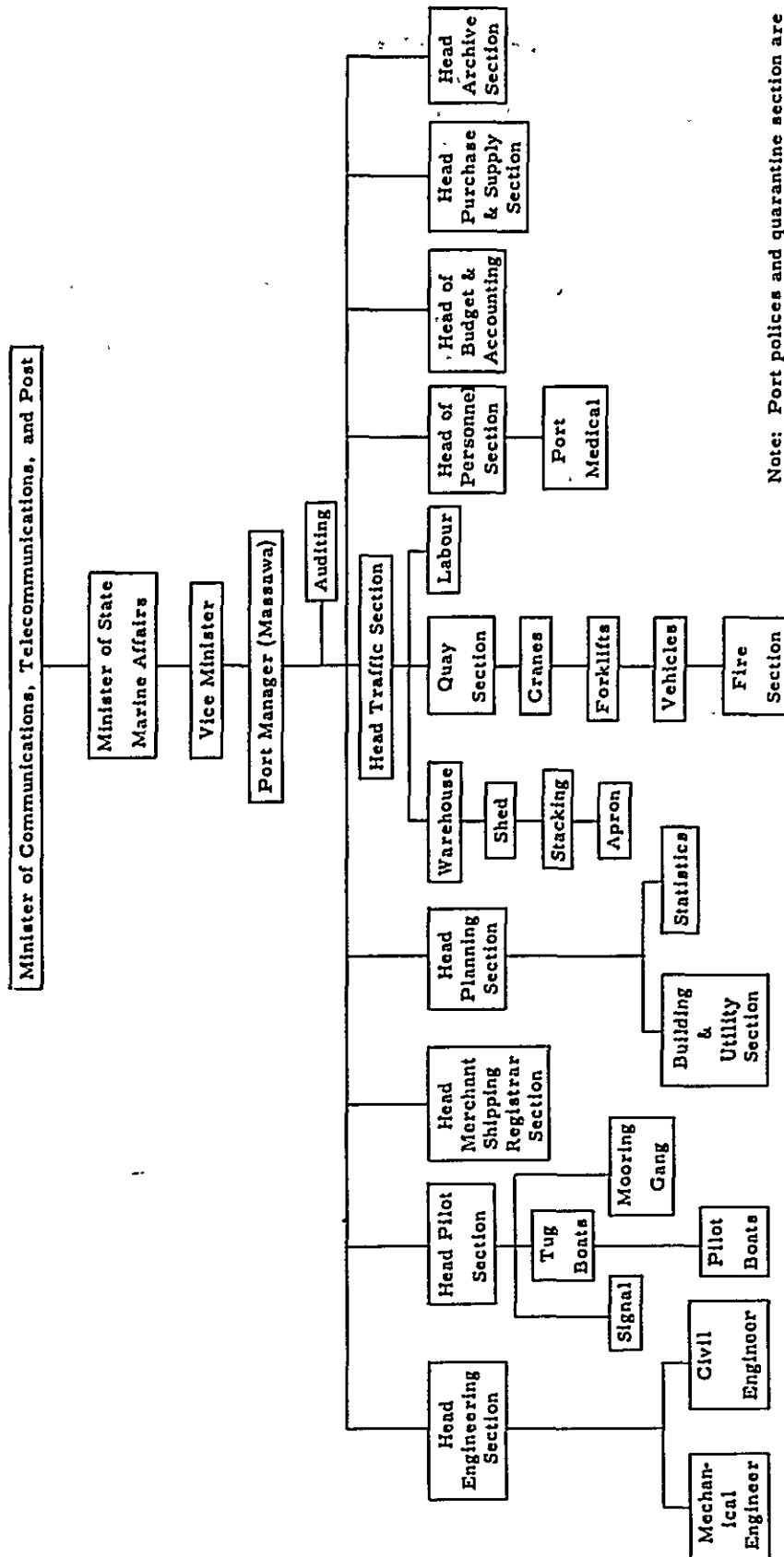
Table III - 12 Berth Utilization of Massawa Port (1964 E. C.)

Name of Berth	No. of Berth	Discharged			Loaded	Total
		Dry	Oil	Total	Dry	
No. 1	1,000 <sup>D/W</sup> <sub>x2</sub> <sup>B</sup>	1,718	-	1,718	22,475	24,193
No. 2	4,000 <sup>D/W</sup> <sub>x1</sub> <sup>B</sup>	13,956	1	13,957	28,738	42,695
No. 3	6,000 <sup>D/W</sup> <sub>x1</sub> <sup>B</sup>	34,805	-	34,805	32,410	67,215
No. 4	6,000 <sup>D/W</sup> <sub>x1</sub> <sup>B</sup>	29,040	-	28,040	23,571	52,611
No. 5	6,000 <sup>D/W</sup> <sub>x1</sub> <sup>B</sup>	24,028	2,783	26,811	29,464	56,275
No. 6	10,000 <sup>D/W</sup> <sub>x1</sub> <sup>B</sup>	11,823	-	11,823	21,566	33,383
Agip Oil Terminal	10,000 <sup>D/W</sup> <sub>x1</sub> <sup>B</sup>	-	81,223	81,223	-	81,223
Mobil Oil Terminal	10,000 <sup>D/W</sup> <sub>x1</sub> <sup>B</sup>	-	61,691	61,691	-	61,691
Salt Berth	2,000 <sup>D/W</sup> <sub>x1</sub> <sup>B</sup>	-	-	-	46,620	46,620
Cement Berth	2,000 <sup>D/W</sup> <sub>x1</sub> <sup>B</sup>	-	-	-	850	850
Others	-	115,660	145,698	261,358	206,025	467,383

Source: Massawa Port Office



Fig. III - 4 ORGANIZATION OF MASSAWA PORT OFFICE



Note: Port police and quarantine section are within the port though under separate ministries.

### (3) Port of Djibouti

The Port of Djibouti belongs to the French Territory of Afars and Issas, and is one of the principal ports for exports and imports of southern part of Ethiopia.

Djibouti is a free port and its two major activities are the banking services for ships, and transshipment including transit of traffic to and from Ethiopia. Especially the transshipment for other countries than Ethiopia will be more active as the result of decline of Port of Aden.

The Franco-Ethiopia Railway, 1,000 mm gauge and 781 km long, connects directly Djibouti to some principal Ethiopian cities, Addis Ababa, Dire Dawa, etc. Poor road networks across the boarder necessitate the railway to accept most of cargoes to and from Ethiopia.

The port is operated under the state supervision by Government officials, who are responsible for administration, maritime and maintenance services. The port budget is annexed to, but separate from, the general budget for the territory since 1955.

This port had only a rudimentary jetty before 1943 when the Expansion project was started, and present port took shape between 1948 and 1957.

#### (3) - 1 The present Situation of the Port Facilities

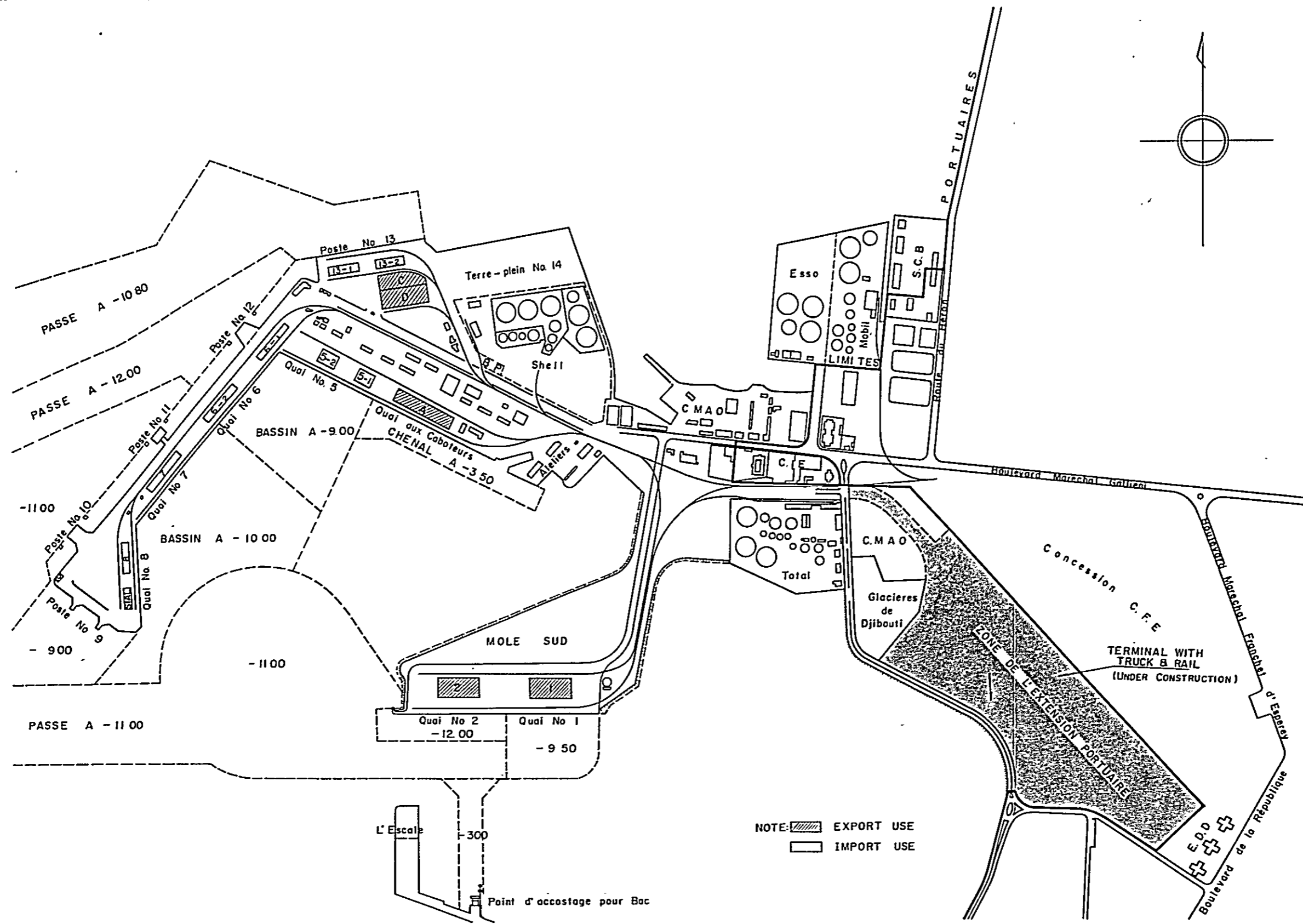
The port facilities are divided into two; the commercial harbour where the general cargoes are handled and the special berths for bunkering and water-supply. The former has 7 berths suitable for accommodating ocean-going vessels, with the depth of -8 m, and 1 berth suitable for smaller ships with length of 250 m out of the the above 7 berths. No. 5 Berth 250 m long and No. 6 and 7 Berths 430 m long together are considerably so long as these are utilized as 2 berths and 3 berths respectively.



Post 9 - 12 berths are the modern accommodation specifically designed for bunkering and water supply with supply pipe.

Behind these berths, warehouses, open storages and transit sheds are located, and between them, railways are put, all these are well organized so that the cargo handling works can be assured. There is also the facilities of the petroleum tank big enough to store the petroleum not only for supply for bunkering but also for distribution to Ethiopia. The inland transport terminal of approximately 25,000 M<sup>2</sup> is also reserved for future increase of transportation by lorry.

The following Table III-13 and Fig. III-5 indicate the plan of the port and the existing port facilities respectively.

FIG. III-5 PORT OF DJIBOUTI



NOTE:  EXPORT USE  
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Table III - 13 Existing Port Facilities (Port of Djibouti)

<u>Berth</u>	<u>Length</u>	<u>Depth</u>	<u>Remarks</u>
1	180 m	9.5 m	
2	220 m	12 m	
5	230 m	8.2 m	
6	215 m	7.9 m	
7	215 m	7.9 m	
8	202 m	9.4 m	
9	200 m	8.2 m	Bunkering only
10	260 m	10.9 m	Bunkering & Discharging black oils
11	170 m	10.9 m	Bunkering only
12	160 m	12.2 m	Bunkering & Discharging black oils
13	210 m	10.3 m	Bunkering & Discharging petroleum products (including liquid gas)
Coastal Quay	240 m	3.5 m	
Warehouse: Public	18,740 m <sup>2</sup>		
Private	6,878 m <sup>2</sup>		
Open shed:	183,000 m <sup>2</sup>		
Towage:	4 Tug Boats, 1, 320 H.P., 1, 000 H.P. and 2 x 600 H.P.		
Cargo Handling:	Floating Crane (80 T)		

(3) - 2 The Utilization of the Port Facilities

The calling vessels to the port in 1972 are 764, about 60 % increase than the preceding year. The following Table III-14 shows calling vessels in the order of tonnage in the past 3 years, featuring the calling of larger tonnage vessels of more than 3,000 G/T occupying approximately 70 % of the total. The big ocean-going vessels of more than 10,000 G/T are rapidly increasing since 1972.

Table III - 14 Distribution of Gross Tonnage of Calling Vessels at Djibouti Port

Rank of G/T	1970		1971		1972 (G. C.)	
	Number	%	Number	%	Number	%
0 - 3,000	201	31.3	221	31.6	220	28.8
3,000 - 5,000	39	6.1	77	11.0	82	10.7
4,000 - 10,000	360	56.1	379	54.2	405	53.0
10,000 -	42	6.5	22	3.2	57	17.5
Total	642	100	699	100	764	100

Source: Statistiques 1965 - 1972, Port De Commerce De Djibouti

The cargo handling volume including bunkering etc. is about 1,400,000 tons in 1972. Of the export of about 700,000 tons, approximately 80 % is for bunkering etc., and the general cargoes are only 132,400 tons. In the same manner, about 75 % of the total import is for petroleum and the balance for the general cargoes. The following Table III-15 and Table III-16 indicate the cargo handling volume in the past 5 years and in 1972 respectively.

Table III - 15 Import and Export through Djibouti

(Metric Tons)			
Year	Export	Import	Total
1968	633,799	728,960	(T 10,296) 1,362,759
1969	760,464	831,744	(T 14,566) 1,592,208
1970	821,407	998,333	(T 8,780) 1,819,740
1971	697,914	894,825	(T 20,820) 1,592,739
1972	693,026	782,386	(T 11,299) 1,475,412

Source: Statistiques 1965-1972, Port De Commerce De Djibouti

Note: 1) Both of Imports and Export include Bunkering and Water Supply:

2) (T) Indicates Volume of Transshipment and is not included in total.

Table III - 16 Cargo Handled at Djibouti by Type of Cargo (1. 1972)

Export	General Cargo	132,421
	Bunkering	560,605
	Refined Oil	451,540
	Water Supply.	109,065
	Total	693,026
Import	General Cargo	195,448
	Refined Oil	586,938
	Total	782,386
Transshipment		(11,299) (T: 11,299)
Grand Total		1,575,411

Source: Statistique 1965 - 1972, Port De Commerce De Djibouti.

The Table III-17 below indicates the cargo movement through the port destined to and originated from Ethiopia, which suggests imbalanced cargo movement of import cargo of 230,400 tons and export cargo of 69,800 tons. The share of the Ethiopian general cargoes in the total handled in this port is approximately 85% in 1970-1971, which means the port of Djibouti is functioning as one of the in and out-lets of the foreign trade of Ethiopia, in particular, of import of machinery, chemical and industrial goods etc. Table III-18 shows the movement of the Ethiopian goods out of the cargoes handled in this port.

Table III - 17 Ethiopian Imports and Exports through Port of Djibouti as Transit (1971)

(Thousand Metric Tons)

Import	Grain	28.5
	Sugar and Salt	28.4
	White Products of Petroleum	28.3
	Gas-Oil and Black Products of Petroleum	43.8
	Papers, Cartons and Applications	5.3
	Textile Fabrics, Files, Cords etc.	12.2
	Iron, Foundry Iron, Steel	9.7
	Metal Pipe and Plate	14.3
	Machinery	6.2
	Chemical Products	27.8
Others	26.2	
	<b>Total</b>	<b>230.4</b>
Export	Fruits and Vegetables	12.2
	Meats and Fishes (Fresh, Frozen etc.)	7.3
	Coffee and Tea	35.9
	Sugar and Salt	10.0
	Others	4.3
		<b>Total</b>

Source: Bulletin de statistique et de documentation  
No. 7, Janvier 1972, Ministère des Affaires Economiques  
Territoire Français des Afars et des Issas

Table III - 18 Transshipment to Ethiopia via Djibouti

(unit: M/T)

	Import		Export		Total	Transshipment to Ethiopia
	Total	Transshipment to Ethiopia	Total	Transshipment to Ethiopia		
1970 G. C.	232,866	219,912 (0,545)	88,092	74,666 (0,896)	320,958	294,578
1971	256,461	230,383 (0,845)	90,937	69,789 (0,767)	347,398	300,172
<b>TOTAL</b>	<b>489,327</b>	<b>450,295</b> <b>(0,921)</b>	<b>179,029</b>	<b>144,455</b> <b>(0,806)</b>	<b>668,356</b>	<b>594,750</b> <b>(0,864)</b>

As shown in Table III-19, the utilization ratio of the berths for the general cargo is approximately 48.7 %. For the maximum utilization No. 5 Berth and No. 6-7 Berths are utilized as 2 or 3 berths as described previously, thus reasonably utilized as a whole, while the utilization ratio of the bunkering berths is still about 20% leaving room for more utilization.

Table III - 19 Berth Occupation of Djibouti Port (1964 E. C.)

Name of Berth	Length	Depth	No. of Ships	Total Hr. Occupied	Average Hr. Occupied	Berth Occupation	Remarks
	(m)	(m)		(Hr.)	(Hr.)	(%)	
Quay. 1	180	9.5	83	9,010	60.4	51.9	2 Berths
" 2	220	12.0	66				
" 5	230	8.2	171	10,011	58.5	57.7	2 Berths
" 6		7.9	101				
" 6+7	430	7.9	28	7,744	38.6	43.1	2 Berths
" 7		7.9	88				
" 8	220	9.4	123	3,267	26.6	37.5	
" 13	210	10.3	116	4,076	35.1	46.6	
<b>Total</b>	-	-	<b>776</b>	<b>34,108</b>	<b>46.5</b>	<b>48.7</b>	
Post 9	200	8.2	17	1,635	96.2	18.7	
10	260	10.9	145	2,491	17.3	28.4	
11	170	10.9	31	1,107	35.7	12.6	
12	260	12.2	67	1,473	22.0	16.8	
<b>Total</b>			<b>260</b>	<b>6,706</b>	<b>25.7</b>	<b>19.3</b>	
<b>Grand Total</b>			<b>1,036</b>	<b>40,814</b>	<b>39.5</b>	<b>38.8</b>	

Source: Djibouti Port Office



**IV. PROJECTION OF EXPORT AND IMPORT VOLUME**



#### IV. PROJECTION OF EXPORT AND IMPORT VOLUME

##### (1) Macroscopic Analysis

The most familiar method of estimating the export and import volume in macroscopic way is use of correlation among the export and import volume and relevant economic index such as Gross National Product. Owing to the following two reasons, a modified method is adopted in this report. One is the lack of reliable statistical data and the other is the absence of authorized economic index which will cover the planning period of some 20 years.

The method adopted is as follows:

- i) Volume of export and import at the target years estimated in terms of value. 1971 G.C. is selected as the base year and average annual growth rates for export and import are decided by use of figures of external trade statistics in last 20 years.
- ii) Estimated volume from the above applied to commodity. Change of the export and import structure should be taken into account. To this aim, weight of each commodity group in the total export or import is estimated in value. Information acquired through sectoral study is fully utilized, too.

##### (1) - 1 Export and Import at the Base Year

1971 G.C is adopted as the base year and values of export and import, also in volume, average of 1970 - 1972 is used as the base, as an annual fluctuation of figures is very strong as shown in Fig. IV-1.

A fairly large discrepancy is observed between the figures of external trade statistics and port statistics. Calculation is made by external trade statistics at first, then adjusted by the port statistics. By this procedure, 6 months time lag is induced. \*1 But, this is not significant to the long term forecast.

Table IV - 1 Volume of Export and Import in Base Year

(1,000 M/T)

Year	Import				Export			
	Massawa	Assab	Djibouti	Total	Massawa	Assab	Djibouti	Total
1970 (1962 EC)	187.9	88.1	186.8	462.8	176.4	411.7	84.7	672.8
1971 (1964 " )	220.2	112.0	224.5	556.7	252.7	430.1	71.2	754.0
1972 (1964 " )	139.7	98.8	205.2	443.7	204.6	397.5	86.8	688.9
Total				1,463.2				2,115.7
Average				487.7				705.2

- Note: 1) Transshipment and home trade are excluded.  
 2) Import of crude oil is not included.  
 3) Transit cargo for Ethiopia is picked up from Djibouti port and compiled as Ethiopian calendar year.

Source: Port Office of Massawa, Port Office of Assab and Port de Commerce de Djibouti.

FIG. IV-1 EXPORT AND IMPORT OF EACH PORT

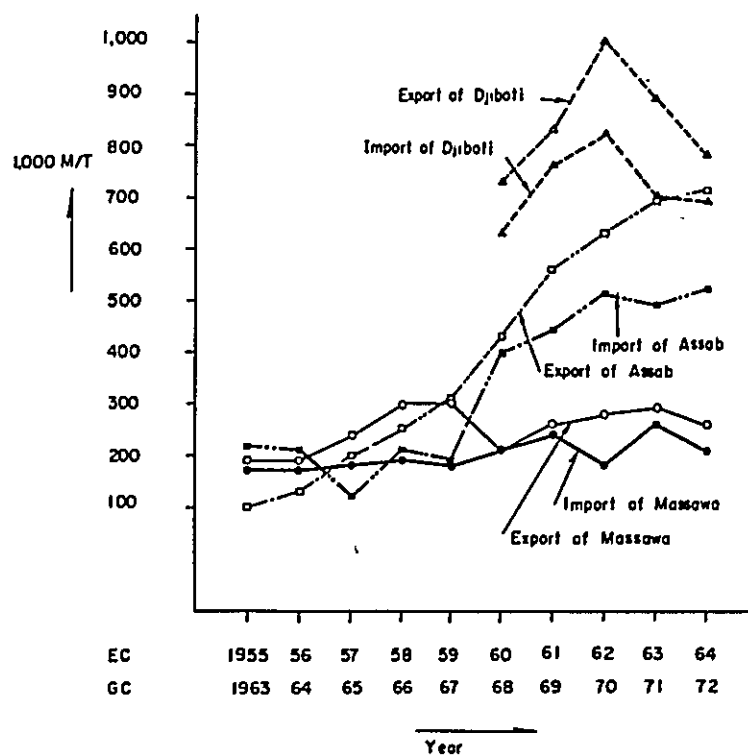


Table IV-2 Total volume of Import & Export in Base Year

(in 1,000Eth\$)			
Year	Import	Export	Total
1970	294,622	429,080	623,702
1971	309,955	469,555	779,510
1972	376,955	435,603	812,558
Total	981,532	1,334,238	2,215,770
Average	327,177	444,746	771,923

(1) - 2 Average Annual Growth Rate of Export and Import

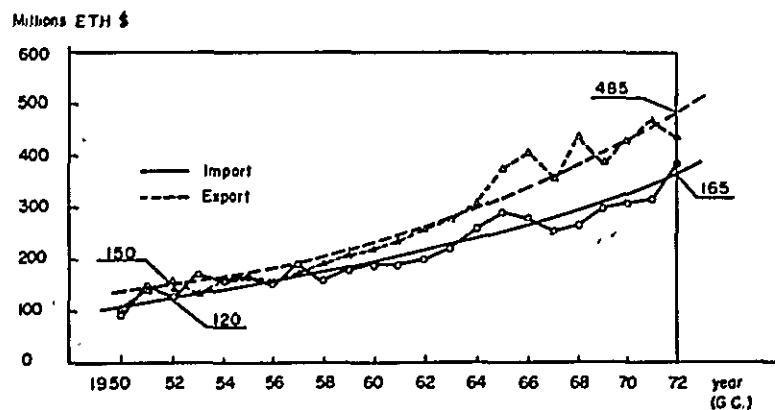
For estimating average annual growth rate of export and import, two kinds of information are available at the moment. One is the trend of last 20 years and the other is a general framework for the Fourth Five Year Development Plan. There is no authorized long range economic development plan than five year in this country.

Export and import in value base for last 22 years has shown in Fig. IV-2.

1\* : The reason is that external Trade statistics is compiled for Gregorian calender while port statistics is compiled for Ethiopian fiscal year.

The average annual growth rates have been calculated for last 21 years from Fig. IV-2. The figures, 6.5 % for import and 5.7 % for export, are relatively low in comparison with the following figures of general framework for the FFYP.

FIG. IV-2 ANNUAL GROWTH RATE OF EXPORT AND IMPORT



Source: Annual External Trade Statistics (1972)

Table IV - 3 Growth Rates in General Frame-Work for the FFYP

Average Rate of GDP Growth	6.0 - 6.5 %
Average Rate of Growth of Commodity Export	8.5 %
Average Rate of Growth of Commodity Import	9.2 %
Foreign Exchange Gap	11.5 %

Note: Estimated at constant price.

Source: Imperial Ethiopian Government

Among the figures listed above, the most conspicuous is the foreign exchange gap which may be feasible for shorter period but could not be extrapolated for over 20 years. The figures adopted are 6.5 % for export which is corresponding to the average of past trend and 7.0 % for import which will keep visible balance of trade at the present level in the target year of 1994 G.C. under the above mentioned assumption for export. The average annual growth rates and corresponding volume of export and import at the target year in value are summarized and shown in Table IV-4.

Table IV - 4 Volume of Export and Import at 1994 G.C.

(million \$ Eth. at 1971 price)

	Base Year (1971)	Target Year (1994)	Average Annual Growth Rate
Import	444.7	1,892.6	6.5 %
Export	327.2	1,550.9	7.0 %

Source: the Survey Team



(1) - 3 Volume of Export and Import at the Target Year

Volume of export and import at the target year 1994 G. C. in 1971 price are transformed into commodity base by following procedure.

$$QI (i) = p VI (i) UI (i)$$

$$QE (i) = u VE (i) UE (i)$$

here,  $QI (i)$  : import volume (Kg.) at year  $i$

$QE (i)$  : export volume (Kg.) at year  $i$

$VI (i)$  : import value (Eth. \$) at year  $i$

$VE (i)$  : export value (Eth. \$) at year  $i$

$UI (i)$  : average unit value of import (Eth. \$/Kg.) at year  $i$

$UE (i)$  : average unit value of export (Eth. \$/Kg.) at year  $i$

$p$  : conversion coefficient from External Trade Statistics to port Statistics.

Volume of export and import at the target year 1994 G. C. in commodity base are calculated as 2,574 thousand metric tons for export and 6,001 thousand metric tons for import (including import of crude oil).

$$QE (1994) = 1.15 (1,551.3/0.696) = 2,574.2 \text{ ('000 M/T)}$$

$$QI (1994) = 1.37 (1,892.6/0.358 - 3,354^{*1}) + 3,354^{*1}$$

$$= 6,001.8 \text{ ('000 M/T)}$$

\*1) import volume of crude oil is estimated separately and adjusted to the formula.

Data used for the above calculations have been shown in Table IV-5, Table IV-6 and Table IV-7.

Table IV - 5 Average Unit Value of Export Commodities

Selected Cargoes	Base Year (1971 G.C.)		Target Year (1994 G.C.)		
	Value ('000Eth. \$)	Quantity ('000M/T)	A: Unit Value (Eth./Kg.)	B: Weight in Volume (%)	AXB
Coffee	175.210	80.822	2.168	7.5	0.163
Pluses	21.973	63.494	0.346	13.7	0.047
Oil seeds & cakes	37.675	103.511	0.364	17.0	0.062
Hides & Skins	25.760	10.859	2.372	5.3	0.125
Meats & Meat Products	8.908	6.431	1.385	3.8	0.053
Bananas	2.746	9.845	0.279	3.5	0.010
Molasses			0.500	2.7	0.014
Salt	1.324	148.361	0.015	10.0	0.150
Copper & Copper Concentrate			1.015	6.5	0.065
Other	46.359	190.965	0.243	30.0	0.070
Total	(273.596) 309.955	(423.323) 614.288	0.505	100.0	0.696

Source: External Trade Statistics and the Survey Team

Table IV - 6 Average Unit Value of Import Commodities

	Base Year (1971 G. C.)			Target Year (1994 G. C.)	
	Unit Value ('000Eth. \$)	Value Volume ('000 M/T)		Unit Value (Eth. \$/Kg.)	
Crude Oil	20.025	573.500	0.039	64.0	0.025
Phosphate Rock & Sulphur			0.050	9.0	0.005
Others	449.055	355.50	1.263	26.5	0.328
Total	469.080	869.00	0.540	10.0	0.358

Note: Unit Price of phosphate rock and sulphur are based on the sectoral study.

Source: External Trade Statistics and the Survey Team

Table IV - 7 Conversion Coefficients

(unit: '000 M/T)

	Port Statistics	External Trade Statistics	Conversion Coefficient
Export	705.2	614.3	1.15
Import	487.7	355.5	1.37

Note: Import of crude oil, home trade and transshipment are not included.

Source: External Trade Statistics, Port Statistics of Massawa, Assab, Djibouti and the Survey Team

Lack of statistical data makes this conversion coefficient vague a little. There will be certain rooms for improvement, especially for the figures of import.

#### (1) - 4 Adjustment of the Results

Results of macroscopic analysis are summarized in Table IV-8. Calculated average annual growth rates are 7.6 % for import and 5.8 % for export. Figure of import is slightly increased while figure of export is slightly decreased in comparison with those of value base.

This means that the structure of export and import will be changed, then the weight of more precious commodities will increase in export and the weight of raw or semi-processed material will also increase in import.

Table IV - 8 Results of Macroscopic Analysis

(unit: 1,000 M/T)

	1971	1994 (G. C.)	1994/1971	Average Annual Growth Rate
Export	705.2	2,574.2	3.65	5.8 %
Import	487.7	2,647.8	5.43	7.6 %

Note: Refined oil is included.

In this macroscopic analysis refined oil is included. Actually, refined oil is exported from Assab where an oil refinery of 600,000 Kl exists, to Djibouti. Besides, certain amount of refined oil is imported from abroad at Massawa, Assab and Djibouti.

Weights of these refined oil transport are fairly high, 20 % (135.2 '000 M/T) for import and 27 % (192.7 '000 M/T), among the total export or import of the base year 1971.

It is rather difficult to expect that the present pattern of transport will be continued another 20 years because the construction of pipe-line and or new oil refinery around Addis Ababa is already on the program.

Therefore, the amounts of refined oil are listed up separately in Table IV-9, since there is no decisive reason to estimate the reasonable figures at present, this should be solved in further study.

Table IV - 9 Results of Macroscopic Analysis (Revised)

	1970/1972			(1,000 M/T) 1994 (G. C.)		
	Refined Oil	Others	Total	Refined Oil	Others	Total
Export	192.7	512.5	705.2	702.8	1,871.4	2,574.2
	27.3 %	72.7 %	100 %	27.3 %	72.7 %	100 %
Import	135.2	352.5	487.7	733.4	1,914.4	2,647.8
	27.7 %	72.3 %	100 %	27.7 %	72.3 %	100 %

Source: The Survey Team

As the final result of macroscopic analysis projection of dry cargoes is summarized and shown in Table IV-10.

Table IV - 10 Projection of Dry Cargoes

	(1,000 M/T)			
	1970/1971	1979	1984	1994 G. C.
Export	512.7	804.9	1,056.2	1,871.4
Import	352.5	633.1	913.3	1,914.4
Total	865.2	1,438.0	1,969.5	3,785.8

Source: The Survey Team

## (2) Sectoral Study for Export Cargoes

Estimation of export volume for major export cargoes is made throughout the planning period. Data and information are acquired through previous reports and interviews with governmental organizations and related agencies. But the figures presented here are computed on the basis of the findings and judgement of the survey team. Figures are summarized and shown in Table IV below.



Table IV - Projection for Major Export Commodities

(1,000 M/T)

Commodities	Base Year	Export Vol. in Base Year	Assumed Annual Growth Rate	Projected Export Volume		
				1979	1984	1994(G.C.)
Total				816.6	1,001.7	1,616.7
Coffee	1968	80.6	3.0 %	111.6	129.4	173.9
Pulses	1968	73.1	*1	123.4	236.2	314.4
Oilseeds & Cakes	1968	82.8	7.0 % *2	174.3	244.5	392.9
Hides & Skins	1968	10.2	10.0 %	29.1	46.9	121.6
Meat & Meat Products	1972	10.6	10.0 %	20.6	33.2	86.2
Bananas	1979	50.0	3.0 %	50.0	58.0	78.0
Molasses	1979	40.0	3.0 %	40.0	46.0	62.0
Salt	1968	163.5	1.5 %	192.6	207.5	232.7
Copper Ore & Concentrate	1979	75.0	5,000 M/T/year	75.0	100.0	150.0

\*1) Estimation is made by Logistic Curve.

\*2) 7.0 % is taken up to 1989, then constant increase of 10,000 M/T per year is adopted.

Source: The Survey Team

(2) - 1 Selection of Base Year

The year of 1968 (G. C.) is selected as the base year of export projection for major agricultural commodities and salt. These are coffee, oilseeds and cakes, pulses, hides and skins. Export volume in the base year is calculated by weighted average of 1967 - 1969. Weight given to the figures are 1/2, 1 and 1/2 for 1967, 1968 and 1969, respectively. This is shown in Table IV-1.

Table IV - 1 Export Volume of Major Agricultural Products in Base Year

(1,000 M/T)

	1967	1968	1969	Weighted Average
Coffee	73.6	80.3	88.4	80.6
Oilseeds & Cakes	89.1	76.0	90.1	82.8
Ground nuts	1.589	3.083	1.866	
Linseed	9.689	3.715	0.290	
Cottonseed	11.206	6.891	9.878	
Castor Seed	1.919	1.056	1.962	
Sesame Seed	19.752	27.015	30.683	
Niger Seed	8.841	6.933	10.323	
Seeds, Other	4,804	1.444	1.084	
Oilseed cakes	31.289	25.846	34.056	
Pulses	68.4	73.8	76.6	73.1
Lentils	15.031	22.089	24.534	
Horse Beans	24.749	18.470	27.420	
Haricot Beans	17.885	19.329	16.672	
Chickpeas	10.724	13.863	7.981	
Hides & Skins	11.4	8.8	11.8	10.2
Hides	5.873	3.466	5.265	
Goat Skins	1.739	2.096	2.150	
Sheep Skins	3.295	3.259	4.363	
Skins, Other	0.501	0.019	0.012	

Source: Customs Head Office and the Survey Team

The same procedure is applied to salt. Export volume of salt is 156,480; 159,524 and 178,301 metric tons for 1967, 1968 and 1969 (G.C.), respectively, and weighted average is 163.5 ('000 M/T). Figures above are also taken from Annual External Trade Statistics of 1969.

Export of meat and meat products has remarkably increased in recent years. So, the year of 1972 (G.C.) is selected for base year as to cover this. The figure taken from the Annual External Trade Statistics of 1972 is 10.6 ('000 M/T). Bananas, molasses, and copper ore and copper concentrate will be in the category of major export commodity at the early stage of the planning period. To this group of cargoes, estimated volume at 1979 (G.C.) is adopted as the basis. These figures are 50.0; 40.0 and 75.0 ('000 M/T), respectively.

## (2) - 2 Coffee

In the 3rd Five Year Development Plan, annual growth rate of 3.5 - 4.0 % is assumed for the export of coffee. SRI report presented two figures, HIGH and LOW, which correspond to an annual growth rate of about 3.75 % and 1.6 %, respectively. (3.0 % is adopted as the most probable average annual growth rate throughout the planning period.)

Table IV - 2 Export of Coffee

(1,000 M/T)		
1979	1984	1994 (G. C.)
111.6	129.4	173.9

(2) - 3 Pulses

Report of Experience Incorporated is taken as the basis of estimation. Since the report has given a forecast up to 1982, an extrapolation is made by Logistic Curve.

$$Y = 320 / (1 + 13 \text{Exp.} - 0.3X)$$

here, X : Number of years from 1972

Y : Volume of export (unit: 1,000 M/T)

The result of the calculation is shown in Table IV-3.

Table IV - 3 Export of Pulses

(1,000 M/T)		
1979	1984	1994 (G. C.)
123.4	236.2	314.4

(2) - 4 Oilseeds

Oilseeds is one of the most promising export commodities in Ethiopia. But present situation is a little far from the ambitious target of the 3rd Five Year Development Plan.

SRI report contained a very wide range of estimation on this item. The difference of assumed average annual growth rate among their high and low estimates amounts to about 7 to 8 %.

We have assumed an average annual growth rate of 7.0 % based on Atkins Report on oilseeds up to 1989. Constant increase by 10,000 M/T per year, however, is adopted after the 1989 period.

Table IV - 4 Export of Oilseeds

(1,000 M/T)		
1979	1984	1994 (G. C.)
174.3	244.5	392.9

(2) - 5 Hides and Skins

This item is one of the major money earning commodities and it has shown a high growth rate during the planning period. 10 % is adopted as the average annual growth rate.

Table IV - 5 Export of Hides and Skins

(1,000 M/T)

<u>1979</u>	<u>1984</u>	<u>1994 (G. C.)</u>
29.1	46.9	121.6

(2) - 6 Meat and Meat Products

Ethiopia is believed to have a very high export prospect for meat in the future. We expect that meat and meat products will be one of the major money earning commodities in the later stage of the planning period. An average annual growth rate of 10 % (the same as hides and skins) is adopted here.

Table IV - 6 Export of Meat and Meat Products

(1,000 M/T)

<u>1979</u>	<u>1984</u>	<u>1994 (G. C.)</u>
20.6	33.2	86.2

(2) - 7 Bananas

Estimation of this item is made on the basis of information obtained from a governmental organization that an export contract of 50,000 tons of bananas per year has been made by a firm operating in the Awash Valley. Owing to uncertainty of future expansion, however, the lowest growth rate, namely 3.0 % among the agricultural products is assumed.

Table IV - 7 Export of Bananas

(1,000 M/T)

<u>1979</u>	<u>1984</u>	<u>1994 (G. C.)</u>
50.0	58.0	78.0

(2) - 8 Molasses

Information obtained from a governmental organization suggests that the Ethiopian sugar industries will start exporting molasses in 1974 and 40,000 tons will be exported in 1979. Owing to the uncertainty of this forecast, the average annual growth rate is estimated at 3.0 %.

Table IV - 8 Export of Molasses

(1,000 M/T)

<u>1979</u>	<u>1984</u>	<u>1994 (G. C.)</u>
40.0	46.0	62.0

(2) - 9 Salt

Export of salt is handled at the port of Assab and Massawa both by privately owned loading facilities. Owing to the high freight rate involved to export it, estimation could not be so favorable to this item. So, an average annual growth rate figure of 1.5 % is adopted. This is almost on the same line of SRI's low estimate.

Table IV - 9 Export of Sale

(1,000 M/T)

<u>1979</u>	<u>1984</u>	<u>1994 (G. C.)</u>
192.6	207.5	232.7

(2) - 10 Copper Ore and Copper Concentrate

Exploitation of copper in the Asmara area shall come to the stage of export before 1979. We adopted the tentative plan of Nippon Mining Co. with some modification as the base of our estimate. Naturally, this cargo will be exported through Massawa.

Table IV - 10 Export of Copper Ore and Copper Concentrate

(1,000 M/T)

<u>1979</u>	<u>1984</u>	<u>1994 (G. C.)</u>
75	100	150

(2) - 11 Potash

According to the information we received from the Ministry of Mines, some 600,000 M/T shall be exported. The site of the potash mine is located in an area where transport to the existing port presents some difficulties. Therefore, most probably it will be handled by a new loading site which will be constructed somewhere between Massawa and Assab.

(3) Sectoral Study for Import Sargoes

(3) - 1 Crude Oil

All of crude oil imported to this country is processed at Assab Oil Refinery. It is told that the refinery has the expansion plan to cope with increasing demand of refined oil. Capacity under consideration is said about 1.0 million M/T per year at 1976 and 1.5 million M/T per year at 1980.

This figure and statistics of previous years show fairly good coincidence around the average annual growth rate of 8.0 %. Figures are calculated on this rate, but search for oil wells now underway is an unknown factor that may change the situation sometime. 1970 is chosen as the base year and moving average of 1969 - 1971 with the weight of 1/2, 1 and 1/2 yields 529 (1000 M/T) on the import volume of base year.

Table IV - 9 Import of Crude Oil

(1,000 M/T)

<u>1979</u>	<u>1984</u>	<u>1994</u>
1.057	1,554	(3,354)

(3) - 2 Fertilizer

The use of chemical fertilizer has been started last few years and now is in the stage of take-off. Import of fertilizer recorded about 27 and 37 thousand metric tons at 1972 and 1973 G. C. respectively.

Implementation of minimum package program which is now enthusiastically pursued as the governmental policy includes huge amount of fertilizer import as its essential part. At present, final report of Pre-Feasibility Study; Fertilizer Manufacture in Ethiopia seems to us most reliable.

Following the line of above mentioned report, figures are adopted in a rather moderate estimate.

Table IV - Import of Fertilizer

(1,000 M/T)

<u>1979</u>	<u>1984</u>	<u>1994</u>
150.0	300.0	(600.0)

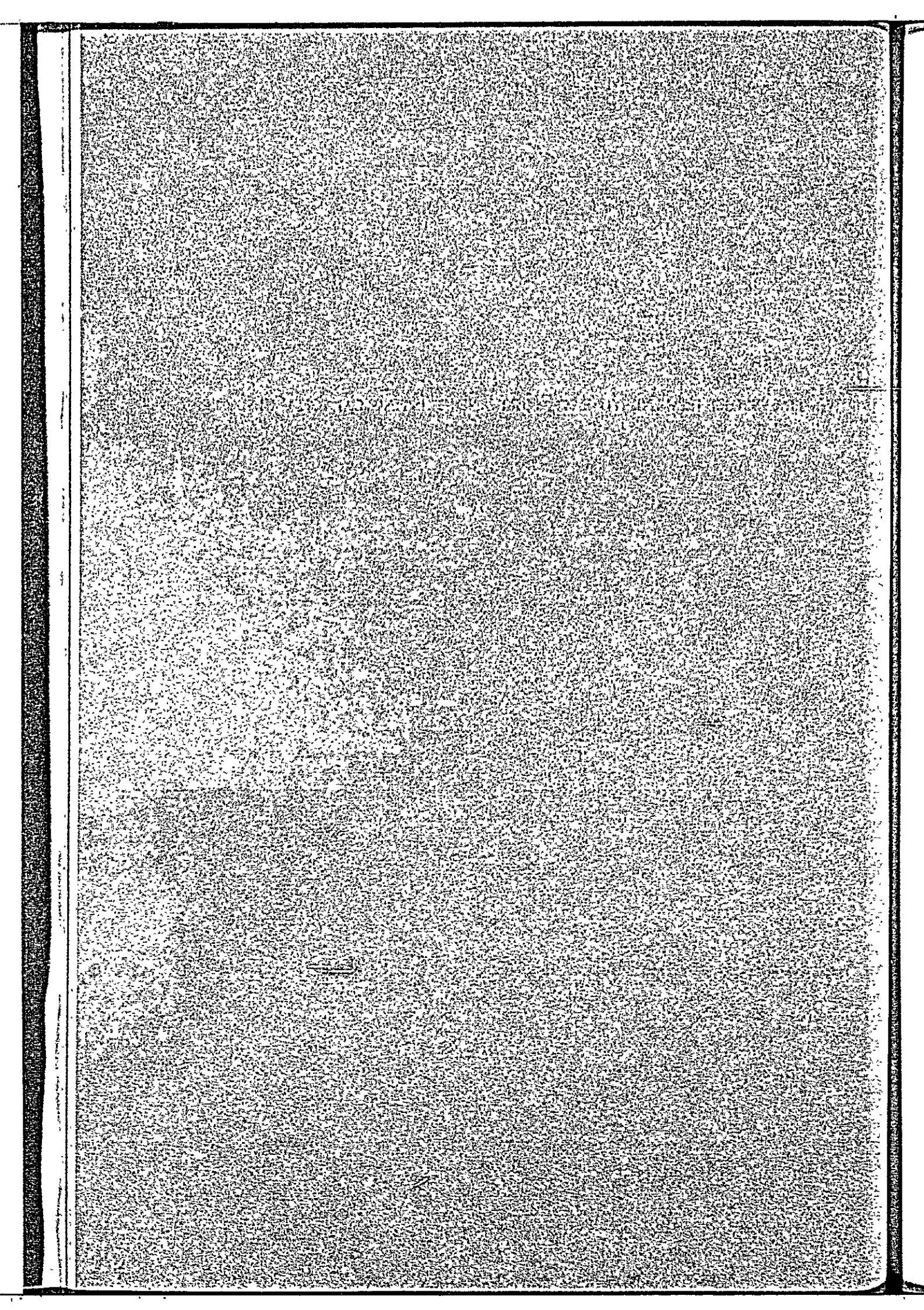
Corresponding annual growth rates are about 15 % for 1979 - 1984 and 7 % for 1984 - 1994.

If the figure of 1984 is realized, construction of fertilizer plant, including acid plants, will be justified. In this case, import of fertilizer will be substitute by import of phosphate rock and sulphur.

Import volume of these raw materials mostly depend on the ratio of final products, namely Urea and DAP (Dai - Ammonium Phosphate). Assuming that of 350,000 M/T for Urea and 250,000 M/T for DAP, import volume is estimated 375,000 M/T for phosphate rock and 125,000 M/T for sulphur.

**V. TRANSPORT DEMAND TO EACH PORT AND EXISTING CAPACITY OF PORT**







## V. TRANSPORT DEMAND TO EACH PORT AND EXISTING CAPACITY OF PORT

As a frame-work of making master plan of port, projected volume of export and import should be allocated to each port. General discussion on the allocation of hinterland to each port is the first theme, then special features of cargoes which will affect the allocation of hinterland are discussed. The last part of this section is the estimation of existing capacity of port.

### (1) Hinterland of Each Port

International marine transport of Ethiopia completely depends on the three sea ports namely Massawa, Assab and Djibouti. According to the geographical conditions and transport facilities, rail and/or road, which is under operation or will be put into operation within the planning period, hinterland of each port is defined as follows:

- i) The most part of Eritrea, Tigre and Begemdir, half of Wello and Gojam will depend on the port of Massawa. The center of commercial activities in this area is the Ethiopia's second largest city Asmara.
- ii) Harar where Dire Dawa is the center of commercial activities will be served by Djibouti and Franco-Ethiopia Railway will be the main transport mean in inland transport to and from the port.
- iii) The half of Wello, and some part of Eritrea and Tigre will be served by Assab and center of Commercial activities in this area is Dessie.
- iv) The remaining regions where the capital Addis Ababa has direct control on business activities will be served either Assab or Djibouti. The significant part of inland transport will be carried by the road transport. Franco-Ethiopian Railway will loose gradually its significance as transport mean between Addis Ababa and Djibouti is developed.

The weight of population inhabited in assigned hinterland of each port is calculated as follow.

Table V - 1 Weight of Population in Each Interland

<u>Massawa</u>	<u>Assab</u>	<u>Djibouti</u>
<u>25 %</u>	<u>35 %</u>	<u>40 %</u>

This figure is used as a base of allocation of cargoes which are difficult to allocate by the nature of cargoes themselves. Population in 1971 by region is shown in Table V-2.

Table V - 2 Estimated Rural and Urban Population by Province, 1971

	Population ('000)			% Urban Population in the Province
	Total	Rural	Urban	
ARUSSI	833.5	784.6	48.9	5.9
BALE	692.6	666.6	26.0	3.8
BEGEMEDER	1,325.1	1,234.8	90.3	6.8
ERITREA	1,889.7	(1,497.6)	392.1	20.7
GEMU GOFFA	683.5	648.9	34.6	5.1
GODJAM	1,712.3	1,622.4	89.9	5.2
HARARGE	3,286.9	3,113.4	173.5	5.3
ILLUBADOR	674.1	648.9	25.2	3.7
KAFA	1,656.7	1,582.6	74.1	4.5
SHOA	5,209.7	4,090.4	1,119.3	21.5
SIDAMO	2,425.0	2,300.1	124.9	5.1
TIGRE	1,787.5	1,659.1	128.4	7.2
WOLLEGA	1,241.7	1,189.1	52.6	4.2
WOLLO	2,407.2	2,298.0	109.2	4.5
TOTAL	25,825.5	23,336.5	2,489.0	9.6

The Population Estimates are obtained from the NSS first round except for Eritrea which is based on the Ministry of Interior Figures.

Source: Area data by Mapping and Geography Institute.

(2) Discussion by Commodity

(2) - 1 Coffee

In this country, exporting coffee is inspected at 2 stations, namely Addis Ababa and Dire Dawa. Coffee produced in Harrar is the main source to the Dire Dawa inspection station.

Examining the records of tonnage inspected at each inspection station during last 10 years, 10 % is assigned as the most probable weight to the Dire Dawa. This 10 % will be exported exclusively through Djibouti and remaining 90% via Assab or Djibouti.

Volume of exporting coffee through Massawa to the Red Sea area is negligible.

Table V - 3 Allocation of Coffee

(unit: '000 M/T)

	Assab (45.0%)	Djibouti (55.0%)	Total
1979 G. C.	50.2	61.4	111.6
1984	58.2	71.2	129.4
1994	78.3	95.6	173.9

Source: The Survey Team

Present figures of coffee export are large in Assab and small in Djibouti in comparison with Table V-3. Under the present conditions, transport of coffee from Addis Ababa to Assab by truck is more economical than to Djibouti by rail. If the road connecting Djibouti to Awash-Tendaho Highway is not constructed, as stated in Interim Report, 90 % of coffee will be exported through Assab.

But some of the potential transport demand to Assab has been shifted to Djibouti by the following two reasons:

- i) Franco-Ethiopian Railway offers an extreme preferential tariff to coffee transport from Addis Ababa to Djibouti (so called seasonal freight system).
- ii) Export tax for coffee is paid at Addis Ababa in case of via Djibouti while it is paid at site in case of via Assab. The fact will give a little thrust on coffee export whenever market price is increasing. The use of free port zone of Djibouti will amplify this tendency.

## (2) - 2 Pulses

According to the information from agricultural expert in Ministry of Agriculture, expansion and improvement of pulses production are under way in the four areas, namely Rift Valley, Nazareth, Dire-Dawa and Dessie. Relative weight of production amount in each area is shown in Table V-4 for the selected year. The route of export is assumed as of Table V-5.

Table V - 4 Relative Weight of Pulses Production

	Rift Valley	Nazareth	Dire Dawa	Dessie	Total
1979 G. C.	55 %	25 %	10 %	10 %	100%
1984	53	25	7	15	100
1994	45	25	6	24	100

Source: The Survey Team

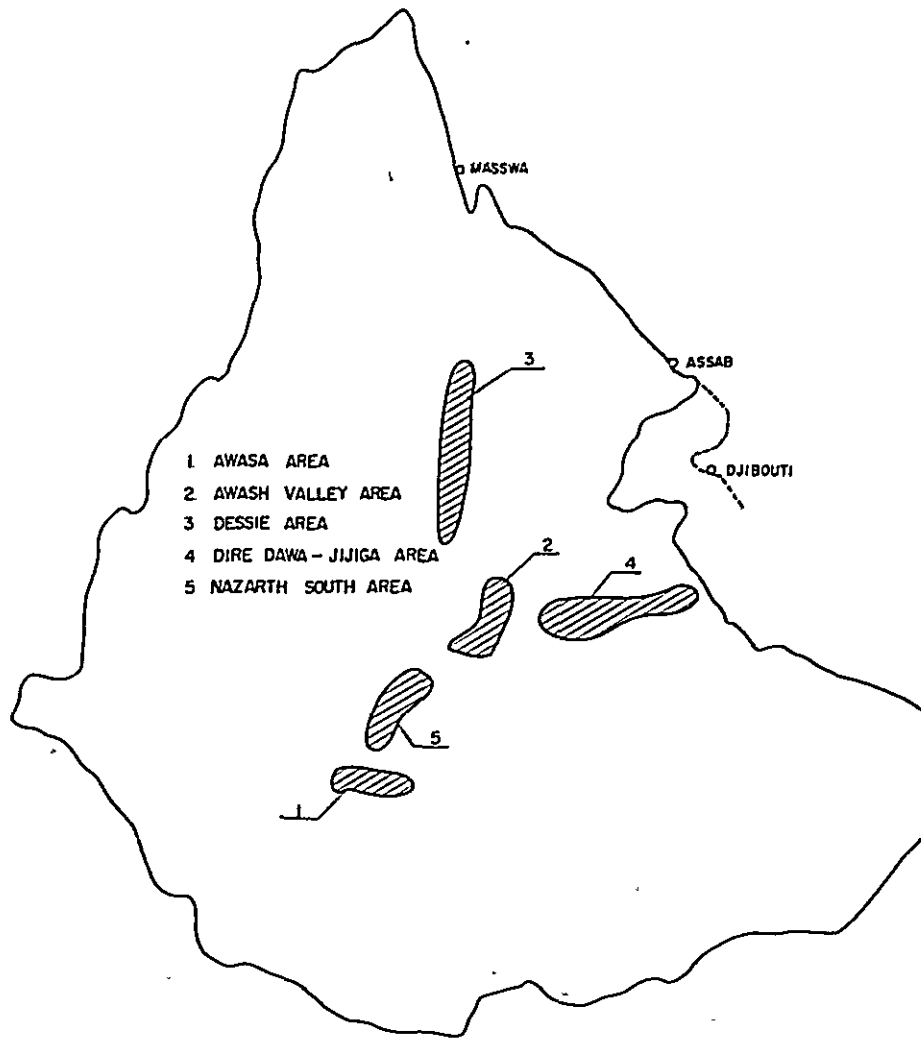
Table V - 5 Route of Export for Pulses

Area of Production	Descriptions
Rift Valley	50 % to Assab and 50 % to Djibouti
Nazareth	" " "
Dire Dawa	100 % to Djibouti
Dessie	50 % to Massawa and 50 % to Assab

Source: The Survey Team

Other than the abovementioned program, certain amount of pulses has been exported through port of Massawa. The amount in base year, 1968 G. C., is estimated at about 15,000 M/T and projected separately with the average annual growth rate of 3.0 %, then the transport demands to three ports are summarized in Table V-6. Location of major production areas is shown in Fig. V-1.

FIG. V-1 PROPOSED AREAS FOR PULSE PRODUCTION



SOURCE : EXPERIENCE INC.

Table V - 6 Allocation of Pulses

(unit: '000 M/T)

		Massawa	Assab	Djibouti	Total
1979	Programed	5.1	46.1	51.2	101.4
	Others	21.0	--	--	21.0
	Total	26.1	46.1	51.2	123.4
1984	Programed	15.9	98.7	97.6	212.2
	Others	24.0	--	--	24.0
	Total	39.9	98.7	97.6	236.2
1994	Programed	33.8	132.8	115.8	282.4
	Others	32.0	--	--	32.0
	Total	65.8	132.8	115.8	314.5

Source: The Survey Team

(2) - 3 Oilseeds and Cakes

Major production area of oilseeds is shown in Fig. V-2. The relative weight of production for each area is estimated as of Table V-7.

Basic data adopted is taken from SRI Report, Report No. 4 Improvement of Ethiopian Ports. But, as shown in Table V-8, routes of export are modified by the Survey Team.

Table V - 7 Relative Weight of Oilseeds Production

Area I	Area II	Area III & VIII	Area IV	Area V & VI	Area VII
35 %	5 %	15 %	5 %	25 %	15 %

Note: The Weight assumed is almost constant through the planning period.

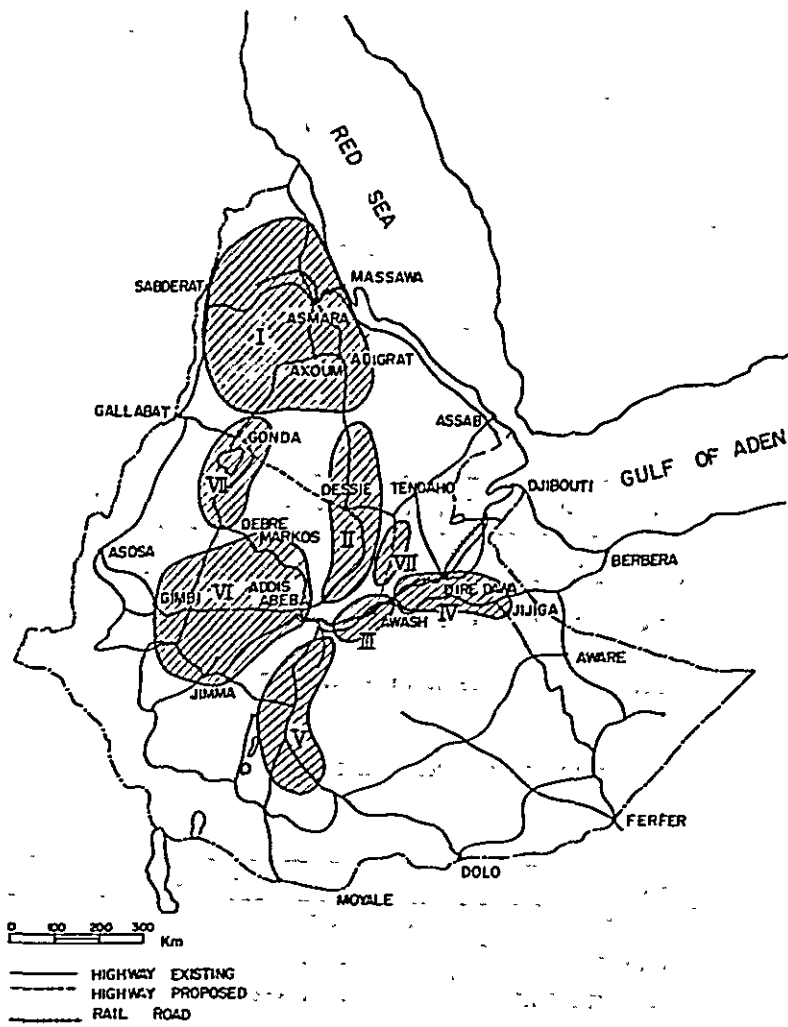
Source: SRI Report and the Survey Team

Table V - 8 Route of Export for Oilseeds

Area of Production	Descriptions
Area I	100 % to Massawa
Area II	100 % to Assab
Area III & VIII	100 % to Assab
Area IV	100 % to Djibouti
Area V & VI	50 % to Assab and 50 % to Djibouti
Area VII	100 % to Massawa

Source: The Survey Team

FIG. V-2 PRODUCTION AREAS OF OILSEEDS



Based on the assumptions listed above, transport demands to Massawa, Assab and Djibouti are calculated and shown in Table V-9.

Table V - 9 Allocation of Oilseeds and Cakes

(unit: '000 M/T)

	Massawa	Assab	Djibouti	Total
1979 G.C.	87.2	56.6	30.5	174.3
1984	122.2	79.5	42.8	244.5
1994	196.4	127.7	68.8	392.9

Source: The Survey Team

(2) - 4 Hides and Skins

Share among the three ports in 1964 E. C. is 27 % for Massawa, 60 % for Assab and 13 % for Djibouti. This is exactly corresponding to the allocation of Dire Dawa area to Djibouti, Asmara and Gondar areas to Massawa and the remaining area to Assab. According to the line of SRI Report, decreasing of weight for Asmara and Gondar area and increasing of weight for Dire Dawa area are assumed. The weight adopted and anticipating allocation of export volume are summarized and shown in Table V-10.

Table V - 10 Allocation of Hides and Skins

(unit: '000 M/T)

	Massawa	Assab	Djibouti	Total
1979 G. C. (weight)	27 %	60 %	13 %	100 %
(volume)	7.9	17.5	3.7	29.1
1984 (weight)	20 %	60 %	20 %	100 %
(volume)	9.4	28.1	9.4	46.9
1994 (weight)	17 %	60 %	23 %	100 %
(volume)	20.6	72.7	27.9	121.2

Source: The Survey Team

(2) - 5 Meats and Meat Products

Port statistics in 1964 E. C. shows that the shares among the three ports are 64 %, 28.5 % and 7.5 % for Massawa, Assab and Djibouti respectively. Allocation of hinterland to each port is assumed as for hides and skins and the same for trends. The weight adopted together with anticipated allocation of export volumes is summarized and shown in Table V-11.

Table V - 11 - Allocation of Meats and Meat Products

(unit: '000 M/T)

	Massawa	Assab	Djibouti	Total
1979 G. C. (weight)	55 %	35 %	10 %	100 %
(volume)	11.3	7.2	2.1	20.6
1984 (weight)	48 %	40 %	12 %	100 %
(volume)	15.9	13.3	4.0	33.2
1994 (weight)	35 %	50 %	15 %	100 %
(volume)	30.2	43.1	12.9	86.2

Source: The Survey Team

(2) - 6 Banana

It is informed that a private firm has an export contract of 50,000 M/T per year through the port of Assab. But, port of Massawa has been exporting about 10 thousand tons of banana. This figure is extrapolated with the average annual growth rate of 3.0 % and the remaining is assigned to Assab.

Table V - 12 Allocation of Banana

(unit: '000 M/T)

	Massawa	Assab	Djibouti	Total
1979 G. C.	12.5	37.5	--	50.0
1984	14.5	43.5	--	58.0
1994	19.5	58.5	--	78.0

Source: The Survey Team

(2) - 7 Salt

Export of salt are handled at privately owned loading terminals both for Assab and Massawa. Allocation is done by the record of 1964 E. C. At the moment, salt field at Assab stops its operation. When it is re-opened, public berth of Assab may be utilized to reduce the handling costs.

Table V - 13 Allocation of Salt

(unit: '000 M/T)

	Massawa	Assab	Djibouti	Total
1979 G. C.	102.1	90.5	--	192.6
1984	110.0	97.5	--	207.5
1994	123.3	109.4	--	232.7

Source: The Survey Team



(2) - 8 Copper Ore and Concentrate

Copper ore and concentrate produced in Asmara will be exported through port of Massawa. Figures estimated are as follows:

Table V - 14 Copper Ore and Concentrate via Massawa

(unit: '000 M/T)

1979	1984	1994
75.0	100.0	150.0

Source: The Survey Team

(2) - 9 Molasses

Molasses have been exported through Djibouti and this will be continued throughout the planning period.

Table V - 15 Molasses Export via Djibouti

(unit: '000 M/T)

1979	1984	1994
40.0	46.0	62.0

Source: The Survey Team

(2) - 10 Others (Export)

The difference of export volume between the macroscopic analysis and the sectoral study in the target year is about 260 thousand tons. Since the corresponding figure in 1971 is 60 thousand tons, average annual growth rate is calculated as of 6.8 %. These figures are allocated by the weight which is listed in section V-(1) throughout the planning period.

Table V - 16 Allocation of Others (Export)

(unit: '000 M/T)

1979G. C.	24.2	33.9	38.8	96.9
1984	33.7	47.1	53.8	134.6
1994	65.0	91.0	104.0	260.0

Source: The Survey Team

(2) - 11 Crude Oil

Assab is the only port which is accommodated with oil refinery and can accept crude oil. Therefore, the discussion in section IV-(3)-1 is enough to this item. Table IV-9 is rewritten as Table-17.

Table V - 17 Allocation of Crude Oil

(unit: '000 M/T)

	Massawa	Assab	Djibouti	Total
1979 G. C.	---	1,057	---	1,057
1984	---	1,554	---	1,554
1994	---	(3,354)	---	(3,354)

Source: The Survey Team

(2) - 12 Fertilizer

Import of fertilizer is allocated to port of Assab. As discussed in section V-(3)-2, fertilizer will be imported in bulk and bagged at bagging plant adjacent to the port area. Then a fertilizer plant together with acids plants will be constructed. Bagging plant will be taken over by the fertilizer plant and be used as a part of it.

In this case, import of fertilizer will naturally be replaced by imports of raw materials, namely phosphate rock and sulphur.

Table V - 18 Allocation of Fertilizer

(unit: '000 M/T)

	Massawa	Assab	Djibouti	Total
1971 G. C.	---	150.0	---	150.0
1984	---	300.0	---	300.0
1994	---	(600.0)*1	---	(600.0)*1

\*1) Raw materials equivalent to this figure is estimated as follows.

phosphate rock : 375,000 M/T  
sulphur : 125,000 M/T

Source: UNIDO Report and the Survey Team

(2) - 13 Others (Import)

The difference of macroscopic analysis and sectoral study treated as one group, others, but there will be certain rooms of improvement by further studies. Lack of statistical data forced us to take this approach inevitably. The weight of allocation is the one which is discussed in section V-1.

Table V-19 Allocation of Others (Import)

(unit: '000 M/T)

	Massawa	Assab	Djibouti	Total
1971 G. C.	120.8	169.1	193.2	483.1
1984	153.3	214.7	245.3	61.3
1994	353.6	495.0	565.8	1,414.4

Source: The Survey Team

(2) - 14 Summary and Discussion

The results of analysis are summarized in the tables from V-20 to V-27. Export of refined oil and also import are not included in these tables because of the reasons discussed in the section IV-(1)-4. The subject is studied in major part as home trade though the main transport route is Assab to Djibouti.

Table V - 20 Transport Demand to Each Port

Export (1979 G. C.)

(unit: ,000 M/T)

Commodities	Massawa	Assab	Djibouti	Total
Coffee	-	50.2	61.4	111.6
Puluses	26.1	46.1	51.2	123.4
Oilseed & Cakes	87.2	56.6	30.5	174.3
Hides & Skins	7.9	17.5	3.7	29.1
Meat & Meat Products	11.3	7.2	2.1	20.6
Bananas	12.5	37.5	-	50.0
Cooper Ore & Concentrate	75.0	-	-	75.0
Molasses	-	-	40.0	40.0
<b>Total</b>	<b>220.0</b>	<b>215.1</b>	<b>188.9</b>	<b>624.0</b>
Others	24.2	33.9	38.8	96.9
<b>Total</b>	<b>244.2</b>	<b>249.0</b>	<b>227.7</b>	<b>720.9</b>
Salt	102.3	90.5	-	192.6
<b>Grand Total</b>	<b>346.3</b>	<b>339.5</b>	<b>227.7</b>	<b>913.5</b>

Note: Crude Oil, Refined Oil and Home Trade not included.

Source: The Survey Team

Table V - 21 Transport Demand to Each Port  
Import (1979 G. C.)

(unit: ,000 M/T)

Commodities	Massawa	Assab	Djibouti	Total
Fertilizer	-	150.0	-	150.0
Phosphate Rock	-	-	-	-
Sulphur	-	-	-	-
Total	-	150.0	-	150.0
Others	120.8	169.1	193.2	483.1
Grand Total	120.8	319.1	193.2	633.1

Source: The Survey Team

Table V - 22 Transport Demand to Each Port  
Export (1984 G. C.)

(unit: '000 M/T)

Commodities	Massawa	Assab	Djibouti	Total
Coffee	-	58.2	71.2	129.4
Puluses	39.0	98.7	97.6	236.2
Oilseeds & Cakes	122.2	79.5	42.8	244.5
Hides & Skins	9.4	28.1	9.4	46.9
Meat & Meat Products	15.9	13.3	4.0	33.2
Bananas	14.5	43.5	-	58.0
Copper Ore & Concentrate	100.0	-	-	100.0
Molasses	-	-	46.0	46.0
Total	301.9	321.3	271.0	894.2
Others	33.7	47.1	53.8	134.6
Total	335.6	368.4	324.8	1,028.8
Salt	110.0	97.5	-	207.5
Grand Total	445.6	465.9	324.8	1,236.3

Source: The Survey Team

Table V - 23 Transport Demand to Each Port  
Import (1984 G. C.)

(unit: '000 M/T)

Commodities	Massawa	Assab	Djibouti	Total
Fertilizer	-	300.0	-	300.0
Phosphate Rock	-	-	-	-
Sulphur	-	-	-	-
Total	-	300.0	-	300.0
Others	153.3	214.7	245.3	613.3
Grand Total	153.3	514.7	245.3	913.0

Source: The Survey Team

Table V - 24 Transport Demand to Each Port  
Export (1994 G. C.)

(unit: '000 M/T)

Commodities	Massawa	Assab	Djibouti	Total
Coffee	-	78.3	95.6	173.9
Pulses	65.8	132.8	115.8	314.4
Oilseeds & Cakes	196.4	127.7	68.8	392.9
Hides & Skins	20.6	72.7	27.9	121.2
Meat & Meat Products	30.2	43.1	12.9	86.2
Bananas	19.5	58.5	-	78.0
Copper Ore & Concentrate	150.0	-	-	150.0
Molases	-	-	62.0	62.0
Total	482.5	513.1	383.0	1,378.6
Others	65.0	91.0	104.0	260.0
Total	547.5	604.1	487.0	1,871.3
Salt	123.3	109.4	-	232.7
Grand Total	670.8	713.5	487.0	1,638.6

Source: The Survey Team

Table V - 25 Transport Demand to Each Port

Import (1994 G. C.)

(unit: '000 M/T)

Commodities	Massawa	Assab	Djibouti	Total
Fertilizier	-	-	-	-
Phosphate Rock	-	375.0	-	375.0
Sulphur	-	125.0	-	125.0
Total	-	500.0	-	500.0
Others	353.6	495.0	565.8	1,414.4
Grand Total	353.6	995.0	565.8	1,914.4

Source: The Survey Team

Table V - 26 Transport Demend to Each Port

Total (1979 - 1994 G. C.)

(unit: '000 M/T)

Year (G. C.)		Massawa	Assab	Djibouti	Total
1979	Total	365.0	568.1	420.9	1,354.0
	Export	244.2	249.0	227.7	720.9
	Import	120.8	319.1	193.2	633.1
1984	Total	488.9	883.1	570.1	1,942.1
	Export	335.6	368.4	324.8	1,028.8
	Import	153.3	514.7	245.3	913.3
1994	Total	901.1	1,599.1	1,052.8	3,558.0
	Export	547.5	604.1	487.0	1,638.6
	Import	353.6	995.0	565.8	1,914.4

Note: Excluding Crude Oil, Refined Oil and Salt.

Source: The Survey Team

### (3) Estimation of Existing Capacity of Ports

#### (3) - 1 Methodology

Cargohandling capacity of existing public berths is estimated by queueing theory. To this aim, the following characteristics are studied both for Assab and Massawa.

- i) ships' arrival to the port
- ii) ships' stay in port
- iii) tonnage of loading and unloading per ship
- iv) number of berths

As indicated in Figure V-3 and V-4 studies clearly show the applicability of M/M/S ( $\infty$ ) type queueing model to both ports.

#### (3) - 2 Port of Assab

The characteristics of Assab Port are as follows:

- tonnage loaded and unloaded per ship : 457 M/T/ship
- average days of ships' stay in port : 1.86 days/ship
- number of berths : 6

Port statistics show that seasonal fluctuation of transport demand exists and that for the busy period it is up by some 20 % than the annual average. If we assume the level of service, berth occupancy, 0.6 and 0.7 during the busy period (\*1) and 500 M/T/ship instead of 457 M/T/ship (expecting some improvement), existing capacity of port will be 300-350 thousand M/T per year.

#### (3) - 3 Port of Massawa

The port characteristics of Massawa are as follows:

- tonnage loaded and unloaded per ship : 572 M/T/ship
- average days of ships' stay in port : 2.17 days/ship
- number of berths : 6
- seasonal fluctuation : 20 %

Assuming the same service level as the Port of Assab, with 600 M/T/ship instead of 572 M/T/ship, we conclude existing capacity of the port will be 300-350 thousand M/T/per year.

(\*1) Berth occupancy of 0.6 and 0.7 are corresponding to A. W. T. /A. S. T. 0.1 and 0.2 respectively.

A. W. T. means average waiting time per ship and A. S. T. average service time per ship.

Case - 1

A. W. T. / A. S. T. : 0.1

Corresponding data are as follows:

S : number of berths 6

$\lambda$  : average arrival rate (ship/day)

$\mu$  : (ships/day, berth) average service rate,  
Assab 0.54 Massawa 0.46

$\rho$  : berth occupancy 0.6 ( $\rho = \lambda / \mu . S$ ).

For a busy period,  $\lambda_1$ (Assab) and  $\lambda_2$ (Massawa) become

$$\lambda_1 = S = 0.6 \times 0.54 \times 6 = 1.94$$

$$\lambda_2 = S = 0.6 \times 0.46 \times 6 = 1.66$$

20 % shift down to the annual average make

$$\lambda_1 \text{ (mean) } \dagger 1.63$$

$$\lambda_2 \text{ (mean) } \dagger 1.38$$

Estimated capacities are

Assab 1.63 ship/day  $\times$  365 day  $\times$  500 M/T/ship  $\dagger$  298,000 M/T/year

Massawa 1.38 ship/day  $\times$  365 day  $\times$  600 M/T/ship  $\dagger$  302,000 M/T/year

Case - 2

A. W. T. / A. S. T. : 0.2

The only change against case-1, is berth occupancy 0.7 instead of 0.6. That gives about 17 % increase to the estimated capacity.

Assab 349,000 M/T/year

Massawa 353,000 M/T/year



FIG. V-3 SHIPS' ARRIVAL, DISTRIBUTION OF ASSAB AND MASSAWA

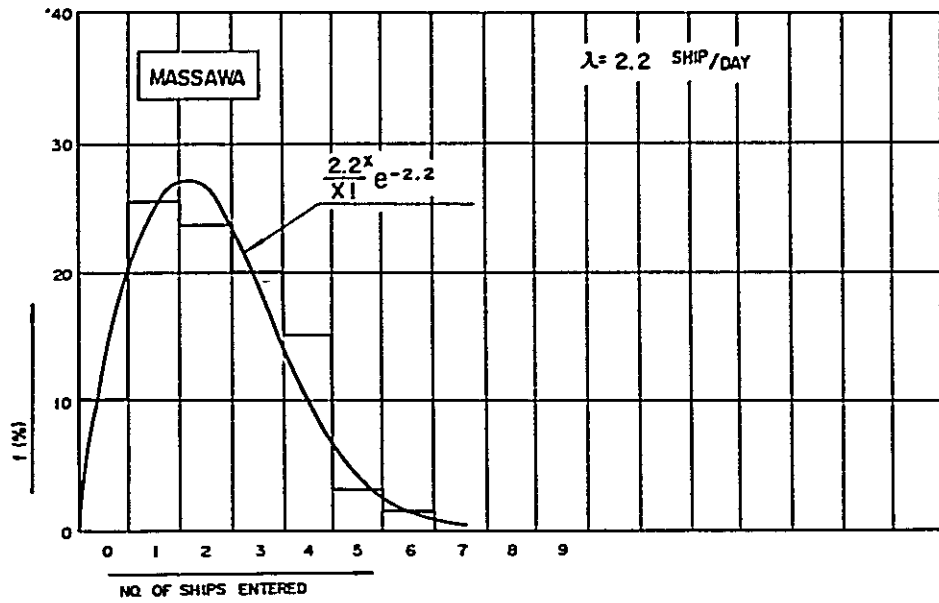
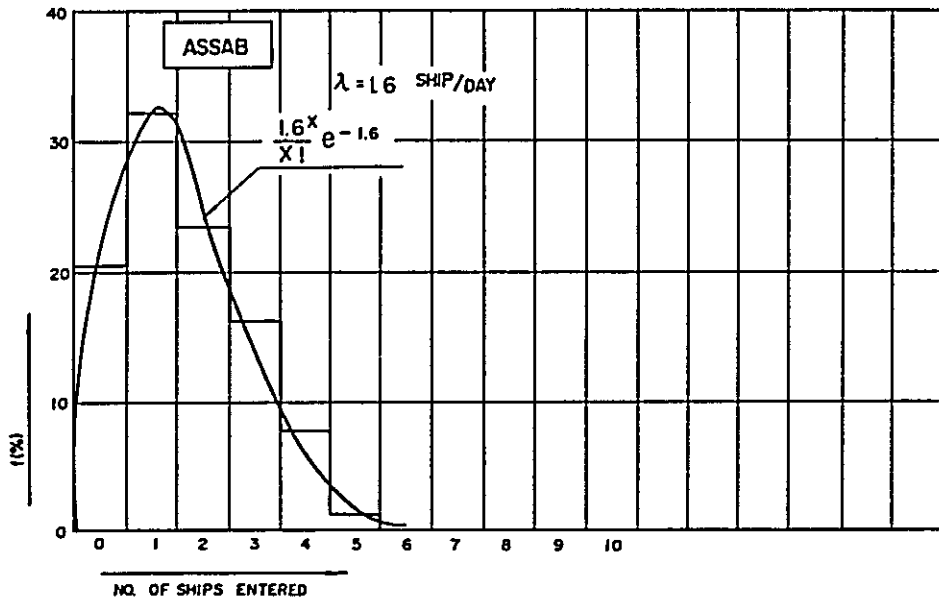
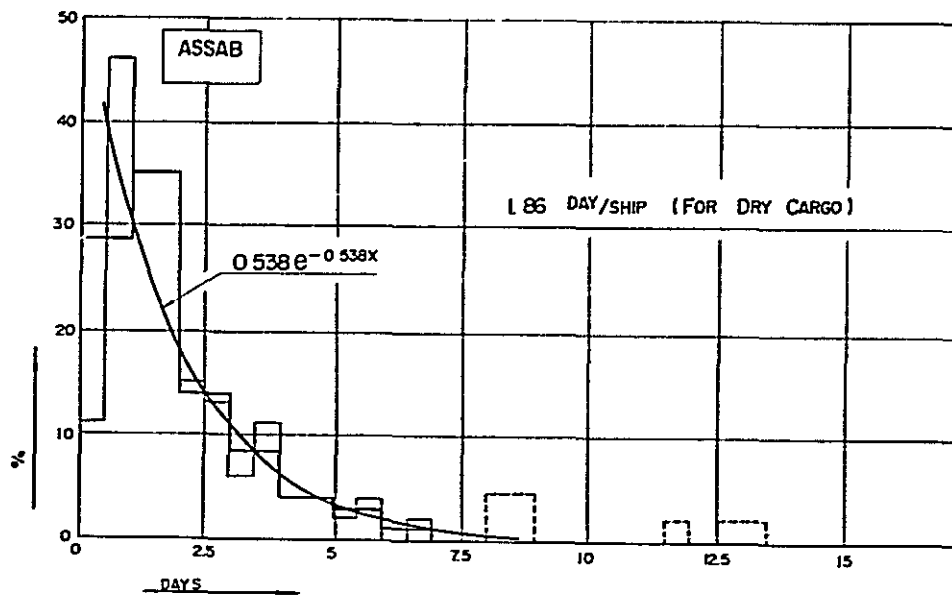
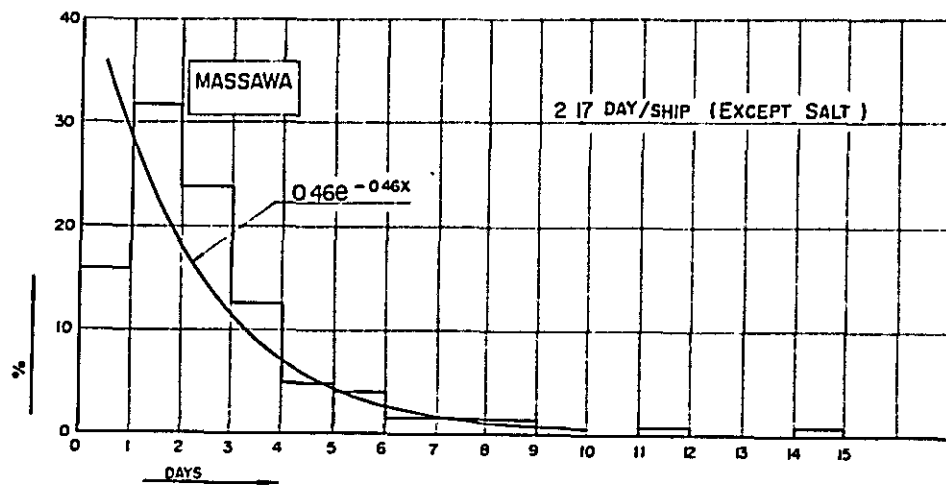


FIG. V-4 CHARACTERISTICS OF SHIPS' STAY IN ASSAB AND MASSAWA  
(Average Stay in Port)



**VI. FRAME WORK FOR MAKING MASTER PLAN**





**VI. FRAME WORK FOR MAKING MASTER PLAN**

**(1) Additional Capacity required for Each Planning Stage**

The two factors, transport demand and existing capacity, discussed in section IV and section V yield the need for additional capacity for each planning stage.

**Table VI - 1 Additional Capacity Required**

(unit: '000 M/T)

	1974 - 79	1979 - 84	1984 - 94 G.C.
Massawa	65.0	123.9	412.2
Assab	218.1	315.0	716.0

Cargohandling capacity of port is increased by i) improvement of cargohandling operation, ii) improvement of existing facilities and iii) construction of additional facilities. In the last case, construction of new facilities, due consideration should be taken on the amount and category of cargoes to be handled to realize the most efficient marine transport and also cargo-handling in port.

**(2) Proposed Size of Construction**

**(2) - 1 Capacities of Berth Assumed**

Cargohandling capacity of existing berths both in Massawa and Assab have been studied by the Team. Actual performance in 1971 G.C. and result of the theoretical analysis for general cargo berth of external trade are shown in Table VI-2.

**Table VI - 2 Capacity of Existing Berth**

(unit: '000 M/T per berth)

	Performance 1971	Theoretical Estimation
Massawa	50	50 - 60
Assab	45	50 - 60

These figures are relatively low, the reasons are already discussed in the section II and V, but drastic changes could not be expected.

Improvement of cargohandling efficiency, increase of lot-size and palletized cargo will gradually take place. Followings are the figures we assumed as the capacity of general cargo berth for the planning period.

**Table V - 3 Capacity of General Cargo Berth Assumed**

(unit: '000 M/T per berth)

1979 G.C.	1984	1994
60	60	70

For shallow water berth which is assigned to home trade and coasters, 400 - 500 M/T per meter per year is assumed through the planning period. Capacities of bulk cargo berth and container berth are arranged as to meet their requirements assuming adequate capacities of cranes and related equipment.

(2) - 2 Analysis of Cargo-Movement at Each Port throughout the Planning Period

Cargo-Movement at Massawa and Assab ports at each planning stage are studied and summarized in Table VI-4 and Table VI-5. Development of ports, both Assab and Massawa, will bring the shifting of cargoes from conventional berth to container or container feeder berth and or conventional to bulk. Allocation of berth to the different category of cargo inevitably occurs during the course of development in planning period.

Of assumed shiftings, following two are the most significant and desirable.

Table VI - 4 Summary of Berth Utilization through the Planning Period  
(ASSAB)

(unit: '000 M/T)

Category of cargo	1979 G. C.			1984 G. C.			1994 G. C.		
	Loading	Un-loading	No. of Berth	Loading	Un-loading	No. of Berth	Loading	Un-loading	No. of Berth
<b>General</b>									
Coffee							78.3		
Pulses				368.4			132.8		
Oil seeds	249.0		418.0			583.1	127.7		800.5
Hides & Meats			(7 Berth)			(9 Berth)			(11 Berth)
Bananas									
Others (Export)							91.0		
Others (Import)		169.0			214.7			370.7	
<b>Bulk</b>									
Salt	90.5		90.5	97.5		97.5	109.4		109.4
Fertilizer		150.0	150.0		300.0	300.0			
Phosphate & Sulphur			(2 Berth)			(2 Berth)		500.0	500.0
<b>Container</b>									
Hides, Meats & Banana							194.6		389.2
Others								194.6	(1 Berth)
<b>Home Trade</b>									
General									
Fertilizer	38.0		38.0	75.0		75.0	150.0		150.0
Others			(1 Berth)			(2 Berth)			(3 Berth)
Container									
Hides, Meats & Bananas								70.3	146.0
Others							70.3		

Table VI - 5 Summary of Berth Utilization through the Planning Period  
(MASSAWA)

(unit: '000 M/T)

Category of cargo	1979 G. C.			1984 G. C.			1994 G. C.		
	Loading	Un-loading	No. of Berth	Loading	Un-loading	No. of Berth	Loading	Un-loading	No. of Berth
External Trade									
General									
Pulses							65.8		
Oil seeds							196.4		
Hides & Meats									
Banana	244.2		364.2	335.6		488.9			612.2
Copper			(6 Berth)			(8 Berth)			(9 Berth)
Other (Export)							65.0		
Other (Import)		120.8			153.3			285.3	
Bulk									
Salt	102.3		102.3	110.0		110.0	123.3		123.3
Copper			(1 Berth)			(1 Berth)	150.0		150.0
									(2 Berth)
Home Trade									
General									
Fertilizer		38.0	38.0		75.0	75.0		150.0	150.0
Others			(1 Berth)			(2 Berth)			(3 Berth)
Container									
Hides, Meats & Bananas							70.3		140.6
Others								70.3	(1 Berth)

- i) Since 1972, fertilizer has been imported in bulk. This will continue to 1984. Construction of a bagging plant just behind the port area is now under study in Assab. It is assumed that all fertilizers will be imported through Assab and bagged at Assab, then distributed to destination. In case of Asmara area, this transport will be the via sea. Therefore, home trade of bagged fertilizer from Assab to Massawa is estimated as 38.0, 75.0 and 150 thousand metric tons for the year of 1979, 1984 and 1994 G. C. respectively.

This import of fertilizer is expected to be replaced with import of raw materials, namely phosphate rock and sulphur, some time after 1984 G. C.

- ii) Export cargo of this country is mainly agricultural products. Meats and meat products, and hides and skins are the suitable cargoes for container transport among them. Volume of these two export cargoes estimated to be 50 thousand metric tons at 1994 in Assab only. We assume the concentration of these cargoes to Assab by feeder service which will make short calling of container ships possible. Balance of exporting cargoes and of importing are severely required for smooth container operation.





Table VI - 7 Number of Berth to be Constructed (MASSAWA)

	1979 G. C.			1984 G. C.			1994 G. C.		
	Existing No. of Berth	Re-quired No. of Berth	Dif-ference	Existing No. of Berth	Re-quired No. of Berth	Dif-ference	Existing No. of Berth	Re-quired No. of Berth	Dif-ference
<b>EXTERNAL TRADE</b>									
General	5	6	1	4	8	4	4	9	5
Bulk	1	1	0	1	1	0	1	2	1
Container	-	-	-	-	-	-	-	-	-
Sub. Total	6	7	1	5	9	4	5	11	6
<b>HOME TRADE</b>									
General	2	1	-	2	2	0	2	*3	*1
Container	-	-	-	-	-	-	-	1	1
Sub. Total	2	1	-	2	2	0	2	4	2
<b>TOTAL</b>	<b>8</b>	<b>8</b>	<b>0</b>	<b>7</b>	<b>11</b>	<b>4</b>	<b>7</b>	<b>15</b>	<b>8</b>

Table VI - 8 Number of Berth to be Constructed (ASSAB)

	1979 G. C.			1984 G. C.			1994 G. C.		
	Existing No. of Berth	Re-quired No. of Berth	Dif-ference	Existing No. of Berth	Re-quired No. of Berth	Dif-ference	Existing No. of Berth	Re-quired No. of Berth	Dif-ference
<b>EXTERNAL TRADE</b>									
General	6	7	1	6	9	3	6	11	5
Bulk	1	2	1	1	2	1	1	*3	*2
Container	-	-	-	-	-	-	-	1	1
Sub. Total	7	9	2	7	11	4	7	15	8
<b>HOME TRADE</b>									
General	1	1	0	1	2	1	1	3	2
Container	-	-	-	-	-	-	-	-	-
Sub. Total	1	1	0	1	2	1	1	3	2
<b>TOTAL</b>	<b>8</b>	<b>10</b>	<b>2</b>	<b>8</b>	<b>13</b>	<b>5</b>	<b>8</b>	<b>18</b>	<b>10</b>

Note: Number of Berth with \* in Tables IV-4, -5, -6, -7 and -8 means one surplus of the berth in each Table: this being caused by an unavoidable change in types of cargo during the planning period.

Table VI - 9 Number of Berth to be Constructed

1994 G. C.

Massawa

General Cargo Berth	15,000 D/W	5 berth	(- 10 m x 185 m)
" (Home Trade)	2,000 D/W	2 berth	(-5.5 m x 90 m)
Bulk Cargo Berth	15,000 D/W	1 berth	(- 10 m x 185 m)
Container (Feeder) Berth	2,000 D/W	1 berth	(-5.5 m x 110 m)

Assab

General Cargo Berth	15,000 D/W	5 berth	(- 10 m x 185 m)
" " "	2,000 D/W	2 berth	(-5.5 m x 90 m)
Bulk Cargo Berth	40,000 D/W	1 berth	(- 12 m x 240 m)
" "	15,000 D/W	2 berth	(- 10 m x 185 m)
Container Berth	70,000 D/W	1 berth	(- 12 m x 300 m)

1984 G. C.

Massawa

General Cargo Berth	15,000 D/W	4 berth	(- 10 m x 185 m)
---------------------	------------	---------	------------------

Assab

General Cargo Berth	15,000 D/W	3 berth	(- 10 m x 185 m)
" " "	2,000 D/W	1 berth	(-5.5 m x 90 m)
Bulk Cargo Berth	15,000 D/W	1 berth	(- 10 m x 185 m)

1979 G. C.

Massawa

General Cargo Berth	15,000 D/W	1 berth	(- 10 m x 185 m)
---------------------	------------	---------	------------------

Assab

General Cargo Berth	15,000 D/W	1 berth	(- 10 m x 185 m)
Bulk Cargo Berth	15,000 D/W	1 berth	(- 10 m x 185 m)

**VI. NATURAL CONDITIONS OF EACH PORT**





## VII. NATURAL CONDITIONS OF EACH PORT

### (1) - 1 Fetch

Both Assab and Massawa Ports are protected by the islands and reefs around the port-areas against ocean waves, especially well sheltered against SE direction. Fetches of both ports traced on the marine charts are shown hereunder. (refer to Figure VII-1)

Direction	Assab	Massawa
N		ca. 100 km
NE	ca. 340 km	ca. 80 km
E	ca. 50 km	ca. 70 km
SE	ca. 40 km	ca. 22 km
S	negligible	negligible

### (1) - 2 Direction & Velocity of Wind

There are observation records of direction & velocity of wind at both ports, Assab and Massawa, however, these records are treated on different ways. Nevertheless we can roughly recognize their characteristics from the records.

#### Assab

Results of our analysis of the observation records at the Assab Port are shown in Table - 1, 2 and Fig. 2.

These records show:

- i) wind from S. to E. predominating 82 %, especially wind of SE. occupies 42 %.
- ii) most frequent wind velocity is 8 to 10 m/sec. and strong wind of over 18 m/sec. is quite few, only 6 times in the year (1.4 %).

FIG. VII-1 FETCH LENGTH OF ASSAB AND MASSAWA

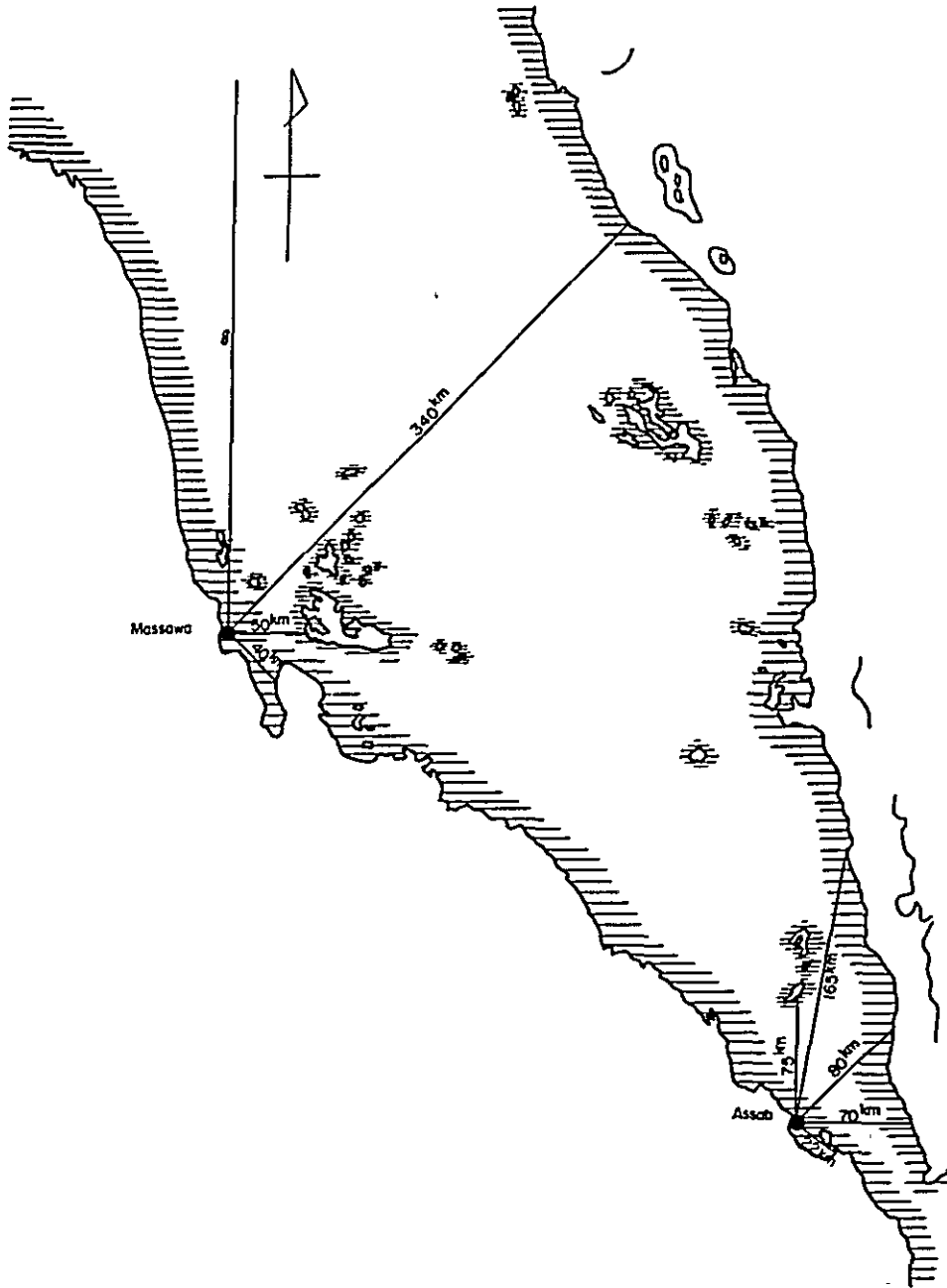


FIG. VII-2 DIRECTION AND FREQUENCY OF WIND IN ASSAB  
Record for 1960 - 1965

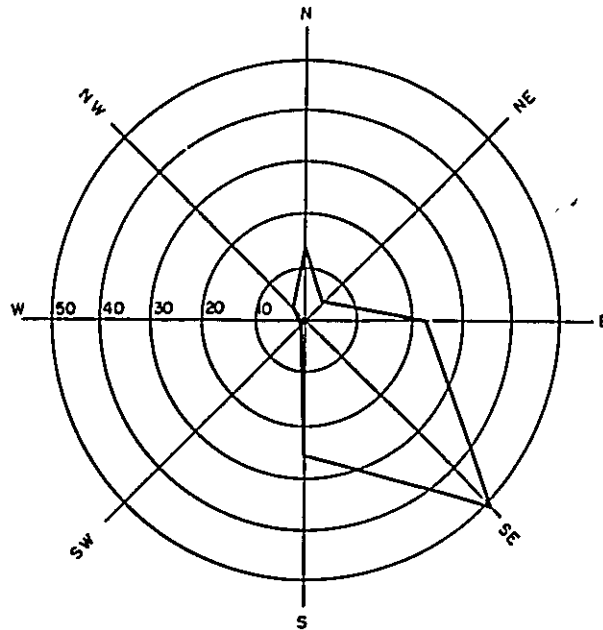


Table VII - 1 Records of Wind Direction and Frequency in Assab

Month Direction	Jan.	Feb.	Mar.	Aor.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
N		5	7	6	10	20	34	36	17	1		2	138
NE				3	7	4	10	12	2	6			44
E	21	18	21	32	32	15	1	9	13	22	32	19	235
SE	86	59	65	57	11	10		2	5	50	78	99	522
S	33	47	39	35	10				7	28	34	27	260
SW		1	1		1				1				4
W			1				6	1	1				9
NW			1	2	8	2	9	3	2				27
<b>Total</b>	<b>140</b>	<b>130</b>	<b>135</b>	<b>135</b>	<b>79</b>	<b>51</b>	<b>60</b>	<b>63</b>	<b>48</b>	<b>107</b>	<b>144</b>	<b>147</b>	<b>1239</b>

Table VII - 2 Records of Wind, by Velocity & Frequency in Assab

(m/sec.) Velocity Month	0.5-2	2-4	4-6	6-8	8-10	10-13	13-16	16-18	18-	Total
	Jan.	3	10	10	22	77	33	25	3	2
Feb.	1	8	11	19	49	42	30	5	4	169
Mar.	1	5	23	22	43	38	37	7	10	186
Apr.	1	4	15	25	55	43	19	14	4	180
May	1	8	37	61	49	17	10	3		186
June	3	20	47	59	41	5	5			180
July	3	5	31	55	42	11	6	1		154
Aug.	2	29	43	40	53	10				177
Sep.	2	9	63	67	40	8				189
Oct.	1	12	35	30	76	24	7			185
Nov.		2	14	19	66	57	16	2	5	181
Dec.		2	25	12	71	50	18	1	7	186
<b>Total</b>	<b>18</b>	<b>114</b>	<b>354</b>	<b>431</b>	<b>662</b>	<b>338</b>	<b>173</b>	<b>36</b>	<b>32</b>	<b>2158</b>

**Massawa**

For Massawa there is an observation record, for 1969 - 1971, from this we see direction and velocity of wind and its frequency as follows:

Direction	Velocity	Frequency
NE	10 m/sec	1,224
N	15 m/sec	783
calm	-	1,053

- Note: 1) Observed at 6, 9, 12, 15, 18, 21 hours in local time each day.  
 2) Record prepared by the Port Office of Massawa.



Table VII - 3 Maximum Wind Velocity in M/sec. with Direction

Month	Direction	Velocity
January	060 degree	26 m/sec
February	030 "	22 "
March	030 "	24 "
April	030 "	24 "
May	020 "	24 "
June	360 "	26 "
July	330 "	25 "
August	360 "	25 "
September	360 "	24 "
October	060 "	23 "
November	080 "	23 "
December	360 "	25 "

(1) - 3 Waves

Estimation of wave characteristics from the above record cannot be made accurately due to lack of data on wind duration and fetch width. As far as we learned at the both ports, the strong wind blew usually only 1-2 hours at maximum, then the fetch width cannot be very large.

Estimated characteristics of waves from wind record on frequency of stronger wind, velocity and direction will be sufficient for drawing up a master plan of port.

From the above we estimate the maximum wave height at the both ports as follows.

	wave height	wind direction
Assab	0.8 - 1.0 m	SE
Massawa	1.6 m	NE

To be noted that height, direction and profile of existing breakwaters, records of wave overlapping and damages, if any, would be a valuable information for a detailed design

(1) - 4 Tide

Assab

No reliable information on this item was available for Assab, however, we can roughly estimate on the basis of records at Massawa mentioned hereunder and those for C. Bole el Mandah as follows.

$$\frac{4 \text{ ft (Massawa)} + 5 \text{ ft (C. Bole el Mandah)}}{2} = \text{ca. } 4.5 \text{ ft.}$$

**Massawa**

Observation records of tide level at Massawa in 1972 have been analyzed and the following table on monthly highest and lowest tide level has been prepared. Mean tide levels are for high tide 3.48 ft or 1.06 m and for low tide -0.23 ft. or -0.70 m respectively.

Table VII - 4 Record of High and Low Tide for 1972 in ft.

	Jan.	Feb.	Mar.	Apr.	June	July	Aug.	Sept.	Mean
Max.	3.5	3.5	3.7	-	3.7	2.9	3.8	3.2	3.48
Min.	-0.1	0.0	-0.2	-	-0.3	-0.8	-0.8	-0.8	-0.23

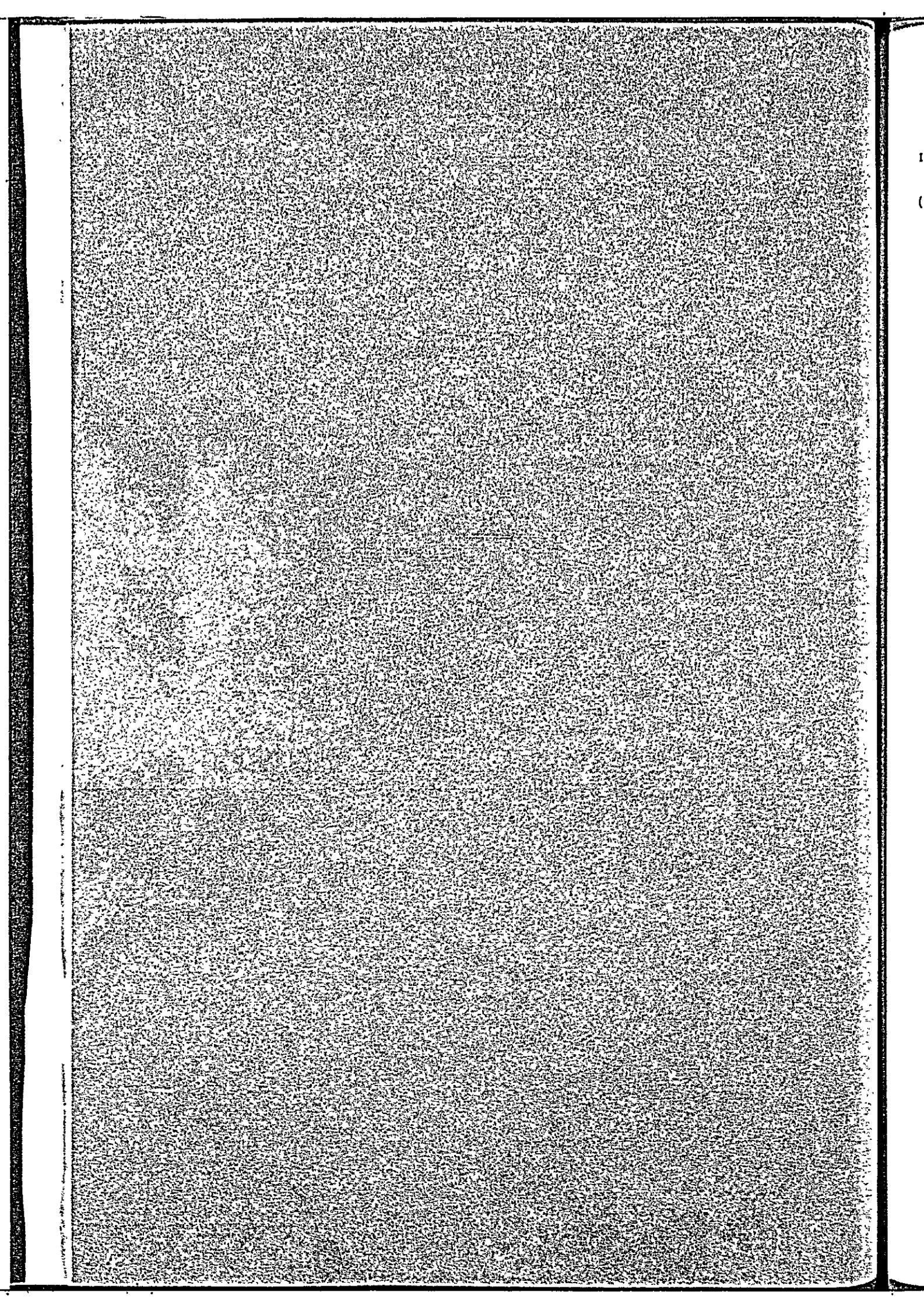
Spring rise at various ports on the Red Sea indicated on the Marine Chart is for Massawa approximately 4 ft, that is to say this figure coincide nearly with the value of the observation above.

For our planning 4 ft. would be sufficient practically.

Spring Rise at various ports on the Red Sea according to the Marine Chart is as follows.

Suez	7 (ft.)
Aden	7
Loheiya	3
Jiddah	2
Massawa	4
C Bole el Mandan	5

**IX. PHYSICAL PLAN**



## IX. PHYSICAL PLAN

### (1) MASSAWA

Summarizing up all the discussions and analysis, we can conclude that the area between the south side of Massawa Island and Sheikh Said Island is the most adequate site for the development to cope with projected transport demand for coming 20 years. Required number of berths by type up to 1994 G.C. are as follows:

General Cargo Berth	15,000 D/W x 4 *1	(- 10 m x 185 m)
" (Home Trade)	2,000 D/W x 2	(-5.5 m x 90 m)
Bulk Cargo Berth	15,000 D/W x 1	(- 10 m x 185 m)
Container (Feeder) Berth	2,000 D/W x 1	(-5.5 m x 110 m)

\*1) Extension of No. 6 Berth is not included.

At first, we will discuss from the construction view point. In this Master Plan, two intermediate target years are set, namely 1979 and 1984 G.C., so we can make use of these indices for better understanding. To meet the projected transport demand, one of 15,000 D/W class general cargo berths should be constructed until 1979 G.C.. But, this will be done by the extension of existing No. 6 berth.

Therefore, following three preparatory works will be the first step for new construction.

Construction of i) a new breakwater, ii) a small boat basin for work boats (when the construction is completed this will be converted as the base of harbour crafts such as tug boats, pilot boats and so on), and iii) access road to existing port area and also serve as the construction road for general cargo berth. Construction of revetment and reclamation work will be required along the south side of Massawa island for the abovementioned road construction.

During the second stage, 1979 - 1984 G.C., four of 15,000 D/W class general cargo berths and necessary dredging work will be executed. With the completion of these new general cargo berths, No. 1 berth will be converted for coaster use.

Allocation of berths within the space, area of new harbour development, is figured out by the above explanation. Four of 15,000 D/W class general cargo berths are arranged along the south side of Massawa Island as to meet transport demand of general cargoes which is expected in early stage of planning period.

Berths for bulk cargoes require relatively wide and ample space just behind the quay. They are planned at opposite side of general cargo berths, in the north side of Sheikh Said Island.

Area between Massawa Island and Sheikh Said Island is utilized as wharves for smaller vessels, maximum 2,000 D/W, and the base of Sheikh Said Island adjacent to the abovementioned area is also allocated for the same purpose. This arrangement will satisfy the requirements of ship's maneuvering in the port and also of minimizing construction cost.

Requirements for future development beyond this planning period, will be satisfied easily by extension of berths along the pierhead line of Sheikh Said Island. If these requirements include the development of waterfront industrial complex, as we recommended, Kohr Dakliyat Bay should be taken into consideration.

Two main access roads have been planned within the port area. One is starting from present entrance of Massawa Island and reaches Sheikh Said Island running along the coast line, and the other is branching off at the intermediate of abovementioned road and is connected with existing port area through the reclaimed land of south side of Massawa Island.



Green belt and adequate plantation is recommended in the area between shore line and the access road running along the coast line. This will give the effect of visual continuation including the seaside park which is planned at Sheikh Said Island and conserve pleasant landscape of Taulud planned at Sheikh Said Island and conserve pleasant landscape of Taulud including its water area.

Connecting part of this access road to Sheikh Said Island is recommendable as the base of leisure boating such as yachting and fishing though we could not see any urgent demand.

Two access roads will be used for transportation of construction materials during the construction period. Present access route which uses wharves apron should be limited only for light traffic as passenger or port personnel.

A channel is designed between Massawa Island and Sheikh Said Island and this will bring the following three effects: i) keeping water clean by accelerating interchange of sea water among port and the outside, ii) increasing calmness of basin, especially in front of wharves for small vessels, iii) small crafts such as for port service & fishing boats etc. can use this as navigation channel. The increase in construction cost will be amply covered by these merits.

Slip width is set about 350 m which corresponds to 2. L of maximum vessel considered, in this case 15,000 D/W, and will provide sufficient space for ship's maneuvering under the proper assistance of tug boats.

New breakwater is so designed as to have the same level of sheltering effect which is expected for existing north breakwater against present harbour basin. This will be enough for port operation because there is no record of any complaint on the calmness of the existing harbour basin, however, we have no special technical difficulty in extending the planned breakwater, if necessary.

Direction of main pierhead lines has been arranged parallel to the one of existing wharves. The direction is chosen in consideration of prevailing wind direction which is parallel to these.

Standard width of wharves (for general cargo) is set at 115 m based on the following assumptions. This may be adjusted in the course of the detailed design.

Apron	25 m
Transit Shed	40 m
Access Road	20 m
Open Storage	30 m
<hr/>	
Total	115 m

Underlying presupposition, transportation of cargoes between port and hinterland is to be carried out by road, with fork-lifts & trucks being fully utilized, no railway siding or branch line is planned in the new harbour.

Total land-use plan within port area has been shown in Fig. IIX-2.

Outline of planning principle:

- i) Area for large scale truck terminal and warehouses (may include cold storages) is allocated behind the general cargo berth along the one of main access roads.
- ii) Ample space for open storage is reserved behind bulk handling berth.
- iii) For port offices use, a small lot of land is assigned in the base of the new port.
- iv) Parks and green areas are so arranged as to make this new port as comfortable as possible.

Rough estimate of construction cost for this Master Plan is summarized and shown in Table IIX-1. This estimate, however has an inevitable uncertainty caused by the lack of information on soil condition of proposed sites and should be adjusted in the course of feasibility studies which necessarily involves boring at site.

FIG. IIX-1 ZONING OF PORT AREA, MASSAWA

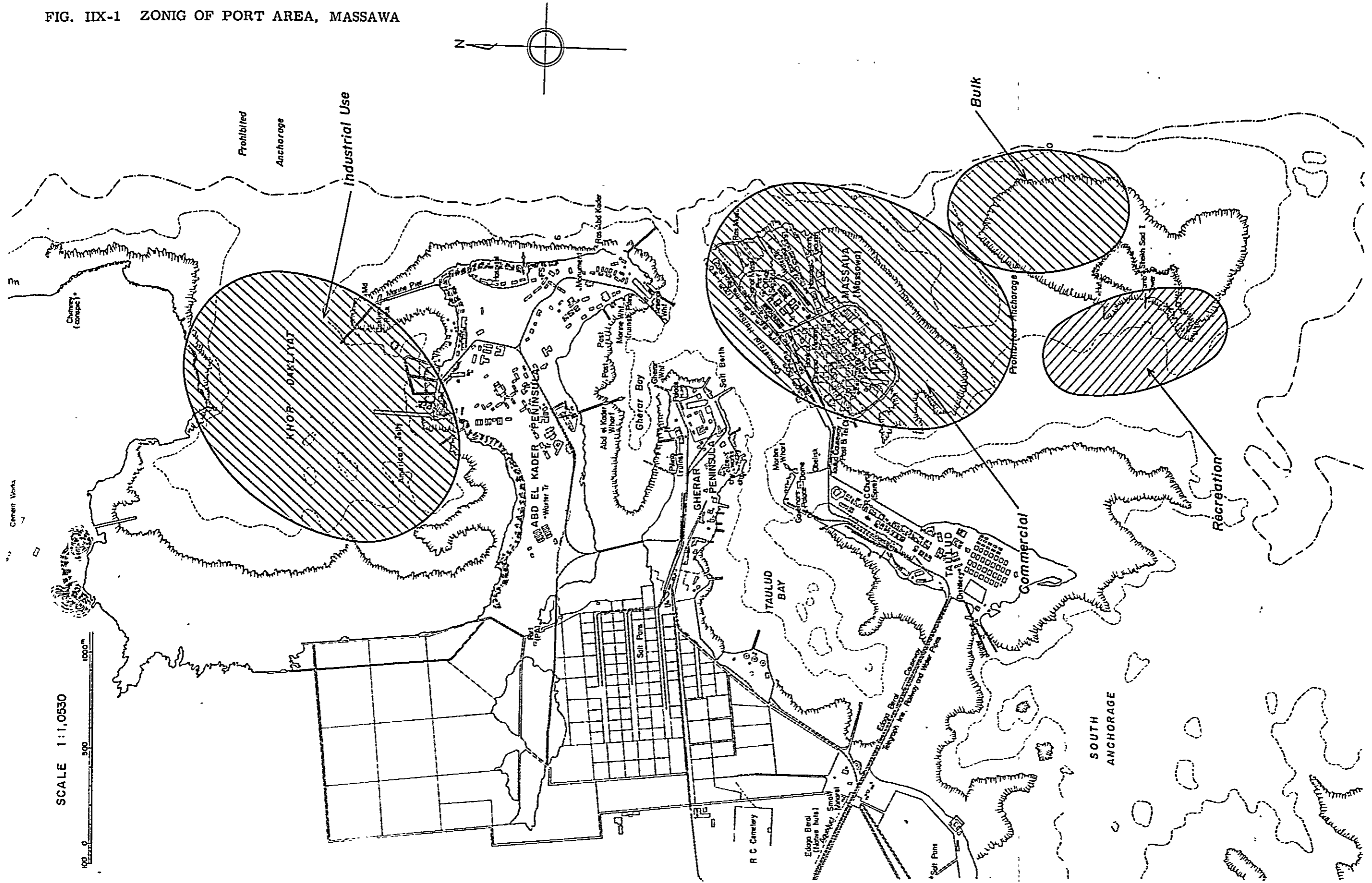
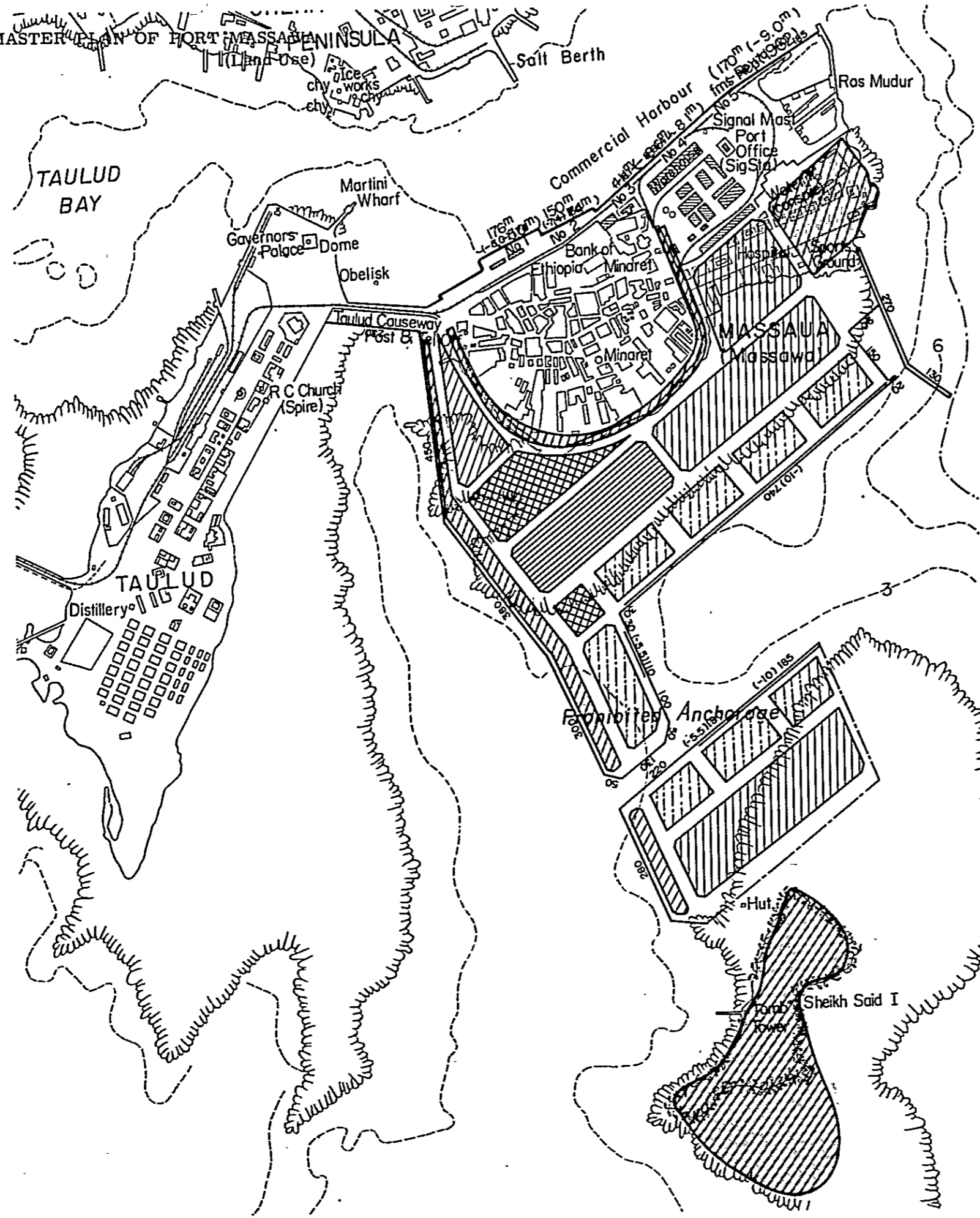







FIG. IIX-2 MASTER PLAN OF FORT MASSAWA PENINSULA



**LEGEND**

-  Office
-  Green And Park
-  Transit Shed And Open Storage
-  Warehouse
-  Truck Terminal

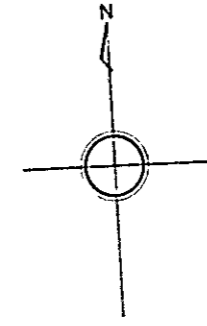




FIG. IIX-3. MASTER PLAN OF PORT MASSAWA  
 Stage I (1979 G. C.)

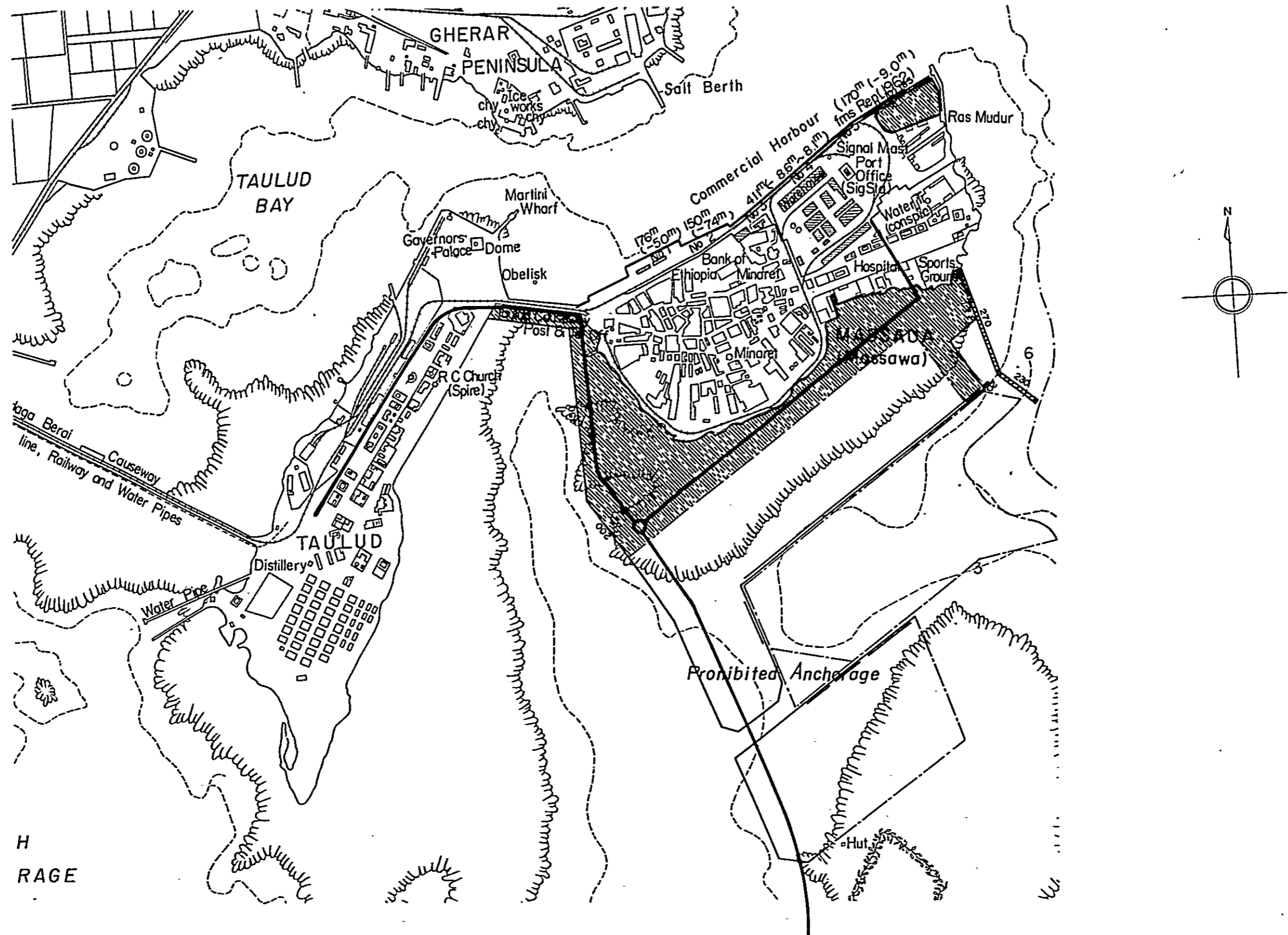


FIG. IIX-4 MASTER PLAN OF PORT MASSAWA  
Stage II (1989 G. C.)

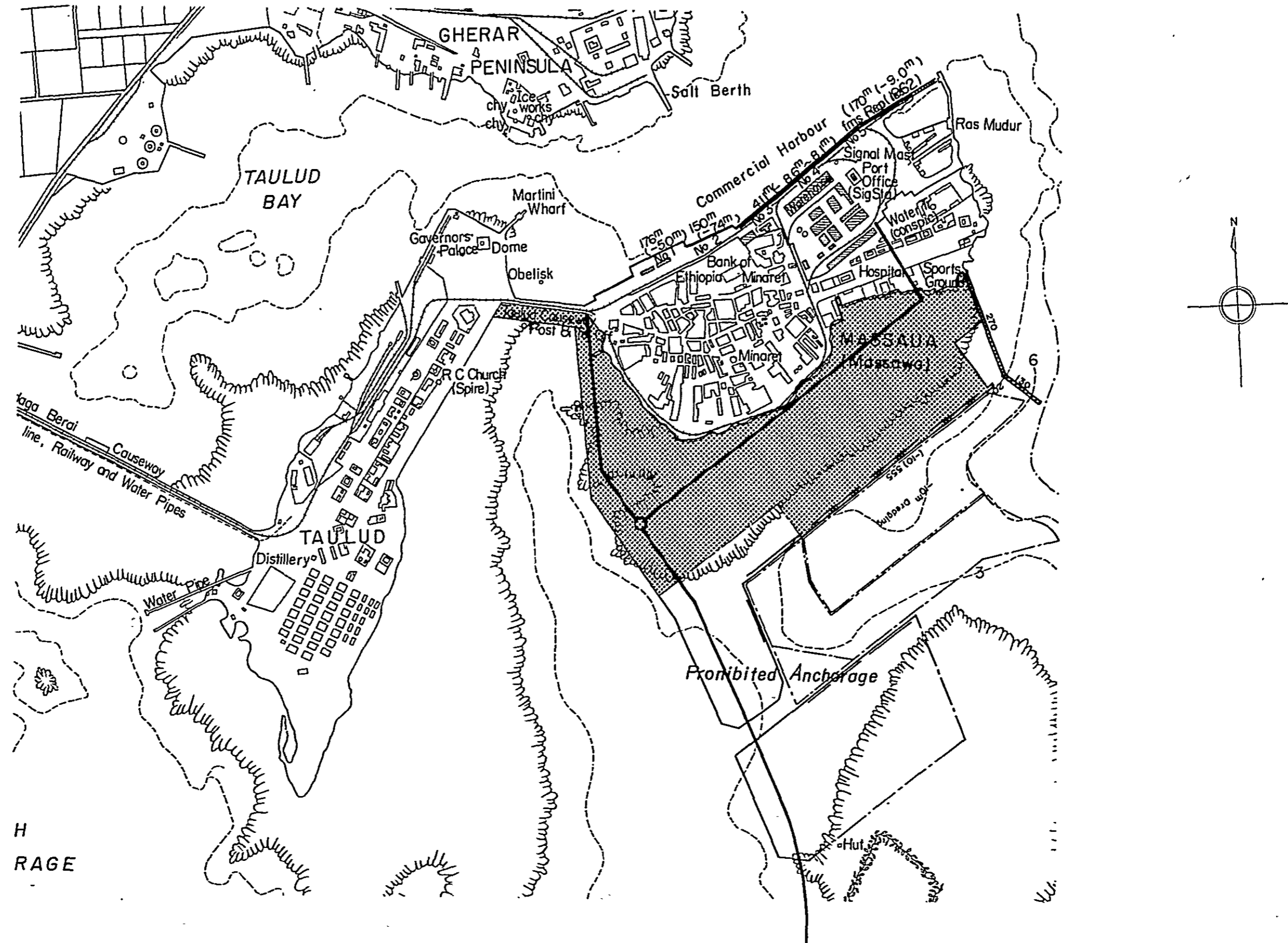


FIG. IIX-5 MASTER PLAN OF PORT MASSAWA  
Stage III (1994 G. C.)

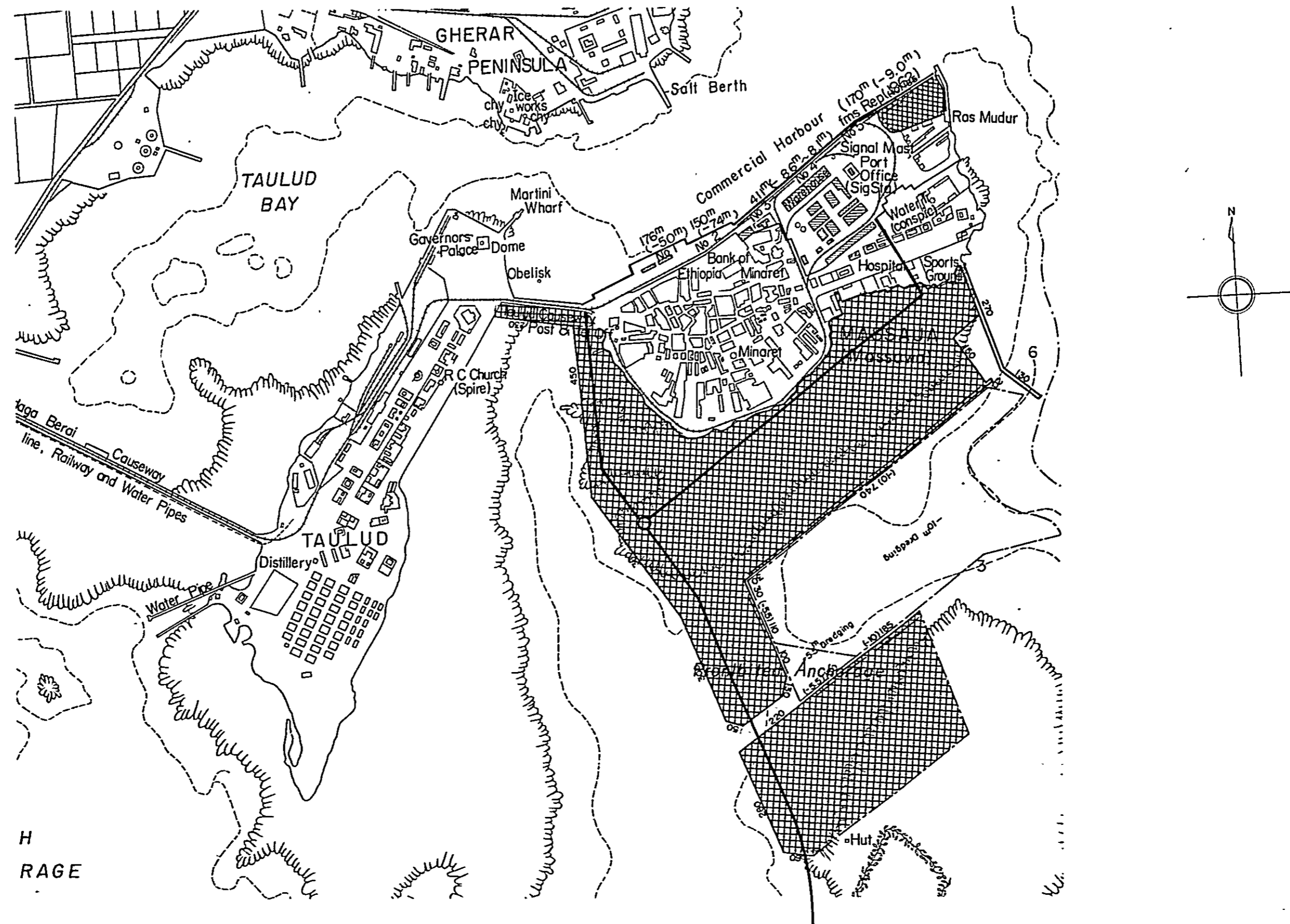




Table IIX - 1 Investment Plan of Massawa Port

(unit: 1,000 Eth. \$)

	Unit	5 year ('67 - '79)		10 year ('67 - '84)		20 year ('67 - '94)	
		Quantity	Cost	Quantity	Cost	Quantity	Cost
<b>Break Water and Others</b>			1, 223		1, 223		1, 223
Breakwater	m	130	600	130	600	130	600
Seawall	m	270	623	270	623	270	623
<b>North Warf</b>			1, 816		1, 816		1, 816
-9.0 m Quay Wall	m	100	1, 230	100	1, 230	100	1, 230
Reclamation	(m <sup>2</sup> )	(25, 500)		(25, 500)		(25, 500)	
	m <sup>3</sup>	127, 000	586	127, 000	586	127, 000	586
<b>South Warf</b>			3, 779		22, 428		34, 832
-10 m Dredging	(m <sup>2</sup> )			(200, 000)		(250, 000)	
	m <sup>3</sup>			260, 000	4, 999	300, 000	5, 768
-10 m Quay Wall	m			555	8, 109	740	11, 250
-5.5 m "	m					110	969
Revement (1)	m					280	646
" (2)	m	880	1, 015	880	1, 015	1, 410	1, 626
Reclamation	(m <sup>2</sup> )	(200, 000)		(340, 000)		(550, 000)	
	m <sup>3</sup>	600, 000	2, 764	1, 500, 000	6, 921	2, 200, 000	10, 151
Container Stacking Yard	m <sup>2</sup>					25, 000	192
	(Unit)			(3)		(5)	
Warehouse	m <sup>2</sup>			18, 000	1, 384	30, 000	2, 307
Quay Crane	Unit					1	1, 923
<b>Small Boat Basin</b>			1, 245		1, 337		1, 337
Breakwater	m			20	92	20	92
Lighter Wharf	m	240	1, 107	240	1, 107	240	1, 107
Reclamation	(m <sup>2</sup> )	(10, 000)		(10, 000)		(10, 000)	
	m <sup>3</sup>	30, 000	138	30, 000	138	30, 000	138
<b>Port Island</b>							15, 531
-10 m Dredging	(m <sup>2</sup> )					(210, 000)	
	m <sup>3</sup>					220, 000	4, 230
-5.5 m	(m <sup>2</sup> )					(5, 000)	
	m <sup>3</sup>					10, 000	192
-10 m Quay Wall	m					185	2, 703
-5.5 m "	m					180	1, 246
Revement (1)	m					220	508
" (2)	m					340	392
Reclamation	(m <sup>2</sup> )					(210, 000)	
	m <sup>3</sup>					840, 000	3, 876
	(Unit)					(1)	
Warehouse	m <sup>2</sup>					6, 000	461
Quay Crane	Unit					1	1, 923
<b>Road</b>	m			1, 650	1, 523	3, 000	2, 768
<b>Total</b>			8, 063		28, 327		57, 507

Note: For warehouse, truck terminal, green and park, costs of earth work are included

(2) ASSAB

Number of berths should be constructed within the planning period is summarized as follows:

General Cargo Berth	15,000 D/W	X 5	(- 10 m x 185 m)
" (Home Trade)	2,000 D/W	X 2	(-5.5 m x 90 m)
Bulk Cargo Berth	40,000 D/W	X 1	(- 12 m x 240 m)
" " "	15,000 D/W	X 2	(- 10 m x 185 m)
Container Berth	70,000 D/W	X 1	(- 12 m x 300 m)
Re-location of oil terminal			

The most preferable site for the above new berths should be the south side of existing jetty, general cargo berth, extending to oil refinery. Arrangement of berths should be in the order from the north, general cargo berths - container berth - bulk handling berth - industrial harbour.

An extension of existing breakwater about 150 m with slight shift toward the East is the only proposal as the outer protective facility. The South breakwater proposed in the Interim Report is to be omitted.

Reasons for this change are i) the proposed site is well protected by coral reefs except North direction lying almost parallel to coast line and ii) -5.5 m berth for home trade will be protected fairly well by the extension of existing breakwater.

Since wind from SE with velocity of 5 m/sec. - 10 m/sec. prevails and will affect ship's maneuver in this port. One of the two alternatives proposed in the Interim Report was the idea to close the north entrance and use the inside of breakwater as wharves. For the sake of easier maneuvering of ships this idea was abandoned.

Projected transport demands require following construction schedule. In the first stage, up to 1979 G.C., one berth of 15,000 D/W for general cargo shall be constructed at the south side of existing south half jetty by expanding its base. Simultaneously, one 15,000 D/W bulk cargo berth together with necessary revetment and access road which will be used as a part of main access road in the port area shall be constructed. The coast line between the abovementioned two wharves will remain as it is.

In the second stage, from 1979 G.C. to 1984 G.C., two of 15,000 D/W general cargo berths, revetment and temporary revetment shall be constructed. Reclamation up to the base line of piers will be completed within this stage. One berth of 2,000 D/W wharf will be constructed at the base of the bulk cargo berth completed in the first stage.

One of the main access roads will be constructed in the reclaimed land starting from present gate of the port up to the access road completed in the first stage.

At the end of this stage, the new loading facilities for the oil refinery shall be constructed to replace existing loading pier which is to be demolished for the construction of bulk cargo berth in the third stage.

In the third stage, from 1984 G.C. to 1994 G.C., all of the remaining facilities proposed in the Master Plan; i) two of 15,000 D/W class general cargo berths, ii) one 70,000 D/W class container berth, iii) one 40,000 D/W class bulk cargo berth, iv) one 15,000 D/W class bulk cargo berth, v) one 2,000 D/W berth for home trade and vi) remaining part of main access road shall be completed. Since the above bulk cargo berths are to be assigned for ores, detached pier type will be recommendable as the structures to reduce the construction cost.

Construction of a sea berth involves pipe line and necessary facilities in off-shore, along the contour line of -18 m, this work shall be started at the early stage of this period and be completed before the two bulk cargo berths put into operation. This sea berth will substitute the function of

existing mooring buoys for oil tanker improving navigability of the port and also reliability of the facility. This will meet future increase in refining capacity of oil refinery and export of natural gas or crude oil. Recommendable type of structure is fixed type.

An adequate system of navigational aids such as light buoys and leading marks should be installed to improve ship's entrance to the port. But, detailed study on this subject shall be done in the stage of feasibility studies.

Some time in between 1984 G. C. and 1994 G. C. load for 1st bulk cargo berth (15,000 D/W class) will be decreased by shifting of bulk import of fertilizer to new detached piers. In this stage, it is recommendable that this bulk cargo berth be converted as grain loading berth equipped with silos and grain loaders.

Standard width of wharves for general cargo berth is set at 115 m based on the following assumptions. This may be adjusted in the stage of detailed design.

Apron	25 m
Transit Shed	40 m
Access Road	20 m (open storage in some case)
Open Storage	30 m
Total	115 m

An underlying presupposition that all cargo destined to this port will be entirely depended upon road transportation, calls for full-scale utilization of fork-lift trucks.

Total land-use plan within the port area has been shown in Fig. IIX-7.

Outline of planning principle is as follow:

- i) One block of land for port offices combined with a small park is set at the base of commercial harbour area. This will be a kind of symbol zone connecting city and port closer.
- ii) Ample space has been reserved for truck terminal and warehouses behind the container and bulk cargo berths and main access roads are arranged to meet this aim.
- iii) Area for industrial use is separated from other area by one of main access roads with a green belt.
- iv) Ample space has been allocated for parks and greens to meet environmental requirements of this new port town. In the course of construction, due consideration shall be taken to realize a nice view of the port through the green.

According to this Master Plan, construction will be taken place at the separate sites simultaneously and this may give us an impression of disorder or inconvenience at the beginning. But, this should be endured for the sake of construction of an efficient and well accommodated port and this is the very reason we need the Master Plan.

One of the urgent problems closely related to the Master Plan will be the allocation of the land for the bagging plant of importing fertilizer. This problem should be treated according to the abovementioned principle. Allocation of this bagging plant in the area of industrial use, the nearest block to the first bulk cargo berth, will be the only practical solution.

Rough estimate of construction cost for this Master Plan is summarized and shown in Table IIX-2. Despite our utmost effort to be accurate this estimate may contain a certain degree of uncertainty due to lack of necessary information on soil conditions of the proposed sites. In the course of the feasibility studies which should involve borings at site some reasonable adjustment should be made.

FIG. IIX-6 ZONIG OF PORT AREA ASSAB

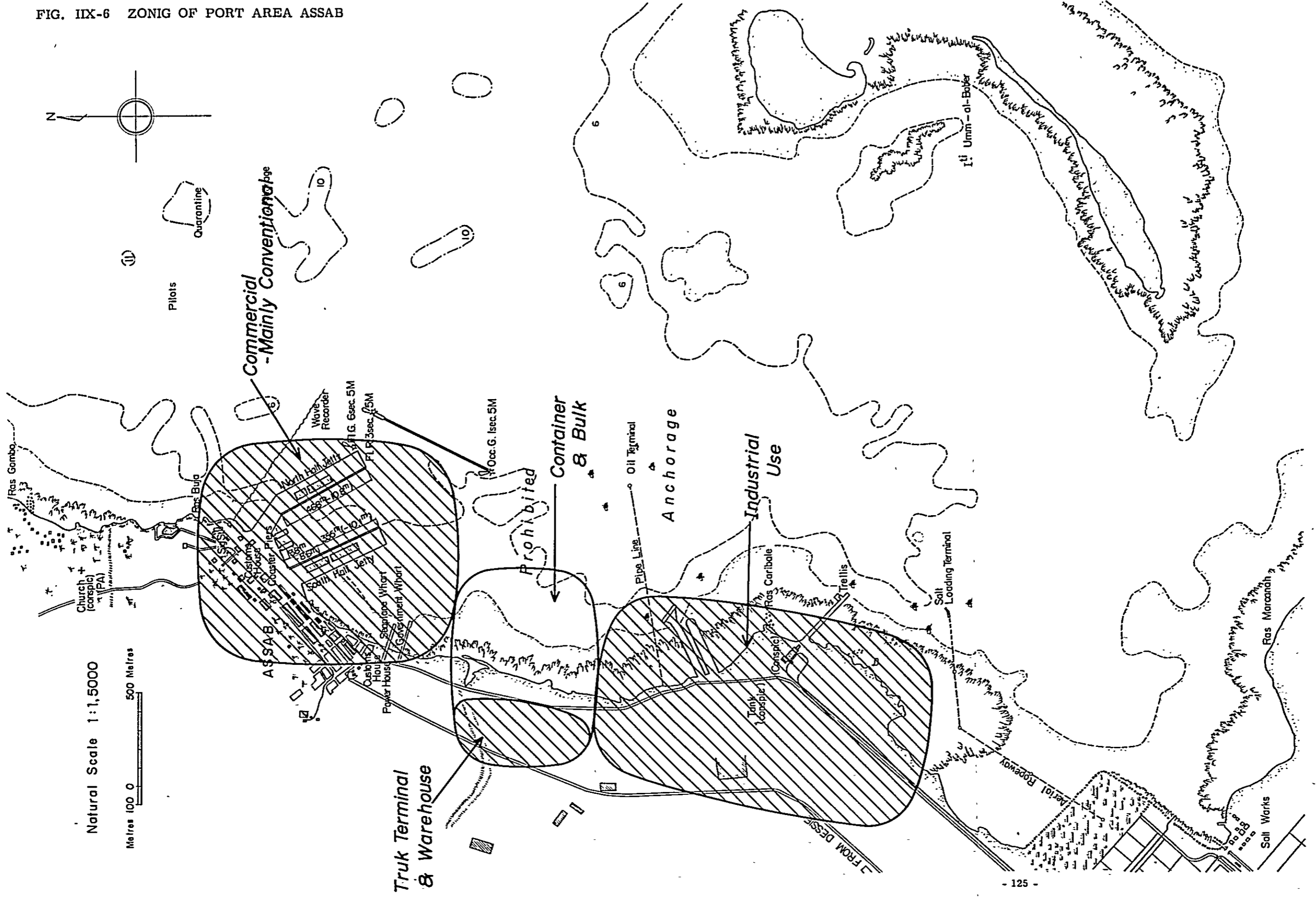




FIG. IIX-7 MASTER PLAN OF PORT ASSAB  
(Land Use)

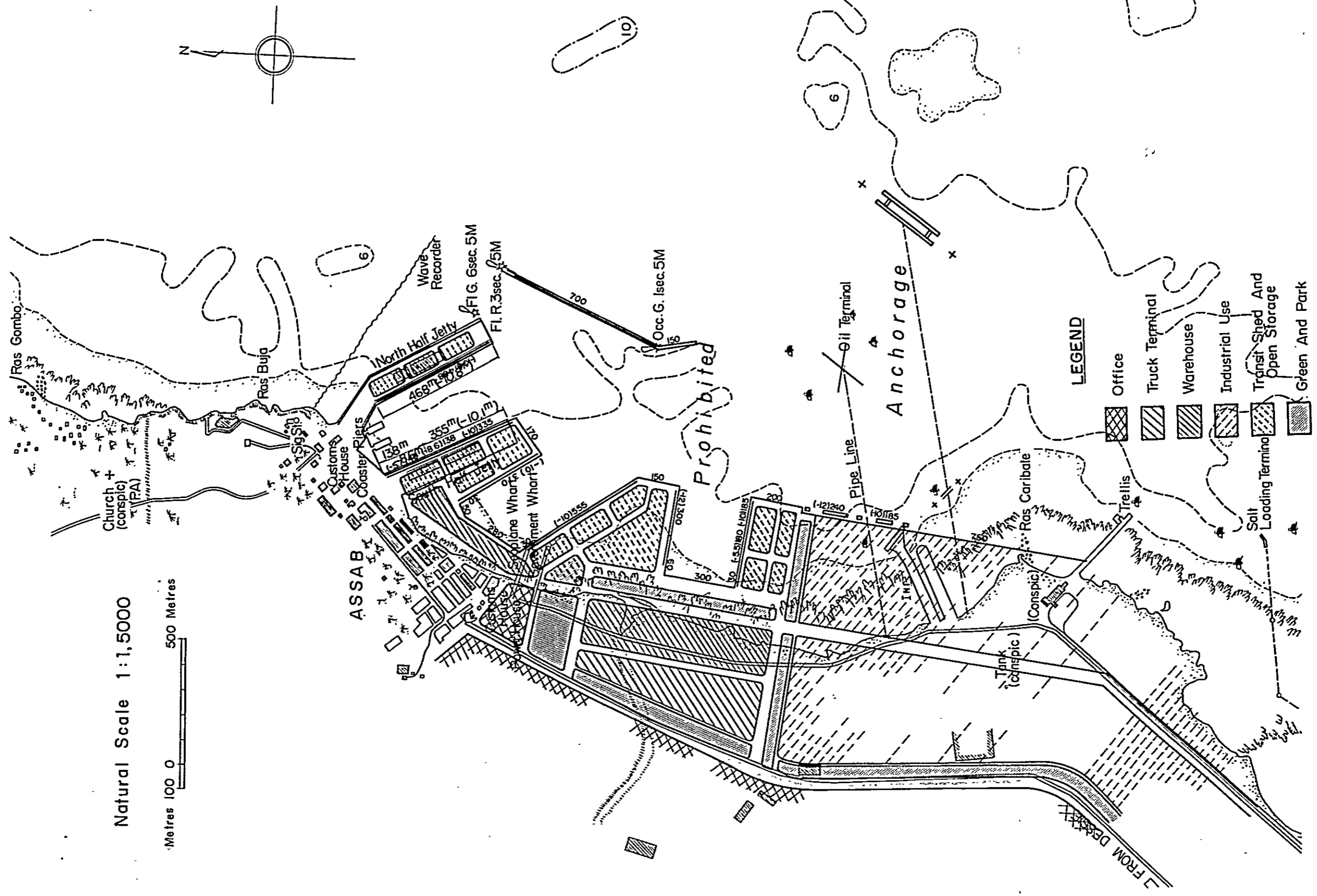


FIG. IIX-8 MASTER PLAN OF PORT ASSAB  
Stage I (1979 G. C.)

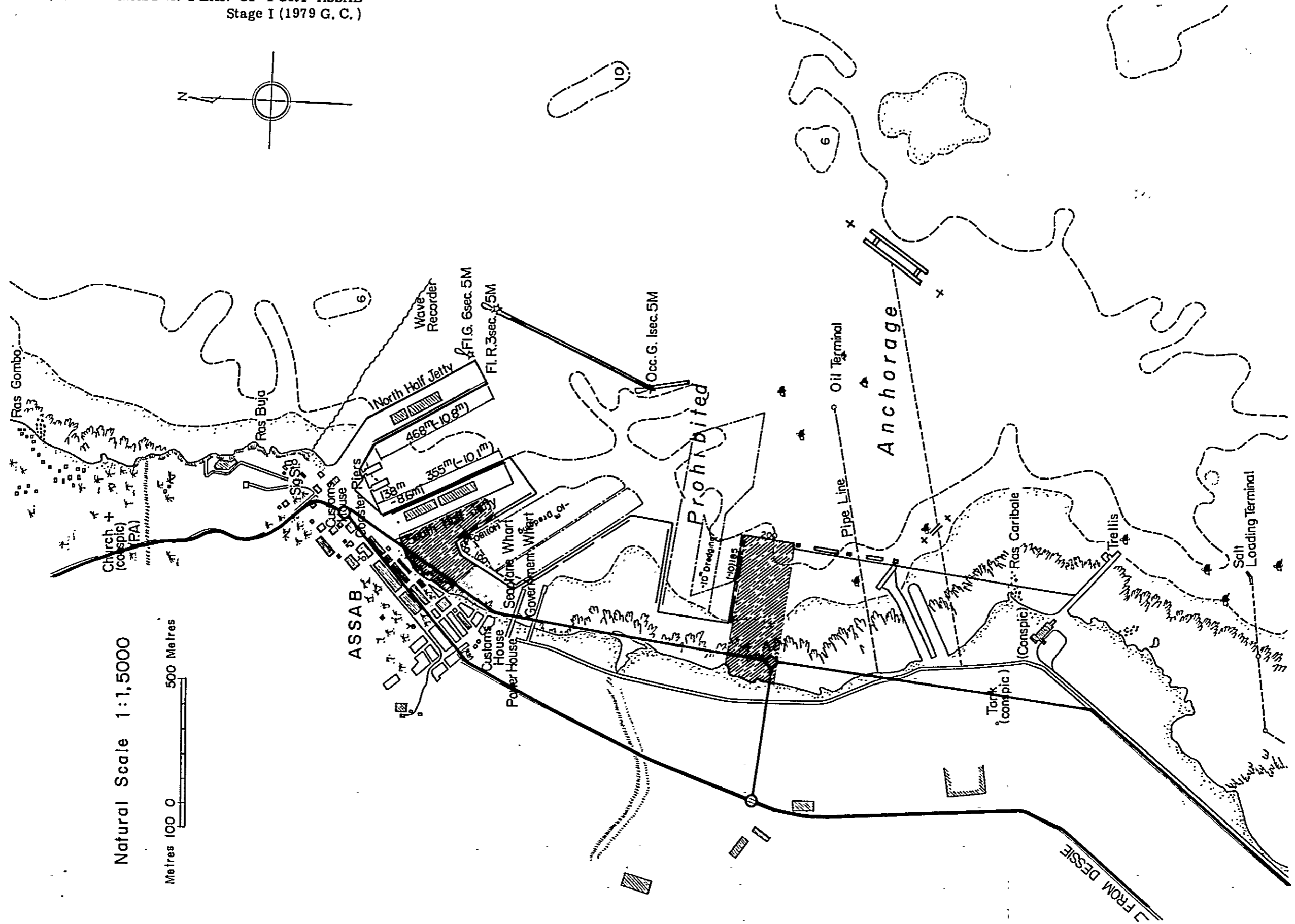
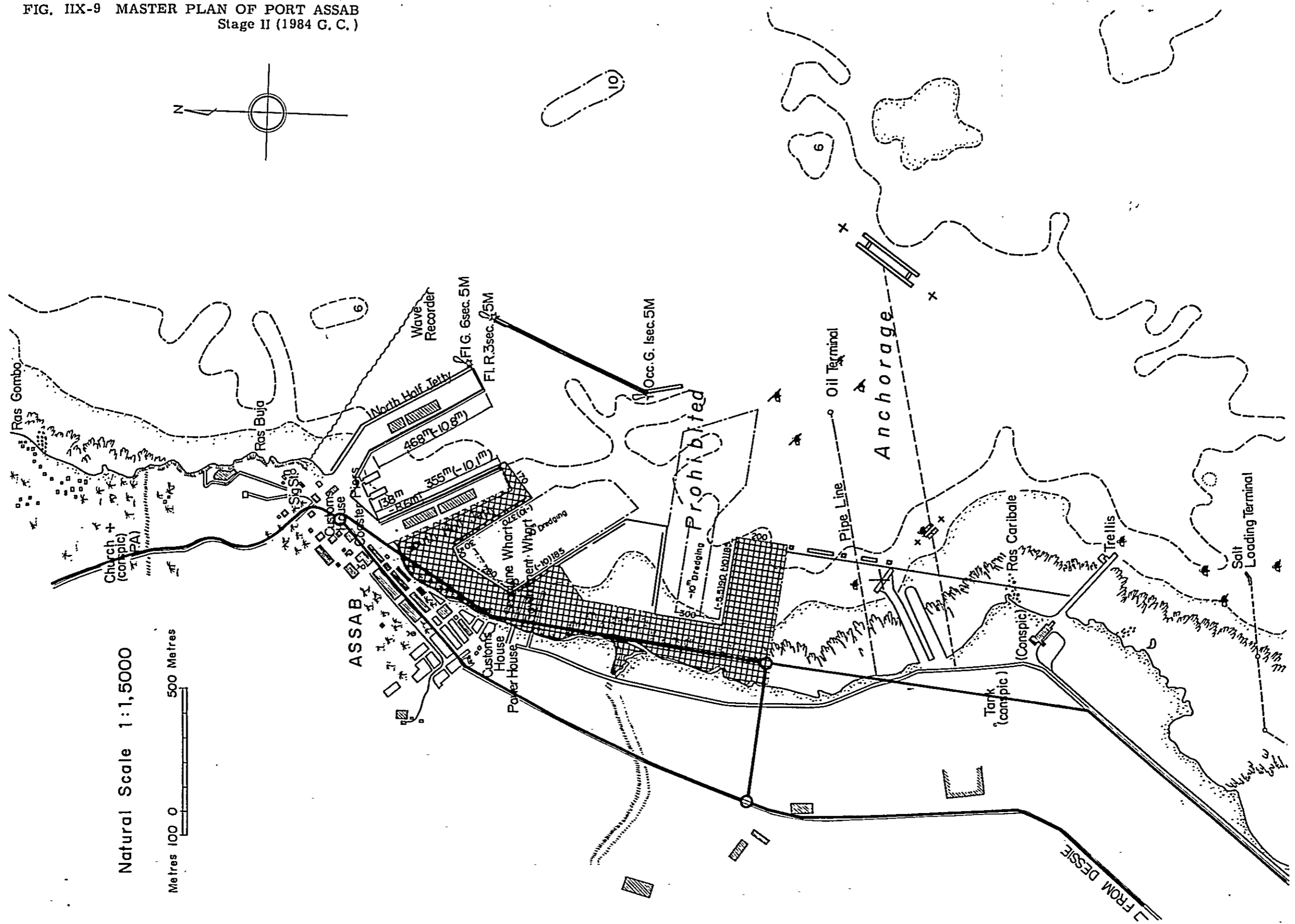


FIG. IIX-9 MASTER PLAN OF PORT ASSAB  
Stage II (1984 G. C.)



Natural Scale 1:1,5000  
Metres 100 0 500 Metres

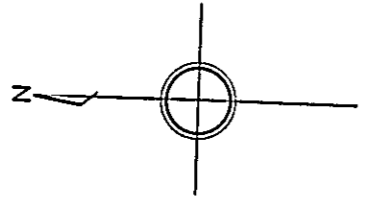
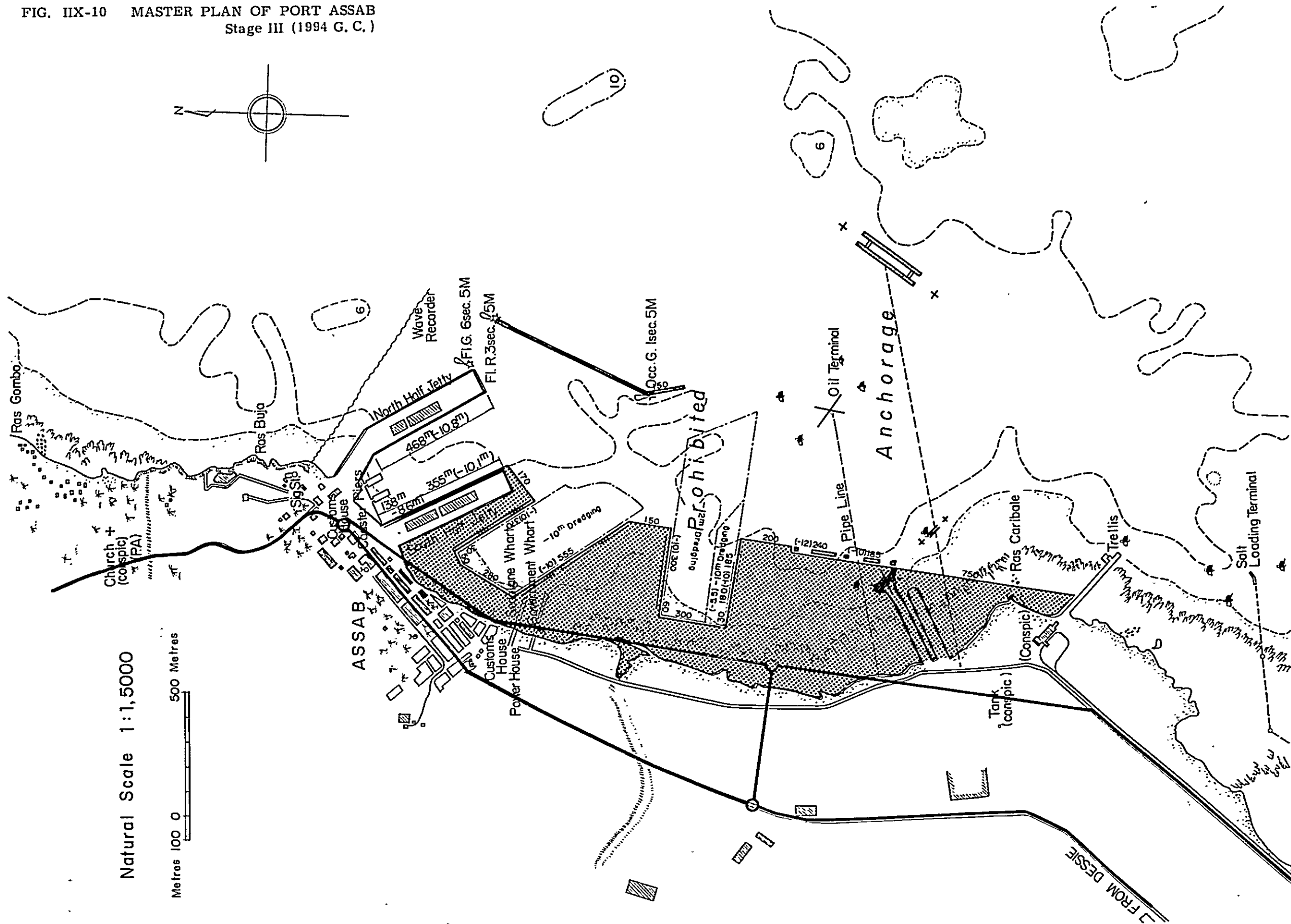


FIG. IIX-10 MASTER PLAN OF PORT ASSAB  
Stage III (1994 G. C.)



Natural Scale 1:1,5000





Table IIX - 2 Investment Plan of Assab Port

(unit: 1,000 Eth. \$)

	Unit	5 year ('67 - '79)		10 year ('67 - '84)		20 year ('67 - '94)	
		Quantity	Cost	Quantity	Cost	Quantity	Cost
Breakwater							1,153
Breakwater	m					150	1,153
North Jetty			6,345		13,641		14,103
-10 m Dredging	(m <sup>2</sup> )	(80,000)		(80,000)		(80,000)	
	m <sup>3</sup>	80,000	1,538	80,000	1,538	80,000	1,538
-10 m Quay Wall	m	185	3,307	370	6,613	370	6,613
Revement	m			170	1,961	170	1,961
"	m	150	346	330	761	330	761
Reclamation	(m <sup>2</sup> )	(60,000)		(100,000)		(100,000)	
	m <sup>3</sup>	250,000	1,154	500,000	2,307	500,000	2,307
Warehouse	Unit			(1)		(2)	
	m <sup>2</sup>			6,000	461	12,000	923
Central Jetty					6,536		39,057
-12 m Dredging	(m <sup>2</sup> )					(200,000)	
	m <sup>3</sup>					500,000	9,613
	(m <sup>2</sup> )					(80,000)	
-10 m "	m <sup>3</sup>					80,000	1,538
-12 m Quay Wall	m					300	6,644
-10 m "	m			185	3,307	555	8,997
Revement (1)	m					150	1,730
" (2)	m			300	692	300	692
Reclamation	(m <sup>2</sup> )			(150,000)		(250,000)	
	m <sup>3</sup>			450,000	2,076	800,000	3,691
Container Stacking Yard	m <sup>2</sup>					60,000	461
Warehouse	Unit			(1)		(4)	
	m <sup>2</sup>			6,000	461	24,000	1,846
Quay Crane						2	3,845
Bulk Harbour			11,612		12,696		13,526
-10 m Dredging	(m <sup>2</sup> )	(37,000)		(37,000)		(37,000)	
	m <sup>3</sup>	40,000	769	40,000	769	40,000	769
-10 m Quay Wall	m	185	2,845	185	2,845	185	2,845
-5.5 m "	m			90	623	180	1,453
Revement	m	200	3,076	200	3,076	200	3,076
Reclamation	(m <sup>2</sup> )	(130,000)		(130,000)		(130,000)	
	m <sup>3</sup>	650,000	2,999	650,000	2,999	650,000	2,999
Quay Crane	Unit	1	1,923	1	1,923	1	1,923
Warehouse	Unit			(1)		(1)	
	m <sup>2</sup>			6,000	461	6,000	461
Industrial Use					2,307		47,454
-12 m Pier	m					240	4,429
-10 m "	m					185	2,845
Revement	m					750	1,730
Reclamation	(m <sup>2</sup> )					(400,000)	
	m <sup>3</sup>					2,000,000	9,228
Quay Crane						2	3,845
Removal of Sea Berth						1	23,070
Removal of Oil Jetty				1	2,307	1	2,307
Rail and Road			415		2,076		3,460
Road (1)	m			1,800	1,661	3,300	3,045
Road (2)	m	600	415	600	415	600	415
Total			18,372		37,256		118,753

Note: For warehouse, truck terminal, green and park, costs of earth works are included.

FIG. IIX-1 STANDARD SECTION OF QUAY WALL

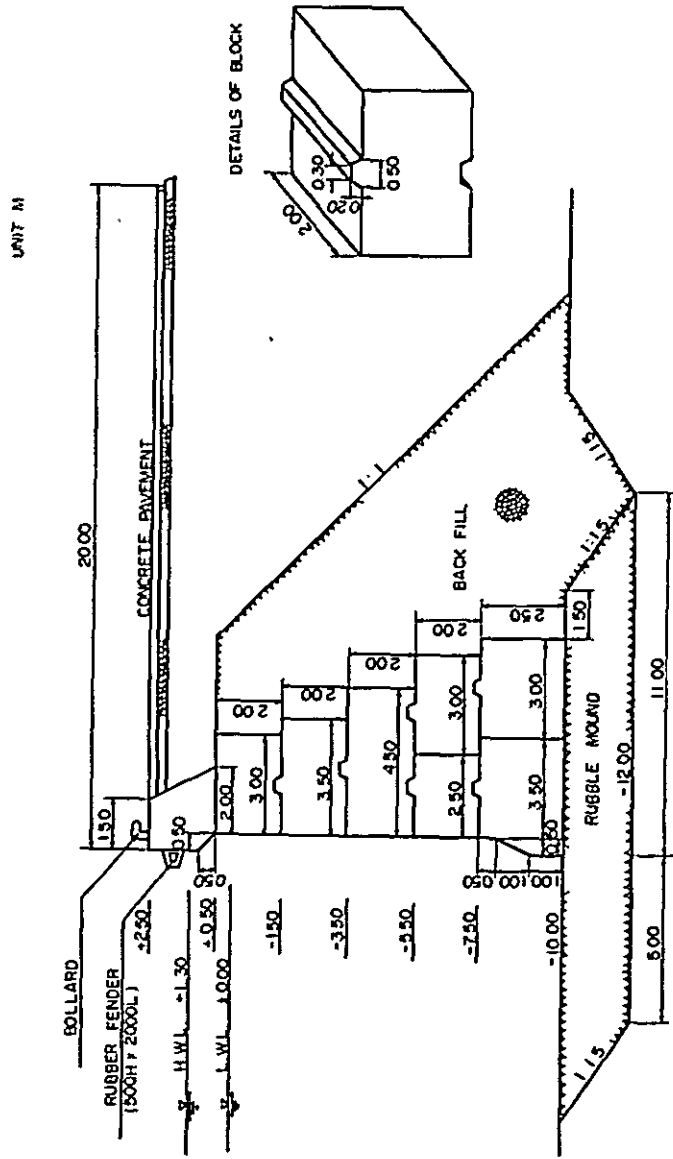


FIG. IIX-2 STANDARD SECTION OF BREAKWATER

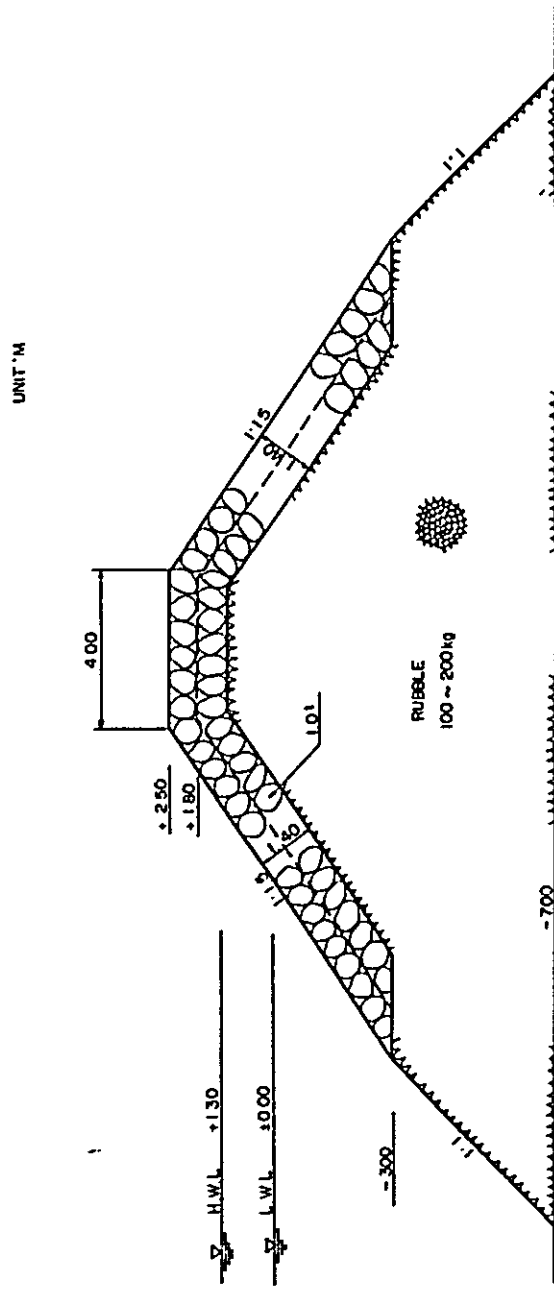
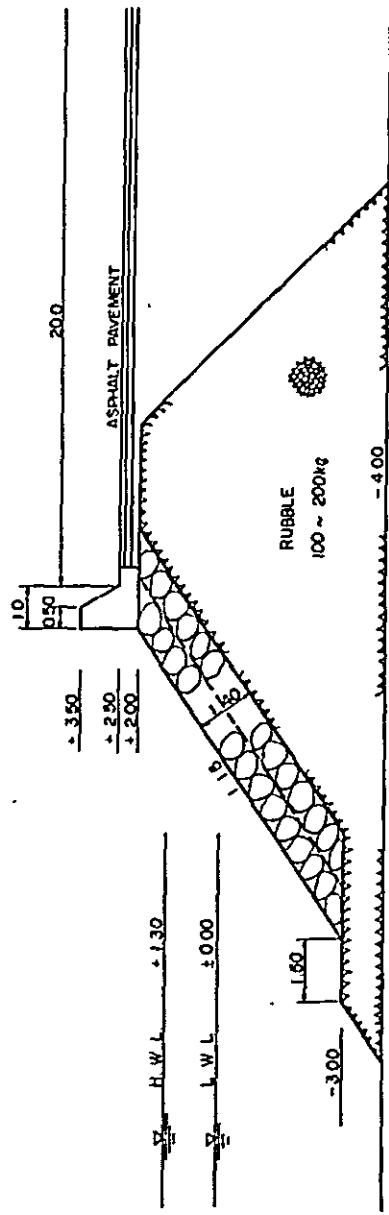


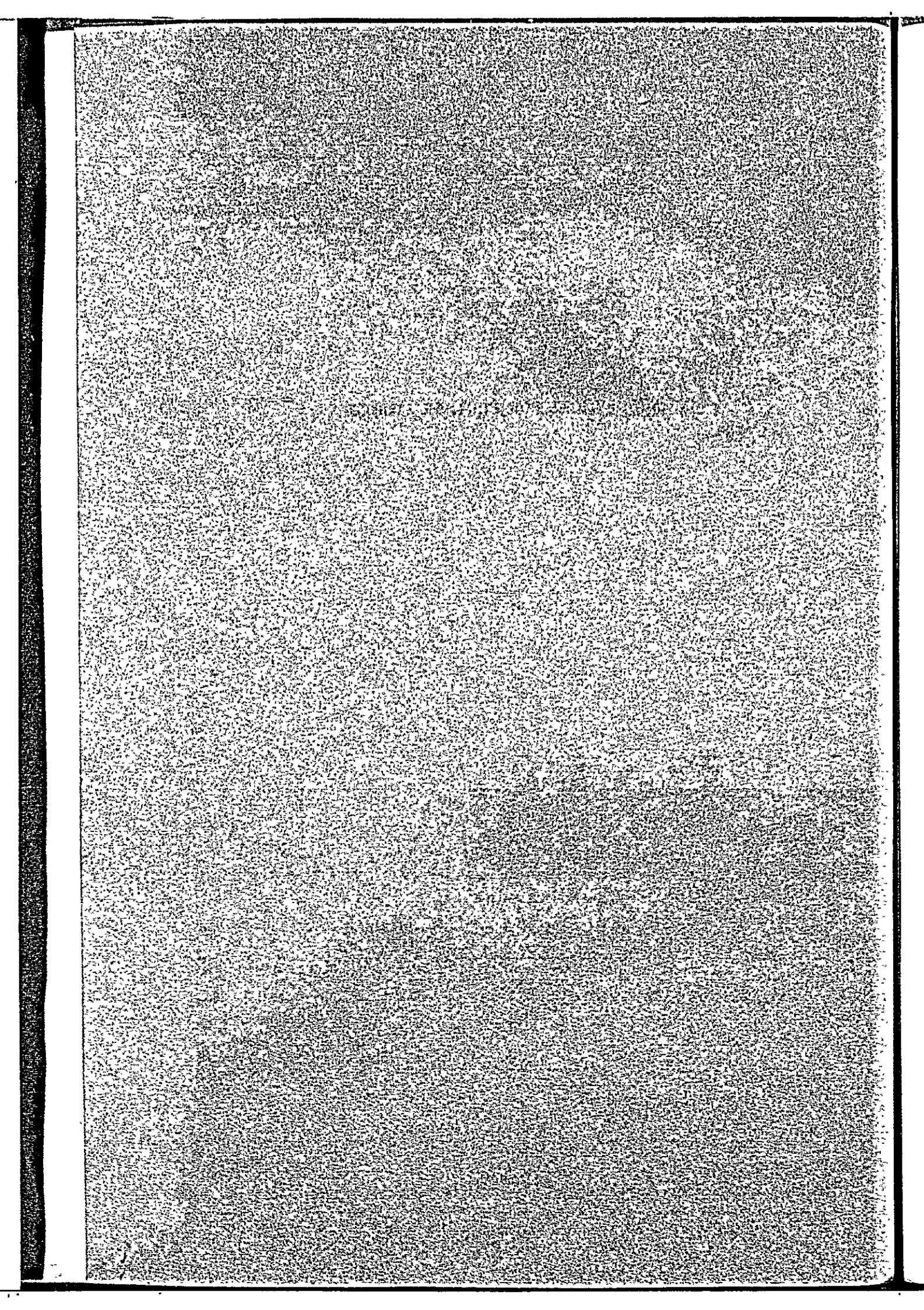


FIG. IIX-3 STANDARD SECTION OF SEAWALL

UNIT . M



**IX. SUGGESTIONS FOR FURTHER STUDIES**



## **IX. SUGGESTIONS FOR FUTURE STUDIES**

In submitting this Master Plan we like to point out some important items which are indispensable for the realization of the development plan. An extensive studies and investigations on these items should be conducted in the future surveys and investigations which must follow soon.

### **(1) Investigations on the Natural Conditions of the Proposed Sites**

- a. Sounding of water areas
- b. Topographical surveys
- c. Investigations on soil conditions including borings at site

Accurate estimation of construction costs, especially those for dredging, is decisively dependent on the results of these surveys and investigations. In preparing present Master Plan we had to omit these fundamental studies royal to the scope of work specified in Terms of Reference requested by the Imperial Ethiopian Government. Under the circumstances the first priority should be given to the surveys and investigations on these items mentioned above in the forth-coming studies. (Feasibility Study)

### **(2) Other Studies (physical and functional)**

- a. on movable cargo handling equipment
- b. on scale of storage facilities (warehouses, truck terminals etc.)
- c. on tug boats and floating cranes
- d. on navigational aids

The Master Plan touched very briefly on these items; extensive studies on cargo flow and maneuvering of ships within port areas should refine the proposals suggested in sketch in the present Master Plan.

As to the land allotment program a keen attention should be paid to the good cordination between port development program and town planning.

### **(3) Cost Benefit Analysis**

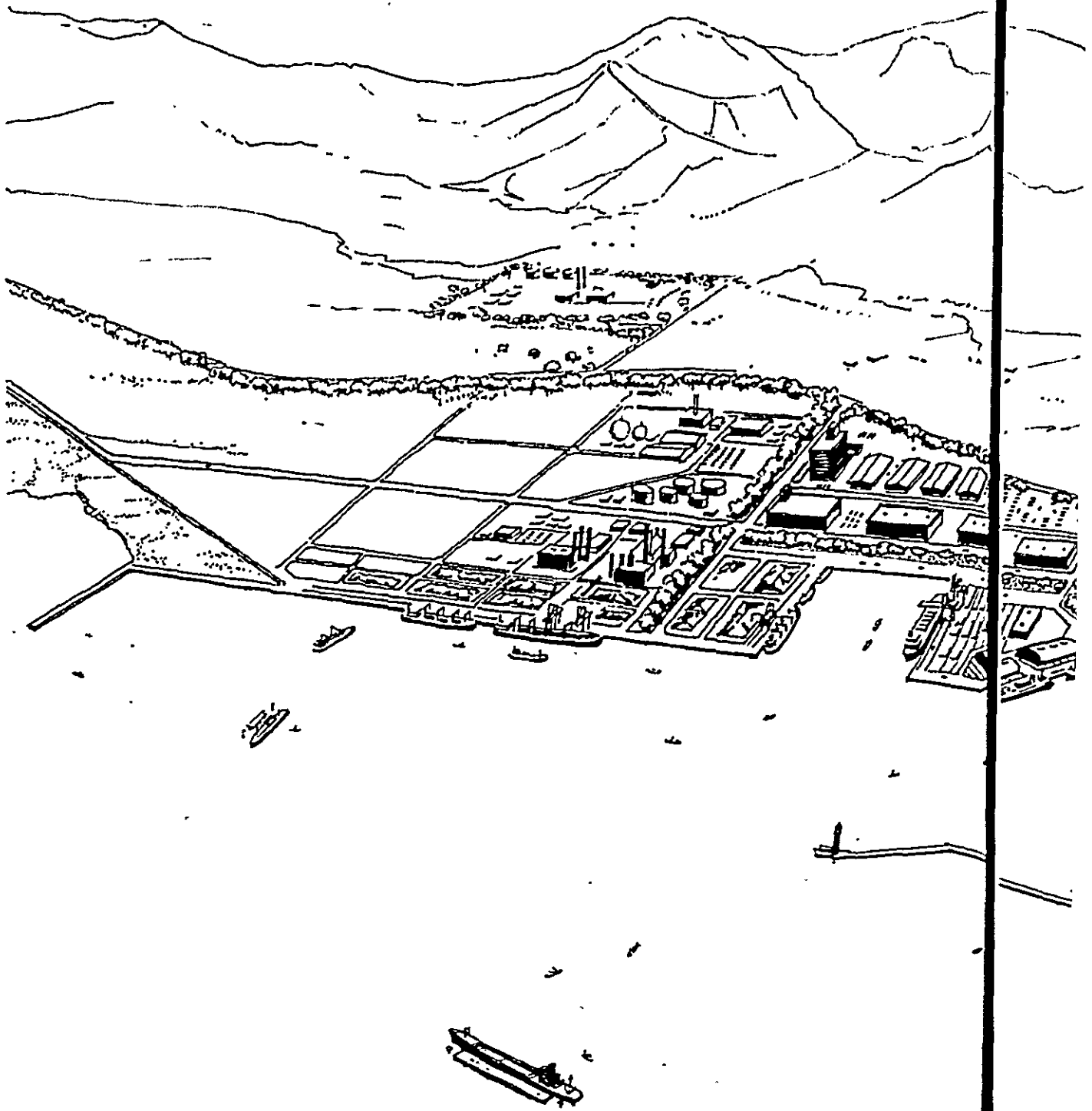
Careful studies must be conducted on the following items.

- a. financing program
- b. Government shares within the program
- c. economic effects (direct and indirect)
- d. non-economic effects

These studies are pre-requisite to the implementation of any development projects; needless to mention that the cost benefit analysis is not the only factor for final decision of development project.

In this connection we strongly suggest to pay deliberate attention to the following problems in conducting the next studies.

- a. positive measures for encouragement of investment from the private sectors to the port facilities.
- b. rationalization of land transport, especially that of long-distance truck transport.
- c. careful evaluation of non-economic effects of the plan.



Artist's Vision of the Port of Assab Completed, Bird's eye view

