FEASIBILITY STUDY
FOR THE
ONNE NEW PORT DEVELOPMENT PROJECT
IN
NIGERIA

MAY 1978

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

At the request of the Federal Republic of Nigerian Government to cooperate in financing the Onne Port Development Project, the Government of Japan decided to conduct the technical and economic feasibility studies of the Project through the Japan International Cooperation Agency (JICA).

JICA dispatched a study mission headed by T. Hirota, Director, Social Development Cooperation Department, JICA, to Nigeria in April, 1978, and the mission has completed this report based on the information obtained in Nigeria.

The report has been prepared on a neutral basis to assess mainly the economic feasibility of the Project and has nothing to do with the present international tender of the Project.

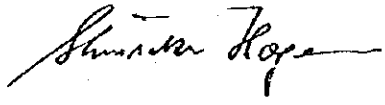
In view of the important role the Project will play in the development of the Nigerian economy, I hope that this report will contribute to the implementation of the Project, and to the closer friendly relations between Nigeria and Japan.

I would like to express my deep appreciation to the Government and the people concerned of Nigeria for their cooperation extended to the study team.

May, 1978

Japan International Cooperation Agency

President

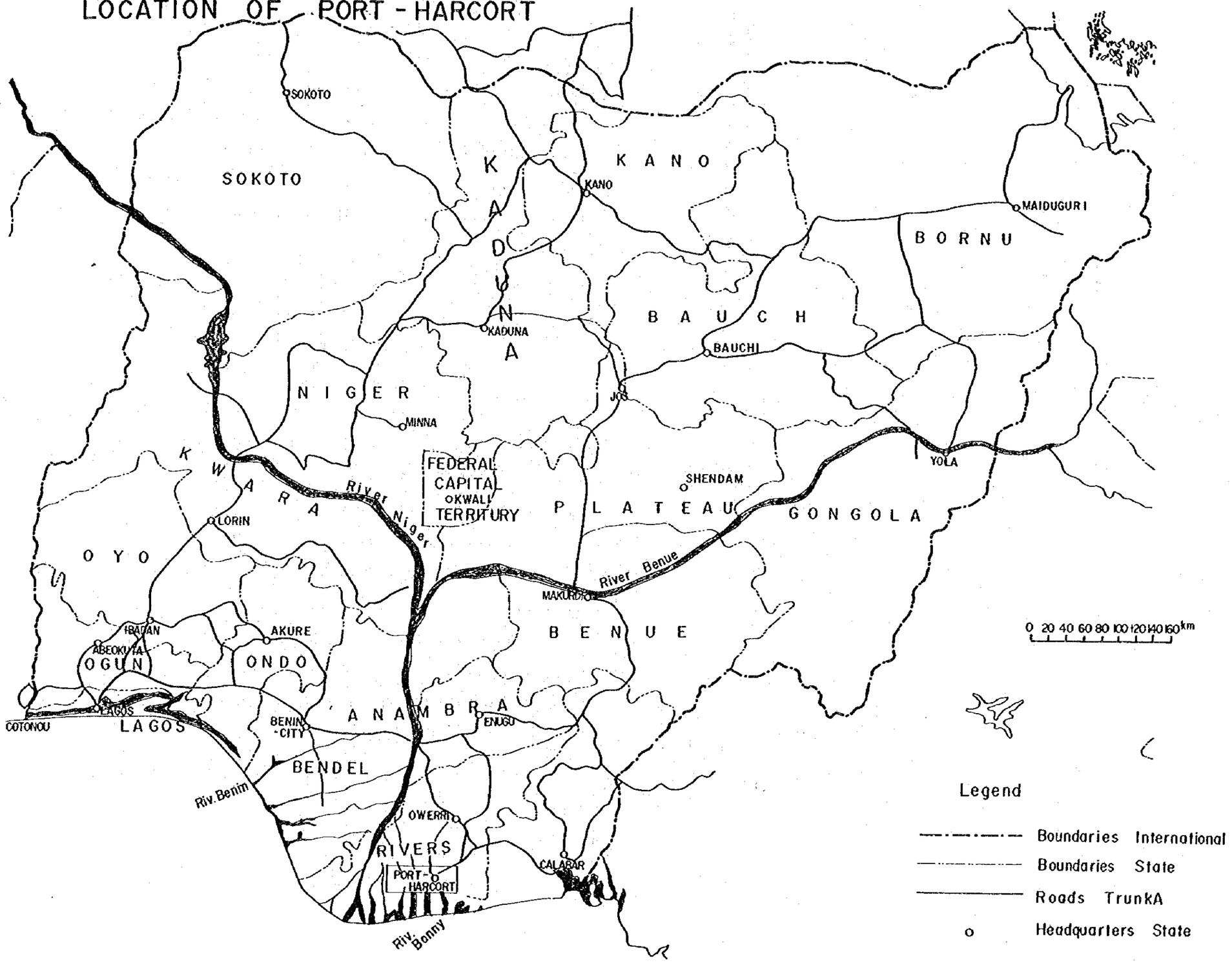


Shinsaku Hogen

CURRENCY EQUIVALENTS

N1.00	=	US$1.64
N1.00	=	¥360.00
US$1.00	=	¥220.00
US$1.00	=	N0.61

LOCATION OF PORT - HARCORT



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I. SUMMARY

At the request of the Federal Republic of Nigerian Government to assist in financing the Onne Port Development Project, the Government of Japan has sent a Mission to confirm the technical and economic feasibility of the Project.

The Project comprises: (a) Construction of a port facility with six berths, including one bulk cargo berth, three general cargo berths, one container berth, and one Ro-Ro berth, and necessary ancillary installations including sheds, warehouses and other buildings; and (b) Dredging of an access channel and a turning basin.

The total cost of the Project is estimated at ¥63,000 million of which ¥44,000 million is the foreign exchange portion.

The tender document for the Project has been prepared by an American consulting engineer based upon Japanese and Dutch proposals and the invitation for tenders was issued on 20 April 1978 and the closing date for the tender is 31 August, 1978.

The tender is for a turn-key contract and the tender has to propose the layout, detailed engineering design as well as the cost for the works. The specifications in the tender document, however, are relatively specific and, considering natural conditions at the site, little room for variation in design is left.

Construction work on the Project is expected to commence in early 1979 and should be completed within 30 months.

Onne is located near Port Harcourt, which is the second largest port in Nigeria, in the Rivers State. The Project site is located on the Bonny river, which is of the branches of the Niger river. Due to economic development and population growth, cargo traffic through the Port Harcourt wharf has increased substantially in

the last 5 years. Over 14 percent of Nigerian foreign trade (excluding oil), of 1.6 million tons per year, is presently handled at Port Harcourt. The wharf length at Port Harcourt is only 1,300 meters, including the coal handling berth and oil berth. Consequently, the existing wharf facilities are inadequate to cope with the critical congestion. Ships waiting for the berths always number 50 to 70 outside the river and thus cause serious loss to the Nigerian economy.

In the Third National Development Plan 1975-80, development of a new port complex in the vicinity of Port Harcourt is proposed. At the suggestion of Japanese and Dutch engineers, the NPA has decided on the construction of six berths at Onne.

The Mission confirmed the need for a new port facility in the vicinity of Port Harcourt and also confirmed that the site at Onne is suitable for the purpose.

The Nigerian Port Authority, a government statutory body, is the directly responsible agency for both construction and operation of ports in Nigeria. The NPA will excecute the Project with it's own engineering staffs, with the assistance of C-E Tec and other consulting engineer(s).

The cost estimates for the Project were prepared by the Mission, based upon the tender document and other information.

II. INTRODUCTION

The Federal Republic of Nigerian Government has decided to develop a new port complex at Port Harcourt, where the second largest international trading port in the country is, in order to resolve serious port congestion and to facilitate the development of the Eastern Region.

Originally the Project was to be financed by the Nigerian Government's own resources, but with the decline in foreign currency reserves in recent years due to the slackening of oil exports, the Nigerian Government made a request to the Japanese Government for financial assistance for the Project.

The Project is considered as one of the prospective projects for economic co-operation because it has not only great impact on the Nigerian economy, but also an important role in the maintenance and development of friendly relations between Nigeria and Japan. The Government of Japan, however, is not in a position to make the final decision on the financial assistance for the Project, since no Project cost or loan amount was officially presented by the Nigerian Government.

The Nigerian Government considers that if the Project, which is considered to be most urgent, follows normal procedure through feasibility study (F/S), detailed engineering design (D/D) and tender, it will require a considerable period of time; and if the project is executed by means of international tender on a turn-key basis, and by evaluation of the tender, the design and the method of works, the costs and the construction period, the most suitable plan and work can be guaranteed.

An engineering feasibility study for the Project has already been made and submitted to the NPA by Toa Harbor, OCDI group, one of the potential bidders of the Project.

NEDECO (Dutch consulting engineers) have also submitted their study to the NPA. Subsequently, the NPA has requested C-E Tec Inc., American consulting engineers, to generalize the proposals into a specification for the Project. An invitation for tenders for the Project was issued on 20 April, 1978.

Under these circumstances, the Government of Japan has dispatched a mission to Nigeria in order to confirm it's feasibility, based upon the official information of the Nigerian Government. The Mission stayed in Nigeria from 23 April, 1978 to 8 May, 1978 and made contact with and exchanged views with the officials concerned from the NPA, the Ministry of Transport, the Ministry of Finance and the Ministry of Industry etc.. The Mission also visited the C-E Tec Inc., in Waltham, Massachusetts, USA and collected additional information.

The Mission examined technical, administrative, operational and economic aspects of the Project and found the Project to be technically sound and economically justificable.

This Report is based on the findings of the Mission which was composed of Messrs. T. Hirota (Mission chief, Director, Social Development Cooperation Department, Japan International Cooperation Agency), K. Tabata (Cost evaluation engineer, Chief engineer, Japan Port Consultants), Y. Yabe (Port planning engineer, Ministry of Transportation) H. Nishijima (Economic analyst, Japan International Cooperation Agency).

III. BACKGROUND

A. General Economic Development of Nigeria

The population of Nigeria is estimated to be 77 million, 1/ which is the largest among African countries. It's GDP in 1976/77 was estimated to be N16,000 million at 1974/75 prices or $26,700 million. Therefore, per capita income is still less than $350.

The GDP has been greatly dependent upon crude oil production in recent years. After the oil crisis in 1973, receipts of foreign currency increased sharply due to oil sales. Accordingly, the Government of the Federal Republic of Nigeria took a bold decision to make use of this opportunity to develop the economy by construction of infrastructures throughout the country.

In the third National Development Plan 1975-1980 the Government contemplated major construction projects for highways, railways and other sectors including port development schemes in Lagos, Rivers 2/ and Delta ports. 3/

At the early stage of the Third National Development Plan, most projects were financed by Nigeria itself. At the end of fiscal year 1976/77, however, circumstances changed due to the slackening of oil exports and excessive imports of consumer goods and construction materials. Thus the Government has tightened it's foreign exchange control and, the same time, has started seeking financial assistance from abroad, either from bi-lateral or multi-lateral sources.

Even though the Government has slowed down the tempo of development projects, port projects remain as exceptions. This is because the state of congestion in the ports in

1/ No official census has been made since the 1963 sensus which counted 54 million.

2/ A group of ports in Rivers State, see Table III-1.

3/ A group of ports in Bendel State, see Table III-1.

Nigeria is extremely serious and causing a bottleneck to the major development projects in the country.

B. Ports in Nigeria

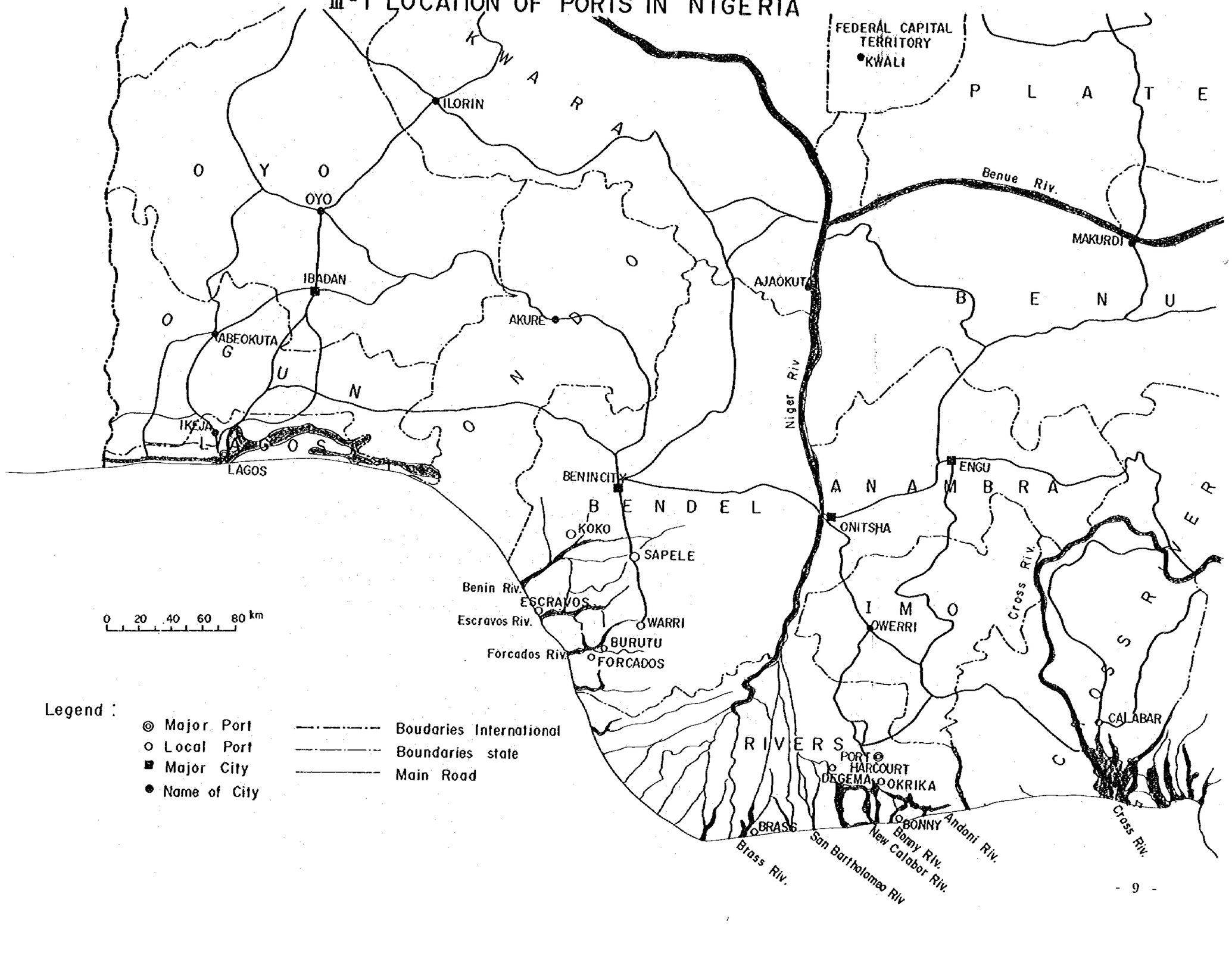
The Nigerian coast faces the Gulf of Guinea on the Atlantic coast of West Africa. The western half of it's coast is sandy beach, with no major inlet, except for some river mouths and lagoon entrances. In one of the lagoon entrances, the port of Lagos is located and this is the only port capable of accepting ocean-going vessels on the western coast of Nigeria. The south-eastern part of the coast borders the swampy delta of the river Niger, which bulges into the Gulf of Guinea.

Ports on the Niger delta area are divided into three groups; namely, Delta ports in Bendel State such as Warri, Koko and Sapele, River ports in Rivers State such as Port Harcourt and Bonny and Calabar in Cross River State.

Table III-1 Ports in Nigeria

Name of Ports		Main Cargo
Name of Port Complex	Name of Port	
Lagos	Apapa wharf	General cargo, Container cargo, Grain, Plant oil, Fish
	Tin-Can Island	General cargo, RO/RO cargo
	Kirikiri lighter wharf	Cement, General cargo
	Ikoroclow lighter wharf	Cement, General cargo
Rivers	Port-Harcourt	General cargo, Container cargo, Grain, Plant oil
	Bonny	Oil
	Okrika	Oil
	Degema	Oil
	Brass	
Delta	Wari	General cargo, Container cargo
	Sapele	Timber
	Koko	General cargo
	Burutu	General cargo, Plant oil
	Escravos	Oil
	Forcados	Oil
	Pennington	Oil
Calabar		General cargo, Bulk cargo, Plant oil

III-1 LOCATION OF PORTS IN NIGERIA



C. Port development in Nigeria

In the Third National Development Plan 1975-80, a total capital expenditure of N322 million is envisaged for the port development programme in the Plan period. This programme includes:

(1) Lagos/Apapa Port

Development of six additional berths at Apapa including a container terminal, four transit sheds, four warehouses, and the purchase of mechanical handling equipment.

(2) New Ocean Terminal

Development of an alternative port to Lagos, during the Plan period. This covers the construction of at least six berths and ancillary facilities such as road and rail links.

(3) Warri and Calabar Ports

Construction of four berths in each port with a dredged depth of 9.5 meters at Warri and 7 meters at Calabar.

(4) Port Harcourt

This project is aimed at providing four berths at a new location in the Trans-Amadi area. The total estimated cost of the project is N65 million, but N40 million will be disbursed within the 1975-80 Plan period. A total of 1,000 meters of quay length will be developed.

(5) Port of Koko

Extension of the existing deep water facilities to provide an additional 300 meters of deep water berthing facilities and another 300 meters of shallow draught wharf for fishing vessel berthing.

(6) Other facilities, including development of dockyards, petroleum jetties and bulk handling facilities for cement and coal.

This programme has been amended and several projects have been added to the original programme. Among them, the construction programme of ten berths at Tin Can Island, Lagos with its cost of N189 million was added.

Except for the projects of New Ocean Terminal, Port Harcourt and some minor items, other construction works have started or are going to be started. The construction of Tin Can Island has been made with remarkable speed and it's berthing facilities were opened for public use in October 1977 after a 15 month construction period.

Actual construction costs in each project do not tally with the cost allocation in the Third National Development Plan. For instance, Warri had an allocation of N27 million in the plan but the actual contract price become N95 million. Actual budget allocation can be made with considerable flexibility.

IV. PORT HARCOURT

A. General

Port Harcourt is located on the eastern edge of the Niger delta and is the second largest port in Nigeria. It is not only the center of the River State but also the commercial center of nine Eastern States where about 40 percent of the total population is. Port Harcourt is approached by highway, railway and waterway. The highway is relatively well developed and the distance to Lagos from Port Harcourt is 689 km. The railway runs only towards the northern city of Kaduna and there is no direct connection to Lagos parallel to the coast.

The Bonny river approach, about 60 km in length, is obstructed by a bar which, by constant dredging, is maintained at 8 meters at MLLW. Virtually no maintenance dredging other than at the bar is required in the Bonny river.

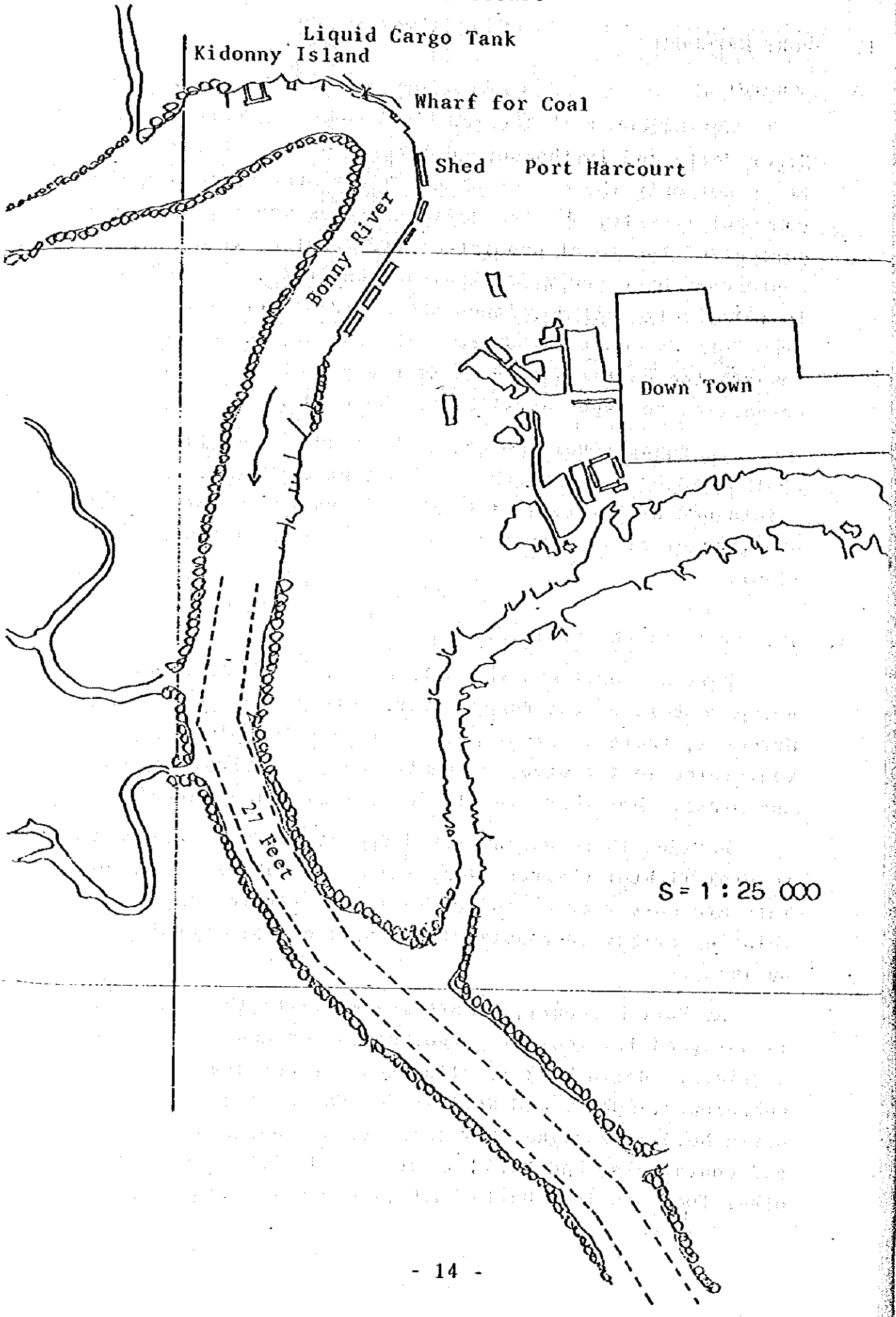
B. The Ports on the Bonny River

Port Harcourt has the only public berths for ocean going vessels on the Bonny River. Other than Port Harcourt, there are four ports, or berthing places, registered in the River; namely, Bonny, Okrika, Degema, and Brass. But they are all for oil handling purposes.

Besides these berths for deep sea vessels, there are several lighter wharves along the east bank of the river. They are mostly owned and operated by private companies relating either to construction works or ship repair business.

At Port Harcourt, 9 berths are available. Berth No.1 is assigned for general cargo, container and automobile carriers. Berth No.2 is allocated for European conference, COWAC, and No.3 is for UK conference, UKWAL. Berth No.4 is assigned for ships to discharge grain, steel and containers, and No.5 is for tinned milk sugar and other food stuffs. Berth No.6 is exclusively used for the

IV-1 Port Harcourt



loading of mainly agricultural products and No.7 is assigned for the West African coastal ships, cement and lighter discharge. Berth No.8 is used for coal export and No.9 is for oil loading and lighter handling.

The lengths of the berths are relatively short. They are 150 meters each for No.1 to No.3, 189 meters for No.4, 123 meters for No.5, 132 meters for No.6 and 7, 135 meters for No.8 and 141 meters for No.9. Available depths of water along the berths are 7.8 meters throughout No.1 to No.7 and 7.5 meters at No.8 and 9.

Ships are allowed to discharge at the anchorage of Dowes Island where 10 berthing spaces are available and one mooring bouy berth in front of the main quay. The lighter operation is restricted to steel, cement, containers and other bulk or uniform cargo, other than general cargo.

C. Port congestion at Port Harcourt

Congestion of the port is serious. The average number of vessels waiting for berths outside the bar is counted at 50 to 70. Particularly those vessels waiting for No.1 have to wait 4 to 8 months. The vessels calling for No.2 and 3 have less waiting time (one to two weeks) due to adjustment in the ships schedules.

Such congestion is caused by inefficient cargo handling and absolute lack of port facilities. With regard to cargo handling efficiency, average through-put is 1,500 tons per day per ship for steel discharge and 500 tons for general cargo. This is considered to be less than half of the through-put for efficient ports.

This inefficiency in operation is not only due to slow discharge but also due to inadequate facilities and operations on shore. The storage space in both transit sheds and warehouses is insufficient (28,545 m^2 for transit sheds and 12,487 m^2 for warehouses). Untidy overdue cargoes are placed inside the sheds and warehouses,

as well as on the apron and open spaces, thus hampering the operation of the port.

Berth occupancy rate at the wharf is practically 100 percent and no time is available to arrange quay space and sheds for the next ships.

Taking into consideration the inadequate facilities and the excessive berth occupancy rate at Port Harcourt wharf, optimum capacity, under reasonable conditions and efficiency, will be 1.2 million tons per annum.1/

1/ See Annex I.

V. PORT HARCOURT TRAFFIC AND NEED FOR NEW FACILITIES

A. Past Traffic

Over 90 percent of total cargo handled in all Nigerian ports, except for oil export, is concentrated in the two major ports of Lagos and Port Harcourt. While Lagos takes 77 to 80 percent of the total traffic, Port Harcourt takes 14 percent.

General dry cargo traffic handled at Port Harcourt has increased by over 2.3 times in the past five year period from 697,000 tons in 1972/73 to 1,615,000 tons in 1976/77. The increase in tonnage handled has entirely been due to the increase in the volume of imports, mainly consumer goods, foodstuffs, automobiles, other machinery, cement and other materials for construction works.

Exports, which primarily consist of agricultural produce such as peanuts, cotton seeds, shear nuts etc., have been unchanged or rather have shown a slight decline in the same period. This is partly because the price of such goods does not have sufficient international competitive power and partly because the extreme port congestion has discouraged ships from waiting for additional days at the port for loading of less attractive cargo such as agricultural products.

Table V-1 Cargo handled at ports in Nigeria

Unit 1,000 ton

Year	Lagos			Port-Harcourt			Delta			Calbar			Total		
	import	export	total	import	export	total	import	export	total	import	export	total	import	export	total
1972/73	3,681	939	4,620 (81.6)	480	217	697 (12.3)	255	27	282 (5.0)	15	47	62 (1.1)	4,431	1,230	5,661
1973/74	4,320	1,053	5,373 (82.1)	628	159	787 (12.0)	291	33	324 (5.0)	17	41	58 (0.9)	5,256	1,286	6,542
1974/75	4,660	566	5,226 (77.7)	789	144	933 (13.9)	402	34	436 (6.5)	80	47	127 (1.9)	5,931	791	6,722
1975/76	6,460	583	7,043 (75.9)	1,198	162	1,360 (14.6)	674	10	684 (7.4)	153	45	198 (2.1)	8,485	800	9,285
1976/*77	8,511	601	9,112 (77.0)	1,475	140	1,615 (13.6)	833	12	845 (7.1)	224	38	262 (2.2)	11,043	791	11,834

Note: 1) Oil export excluded

2) ( ) : percentage of total cargo

3) * : temporary statistics

Source : The Nigerian Ports Authority

B. Future Traffic

Even though construction projects in other Delta ports at Warri and Koko are going to be implemented, the burden on Port Harcourt will not be reduced owing to the fact that Port Harcourt is the center for the Eastern Region and the gate way to the North Eastern States by connections with the railway, highway and river transport.

A new scheme for steel mill at Ajaokuta has meant additional requirement for cargo handling capacity at Port Harcourt. An integrated steel project to construct a blast furnace complex at Ajaokuta with a capacity of 1.5 million tons per annum has been contemplated by the Nigerian Iron and Steel Authority. Ajaokuta is approximately 300 km upstream on the river Niger, the sites of the discovery of high grade iron ore and cokable coal respectively. In the Third National Development Plan 1975-80, a tentative allocation of N800 million has been made for the Authority's programme. The time schedule of implementation shows that test runs should be completed before the end of 1980. It is also expected in the Plan that commercial production will commence within the Plan period.

The actual time schedule for the steel mill project, however, indicates some delay from the original plan. According to the river transportation schedule,[1/] specially made for Ajaokuta Project, the construction period of the plant continues from 1977 to 1983 for its first stage. The peak period of construction materials transportation is from 1979 to 1982. In the mean time the Niger river, where Ajaokuta is located, is being dredged by a Dutch contractor and will be completed by the end of fiscal year 1978/79 with a minimum allowable depth of the channel at 1 meter in the dry season.

Assuming the future cargo increases as is required, the volume of traffic is estimated as shown in the table

1/ See Annex II.

Fig. V-1 Forecast of general cargo traffic in Nigeria

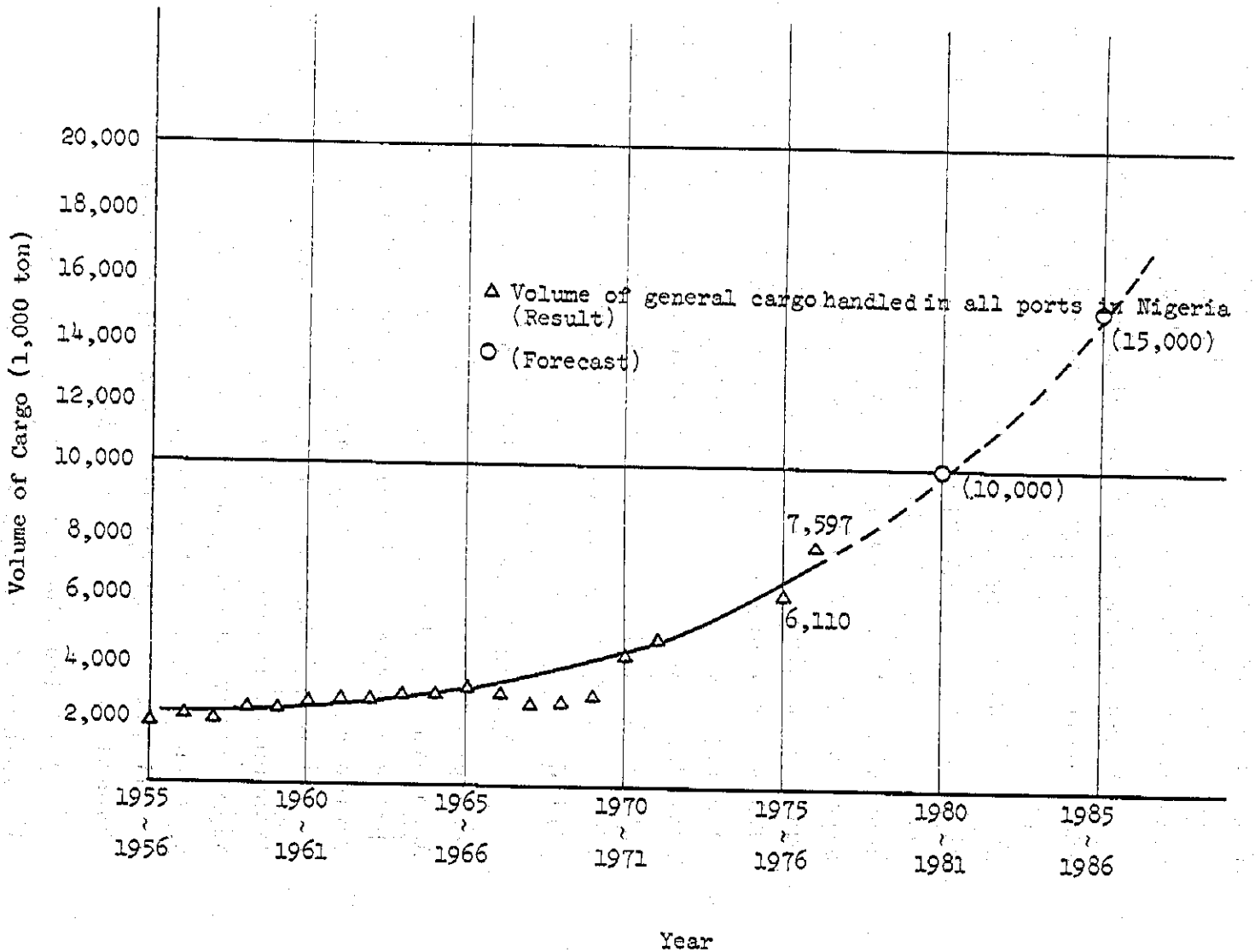


Table V-2 Forecast of cargo traffic at Port-Harcourt

(Unit: 1,000 ton)

Year	Cargo	Total	Present Port-Harcourt	Onne
1980/81	General cargo	1,800	1,200	600
	Container (RO/RO) cargo	200	0	200
	Coal	1,500	0	1,500
	Total	3,500	1,200	2,300
1985/86	General cargo	2,400	1,200	1,200
	Container (RO/RO) cargo	600	0	600
	Coal	1,500	0	1,500
	Total	4,500	1,200	3,300

V-2. In this estimate, the volume of general cargo is calculated in relation to the growth of GDP excluding the oil sector. Besides the general cargo, export of coal is estimated in this area. A coal mine is located at Enugu 180 km north or Port Harcourt. The coal has been exported from Port Harcourt. Export of coal has declined because its main purpose was for bunkering of vessels. In the Third National Development Plan, the prospect for coal export seems to be bright owing to the recovery of the world demand for non petrolic fuel and in 1980 export of 1.5 million tons of coal is expected. This estimate is, however, considered to be optimistic after the slackening of the oil market in recent years.

On the other hand, the steel mill project may generate demand for bulk cargo through the Port Harcourt area. Theoretically the steel mill at Ajaokuta will be self-sufficient for iron ore and coal. However, some amount of high grade cokable coal and other materials may be required from other sources. Consequently, even if 1.5 million tons of coal export may be optimistic, the need for a bulk handling berth for multipurposes will still be justifiable.

With regard to container traffic in the Port Harcourt area, the volume of the containers is still insignificant in the order of ten thousand tons in 1976/77. Considering a sharp increase of container traffic at Lagos, where still only 6 percent of the total volume of the general cargo was containerized in 1976/77, with the completion of adequate facilities, 20 percent containerization at Port Harcourt in 1985, including Roll-on Roll-off, may not be excessive.

C. Need for Onne new port and it's traffic

As indicated in the traffic projection, the volume of cargo through Port Harcourt may reach 4.5 million tons assuming the handling capacity is sufficient. Since the actual optimum handling capacity at Port Harcourt is, as described before, only 1.2 million tons, additional capacity should be created by a new port complex. Therefore, the new port at Onne, approximately 20 km downstream of the existing port at Port Harcourt, should handle cargo of 3.3 million tons in 1985, of which 1.2 million tons may be general cargo, 0.6 million tons may be containers or Roll-on Roll-off cargo and 1.5 million tons will be coal and other bulk cargo.

VI. THE PROJECT

A. Project Description

The Project Comprises: 1/

(a) The construction of three general cargo berths of 250 meters length each and a designed dredged depth of 12 meters with a dredged depth of 9 meters at MLLW. Each berth shall be serviced by a paved open-stacking area of 25,000 square meters, a 7,000 square meters transit shed and a warehouse having the same dimensions as the transit shed.

(b) The contruction of a container berth of 250 linear meters and a designed dredged depth of 12 meters with a dredged depth of 9 meters at MLLW. The berth shall be serviced by a paved open stacking area of 100,000 square meters minimum in addition to the wharf area.

(c) The construction of a Roll-on Roll-off berth with a minimum length of 215 meters and designed dredged depth of 12 meters with a dredged depth of 9 meters at MLLW. The berth shall be serviced by a paved open marshalling area of 100,000 square meters minimum.

(d) The construction of a bulk cargo berth with a minimum length of 200 meters and designed dredged depth of 12 meters with a dredged depth of 9 meters at MLLW. The berth shall be serviced by a paved stockpile area capable of storing the cargo of two vessels.

(e) Dredging of an approach channel from the Bonny River to the wharves. The minimum bottom width shall be 250 meters and dredged depth be 9 meters at MLLW.

(f) The turning basin shall be 9 meters in depth at MLLW and shall be a minimum of two times the length of the design ship plus adequate clearance from channel banks, harbor structures and berthed ships.

1/ Details of the specifications are attached in the Annex III.

(g) All the wharves, sheds, warehouses and open stacking areas shall be serviced by paved roads and railroads.

(h) The construction of miscellaneous buildings including the administration building, the central mechanical workshop, the canteen, the customs facilities, the control tower and other buildings and facilities.

B. The Project site

The Project site has been selected at Onne on the Bonny river and Ogu creek. Onne is 20 km south of Port Harcourt, which provides easier and shorter access for the ocean going vessels than the existing wharf at Port Harcourt. The Bonny river is one of the branches of the Niger delta, but has no direct connection with the main stream of the Niger river. This makes the river water entirely free from suspended silt from the upper Niger river. Therefore, no flood has been experienced along the Bonny river.

Even though no silt suspension occurs in the river water, some maintainance dredging is carried out continuously at the estuary. This is mainly because of littoral drift caused by the monsoon. The present volume of maintenance dredging is estimated to be 400,000 to 600,000 cubic meters a year and the channel depth is maintained at 8 meters at MLLW. The river water is mixed with sea water and changes it's level according to the tide.

The Project site is to be determined within a large area of mangrove-covered marsh of some 12 square km in an area which is served by a paved road from Onne toward the Diving school at Ogu creek. The land has already been acquired by the NPA and no dwellings or cultivated fields exist there. At the end of the paved road from Onne village to the Diving school, a lighter wharf of 1,366 meters in length and dredged depth of 3.6 meters at MLLW, is under construction and it will be completed in September 1978.

Soil conditions at the Project area are alluvial deposits with some soft silt deposit on top of the sand stratum. Thickness of the silt is 18 meters at bore hole No.8 and gradually decreases towards the West and North. Along the paved road from Onne, silt is almost non-existent and the sand stratum is exposed on the surface.[1/]

1/ Annex IV and Annex V.

C. Cost Estimates

The total estimated cost of the Project is as shown in Table VI-1.

The foreign currency portion includes directly imported materials, equipment and plant, the direct overhead and profit of the foreign contractor. Construction materials such as cement and steel, electrical fitting including the generator, water supply and miscellaneous hardwares for the buildings are also imported. The total foreign currency component for the Project will be 70 percent.

The construction equipment, including dredges, is not sufficiently available locally. Due to the special nature of the Project and the relatively limited period of work, the contractors will be required to furnish their own equipment from abroad.[1/]

1/ See Annex VI

Table VI-1 Cost Estimates of the Project

(¥10,000,000)

Item	Local	Foreign	Total
I. Civil Works	11,782	25,326	37,108
1. Earth Works, Roads etc.	4,061	4,554	8,615
2. Dredging	3,999	10,370	14,369
3. Pier Construction	3,258	9,894	13,152
4. Railroad etc.	464	508	972
II. Buildings & Sheds	2,554	6,383	8,937
1. Sheds & Warehouses	1,117	3,295	4,432
2. Other Buildings	1,437	3,088	4,505
III. Utilities	798	2,056	2,854
1. Drainage etc.	353	566	919
2. Water Supply etc.	228	420	648
3. Electrical Installation etc.	217	1,070	1,287
IV. Equipment & Plant	653	2,306	2,959
1. Navigation Aid	31	229	260
2. Port Equipment	622	2,077	2,699
V. Design Fee	21	521	542
Total (I ~ V)	15,808	36,592	52,400
VI. Contingency	3,162	7,318	10,480
Total (I ~ IV)	18,970	43,910	62,880
Approximately	19,000	44,000	6,300

D. Engineering

An engineering feasibility study for the Project has been made and submitted to the NPA by Toa Harbor & OCDI group, one of the potential bidders for the Project. The study covered some soil information and preliminary engineering design. NEDECO (Dutch Consulting Engineers) have also submitted their concept plan to the NPA.

The NPA has requested C-E Tec, American consulting engineers, to generalize the proposals into a specification of the Project. In the mean time, further soil survey is being undertaken by a local engineering firm and it's results may be made available to the tenders in June 1978.

An Invitation for tenders for the Project was issued on 20 April, 1978. In the invitation, the closing date for the tender is set for 31 August 1978.

According to the conditions of the contract, the engineer of the Project is the Assistant General Manager of the NPA, and C-E Tec International, Inc., or any other firm or person appointed from time to time by the NPA may act as the Consulting Engineer to the Project.

The tender, according to Nigerian practice, is on a turn-key basis and the contractor has to work out the detailed engineering design according to the specifications. In principle, a turn-key contract contains more unknown factors and the contractors tend to include a safety margin in the tenders for unforeseeable risk. But the NPA considers this method is more economical because it can reduce the preparation period for the construction by at least one or a half year compared with the normal practice of F/S, D/D and tender.

E. Design concept

Although a detailed engineering design has not been prepared at this stage, the specifications of the Project are fairly specific and little room is left for alternatives to the basic design concept.

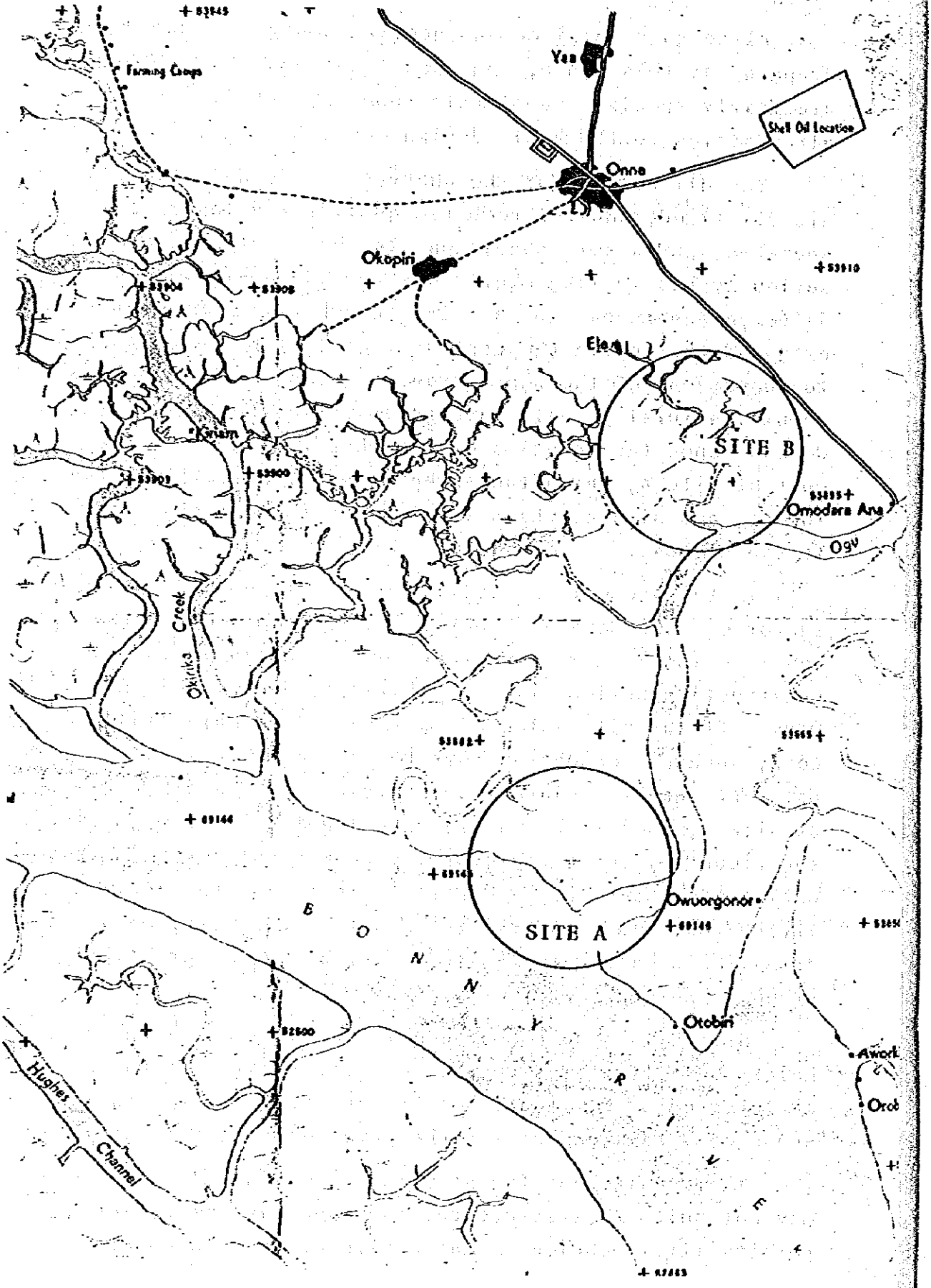
The dimensions for the wharves, sheds and warehouses are all fixed, and the required quality and load are specific. Even soil conditions in the worst area are not seriously bad for the wharf construction design. The difference between the cost for the wharf in the worst area and the one in the best area may not be more than 10 to 20 percent of the wharf structure cost. The dredging volume, naturally, will have great variation and it depends upon the location of the wharf. Therefore the cost at site A, which faces the Bonny river, will be the lowest, and site B, which is close to the existing road, is the highest.

In this tender, however, the cost is not the primary factor of consideration, but the time required for the construction is more important for evaluation. The construction period will be mainly decided by the land work. If the site selected is site B, the major land work, such as foundation work for the buildings and pavement, can immediately be started. On the other hand, at site A, almost the entire site requires improvement of the ground by some means, or replacement of soil over the entire area, and the land work can only be started afterwards. Subsequently the Mission considers, on a prima facie basis, that site B will be more a practical proposal for this Project.

Site B is also supported by the requirement for a maintenance-free area in the specifications. If the site is selected at A, ground settlement after completion and subsequent maintenance for the pavement cannot be avoided.

The requirement for no maintenance for the structure may not suit steel structures for the quay wall. Which permits little choice in the design other than concrete

Fig. VI-1 SITE OF THE PROJECT (A, B)



deck on concrete piles. The structures other than the quay wall have even less choice in design. Consequently, the results of the cost estimates should not be radically different regardless of the non-existence of a detailed engineering design.

With regard to the structural type of the proposed wharves, several types can be listed as prevalent structural types for deepsea wharves, such as steel sheet pile, caisson and relieving platform types.

The steel sheet pile type has the advantage of higher adaptability compared to the other two types, to adverse foundation soil conditions, greater ease of construction and shorter construction time involved. In this project, which calls for an initial depth of -9m alongside the proposed wharves and for the increasing of the depth to -12m in future periods, the steel sheet pile type would offer another advantage in that it will suffice to increase the initial depth as necessary, as long as provision is made for the necessary embedded length and cross-sectional dimensions of sheet piles.

On the other hand, this type of wharf is disadvantageous in that it will require some type of corrosion control system which may entail more or less annual costs. The technical specifications for the project construction require that the proposed wharves be of such construction as to dispense with maintenance for a period of two years after completion. For this reason, the steel sheet pile type must be ruled out for the proposed wharves.

Apart from this, despite it's obvious cost-saving advantages in many wharf construction projects, the steel sheet pile type might not necessarily be an economical choice in this project, since nearly all the construction materials required would have to be imported.

A caisson type wharf presupposes favorable soil conditions, as it is essentially of gravity type

construction. The definite advantages of this type, as compared with the types using steel members, are that it has a much longer service life and can depend largely on domestic supply sources for construction materials involved. In the construction aspect, however, the caisson type wharf demands a rather complicated and prolonged process. Normally, the operations involved in caisson type wharf construction comprise the manufacture of caissons, construction of a rubble mound their installation and filling, and construction of the superstructure, all to be performed in that sequence. An on-shore caisson yard equipped with a slipway or floating dock is required for the manufacture and launching of caissons. The construction of a caisson yard usually takes more than a year's time and floating docks for such purposes have a limited manufacturing capacity.

If caissons are to be used to build the proposed wharves with a combined length of approximately 1,500m, a total of about 150 units are needed. If two 2,000-ton capacity floating docks are used to produce these caissons, the manufacturing process alone will take a total of 37.5 months, assuming that each dock is capable of turning out two units a month. Three floating docks would require 25 months to complete all the caissons required.

Apart from the caisson manufacture, the leveling of the rubble mound is often a restrictive factor in the whole construction works. In view of the time factor in the present project, the caisson type must also be ruled out for the reasons noted above.

The relieving platform type is as common a choice for wharves as the steel sheet pile type. It can adequately cope with rather adverse soil conditions by employing piles of greater rigidity. Another advantage of this type is it's high earthquake resistivity. In recent years, it is a common practice to use steel pipe piles for the sub-structure of a deepwater wharf of the relieving platform type, and this has it's own merits.

For the wharves of this project, however, it is not preferable to use steel products as the main structural members, for the reasons earlier explained. Prestressed concrete piles are sometimes a substitute for steel pipe piles for the relieving platform type wharf. However, the prestressed concrete piles have some technical problems, such as the difficulty in providing good joints and in dealing efficiently with changing depths of the final point of rest of pile toes. For the reasons noted above, the prestressed concrete pile foundation is considered unfit for this project because of the time considerations.

In order to satisfy the requirements of the technical specifications for the project construction, an arrangement is proposed whereby steel pipe piles 8mm thick will be driven first to serve as casing and after removing the material inside, reinforced concrete will be placed in dry in the casing pipes to form in-situ concrete piles. Using steel pipe piles as casing pipes may seem to be an uneconomical method. However, it has the following merits:

1) The steel pipe piles used as casing pipes can readily be cut or spliced if the pile toes go beyond the specified point of rest or do not reach it.

2) Scaffolding and shuttering can readily be welded onto the surfaces of steel pipe piles.

3) A shorter construction time can be achieved.

Because of these advantages, the proposed in-situ concrete pile foundation using steel casing pipes is evidently a better choice than other types of in-situ concrete piling, such as those executed under the reverse circulation method. The in-situ concrete pile foundation as proposed for this project is adopted for the wharves at Apapa near Lagos.

With a relieving platform type wharf, it may be unavoidably necessary to build slopes underneath the wharf according to the final planned depth alongside.

Batter piles are proposed for the container wharves and the bulk cargo wharf shown on the attached standard cross-sections, under the assumption that a large traveling crane will be installed to serve the wharves. However, only vertical piles are proposed for the general cargo wharves, since it will not require a large crane. The embedded pile length indicated on the drawings includes some allowance for safety, because adequate information is not available on the soil characteristics of the project site.

VII. THE NIGERIAN PORTS AUTHORITY — THE EXECUTING AGENCY

A. General

The Government of the Federal Republic of Nigeria established the Nigerian Ports Authority (NPA) under supervision of the Ministry of Transport in April 1955. The NPA has jurisdiction over all ports, navigation channels, pilot services and navigation aids in Nigeria. The NPA is an autonomous body and is supposed to be financially independent from the Government. But in practice, funds for the major works under the Authority are assisted by the Federal Government as loans to the NPA.

B. Organization

The specific functions of the NPA are as follows:

(a) to maintain or provide for the maintenance of adequate and efficient service and facilities for all users of the ports.

(b) to handle cargo and ships at the port and to co-ordinate the activities of the ports.

(c) to be responsible for the improvement and development of the ports. It has the power to purchase, acquire, manage and dispose of immovable and movable property and execution of works.

The NPA has a Chairman, who is appointed by the Federal Government. And under the chairman there is a Board of Commissioners to advise on it's policy matters. The day to day operation matters come under the direct responsibility of the General Manager of the Authority and he is assisted by five Assistant General Managers, they are responsible for engineering service, development & management service, operating & marine service, finance and administration respectively. Each port district has it's port manager who is responsible for the routine management of the ports within his district.

VIII. ECONOMIC BENEFITS

The Project is not only essential to the growth of the economy of the Eastern States of Nigeria but also effective for other parts of the country due to the fact that the lack in capacity at Port Harcourt puts extra burden on Lagos and other ports.

At present, ships calling at Port Harcourt have to wait for berths for an average waiting time of a few days for European and UK conference and of 4 to 6 months for other lines and tramp ships. This is still less than the situation in 1974/75 when the number of waiting vessels was counted at 500 to 700 at a time in Nigerian waters, and waiting time exceeded 10 months. This extraordinary situation was caused by a sudden expansion of the Nigerian economy after the rise in oil prices in 1973.

Accordingly, NPA negotiated with various conference lines and major shipping countries, to adjust the number of vessels calling in Nigeria. Thus the number of ships calling in Nigeria has been artificially reduced in due course. Therefore, the number of waiting vessels may not decrease with minor improvement in berthing facilities because the artificially suppressed demand shall recur immediately.

The cost of a ship waiting for a berth is, on average, ¥1,600,000 per day. This is not the cost merely borne by the ship owners, but it affects the freight rate and thus inflates costs of imported merchandise and reduces the competitive power of export goods on the international market.

As the Nigerian economy grows, demand for trade increases and traffic through Port Harcourt wharf cannot be improved by means of developing a new port complex at Onne, ship waiting time will become impossibly long. Usually, before the waiting time reaches an extreme, certain measures are taken. And some such measures have

already been taken, such as adjustment to ships schedules and some diversion of cargo to Lagos etc..

At Port Harcourt, remaining measures to ease the pressure of growing traffic will be the utilisation of lighters to handle more cargo and/or diversion of the ships to other ports in the country. But the latter is considered to be unrealistic because other ports are also suffering from serious congestion. Therefore, if the new port is not available, time-consuming and expensive lighter handling has to be increased, together with construction of the necessary length of lighter wharves.

Upon completion of the Project, on the other hand, such lighter operation will become unnecessary and the savings in cost will be part on the economic benefit of the Project.

Taking into account the facts mentioned above, against the investment cost, the internal rate of return is 19.9 percent. 1/

1/ See Annex VII

ANNEX

ANNEX I OPTIMUM CARGO HANDLING CAPACITY OF EXISTING WHARF AT PORT HARCOURT

(1) Calculation of the capacity based upon transit sheds' space.

Optimum capacity for transit sheds' space is calculated by the following formula.

$W = A \cdot W \cdot \alpha \cdot \beta$ where A: transit sheds' space m^2
W: cargo volume ton/year
w: storage capacity per unit area ton/m^2
α: rotation per year
β: utilization factor %

assume w: 2.5 ton/m^2
α: 24
β: 0.7 %

∴ W = 28,545 x 2.5 x 24 x 0.7
= 1,199,000 ton/year

(2) Calculation of the capacity based upon berth length.

The following formula is applied for the optimum throughput for the wharf length.

$W = t.m.365\gamma$ where t: daily throughput per ship ton/day/ship
n: number of berths
γ: berth occupancy rate

assume t: 750 ton/day/berth
n: 8 berths
γ: 0.55

W = 750 x 8 x 365 x 0.55
= 1,205,000 ton/year

Consequently, optimum capacity of cargo handling at the existing wharf at Port Harcourt based upon an adequate discharge rate and operation will be 1.2 million tons per year.

ANNEX II

RIVER TRANSPORTATION SCHEDULE FOR AJAOKUTA IRON AND STEEL PLANT

The quantity of cargoes assigned for the first stage of construction of the Iron and Steel Plant will tentatively amount to 1.0 - 1.3 million tons while the maximum volume of supplies will amount to 250 - 300 thousand tons per year. The following is a tentative year-wise breakdown of the freight volume.

1977 - 20,000 tons
1978 - 70,000 tons
1979 - 200,000 tons
1980 - 250,000 tons
1981 - 300,000 tons
1982 - 300,000 tons
1983 - 60,000 tons excluding

cargoes assigned for the second stage construction.

Approximate list, weight and dimensions of the equipment which is to be transported and assemble is as follows:

No.	Description of equipment	Weight tons	Dimension m
1.	Charge distributor	62	Dia - 5.0 Height - 4.5
2.	Large bell with bar of charging	36	Dia - 5.4 Height - 4.0
3.	Charging device hopper	16.5	Dia - 5.4 Height - 4.0
4.	Charging device gas seal	21.5	Dia - 6.0 Height - 3.5
5.	Transformers 63 mVA	95.0	5.5 x 3.0 x 5.5
6.	Lower part of turbine L.P. casing	45.0	7.5 x 5.3 x 2.0

No.	Description of equipment	Weight tons	Dimension m
7.	Condenser	56.0	8.5 x 4.0 x 5.0
8.	Water heater	25.0	7.0 x 2.0 x 2.0
9.	Generator startor	78.0	5.5 x 4.5 x 4.0
10.	Boiler drum assembly	48.0	11.5 x 1.5 x 1.5
11.	Boiler exhaust fan	10.0	4.9 x 2.2 x 3.2
12.	1/4 of converter body	25.0	7.2 x 4.7 x 2.7
13.	Part of converter trunnion ring	87.0	12.2 x 3.5 x 4.3
14.	Part of converter trunnion ring	71.0	9.2 x 3.5 x 4.3
15.	Part of converter ASE	30.0	5.5 x 3.4 x 1.9
16.	Special reducer	66.0	4.9 x 2.9 x 5.3
17.	Steel casting ladle	20.2	4 x 4.7 x 5
18.	Hot metal ladle	19.2	3.8 x 4.7 x 3.75

Weight and dimensions of other large-size equipment will not exceed the ones mentioned above.

However long size equipment (bridges & semi bridges of overhead cranes, columns steel structures, trusses and crane girders) will be transported. The length of these specified equipment may reach 36 m.

NOTE: that the tentative schedule for the importation of the equipment has shifted from April 1977 by 6 months.

TABLE 1

TENTATIVE DISTRIBUTION OF THE EXTERNAL
FREIGHT TURNOVER OF THE IRON AND STEEL PLANT

Name of freight	Approximate tonnage/year	Kind of Packing	Delivered from	Remarks
Manganese ore	80,000	In bulk	Port Harcout	Imported
Bauxite	20,000	"	"	"
Quartzite	20,000	"	"	"
Ferro-alloys	10,000	In barrels	"	"
Absorbent solar oil	7,500	200 l. barrels	"	"
Billets for Rolling Mills	550,000	-	"	"
Coal tar pitch	700	In bags	"	"
Sulphite cellulose liquor concentrate	750	"	"	"

TABLE 2

PRODUCT-MIX FROM IMPORTED BILLETS BY 1981

Mills and Products	Size (mm)	Weight (kg/m)	Production tons/year
Light Section and Bar Mill			
Angle Irons	25 x 25 to 50 x 50	1.12 - 3.77	150,000
Strips	6 - 12 x 12 - 70	0.57 - 6.59	25,000
Hexagons	10 - 26	0.68 - 4.59	25,000
Squares	10 - 30	0.78 - 7.06	50,000
Rounds	10 - 30	0.62 - 5.60	50,000
T-beams	25 - 60		50,000
Channels	22 - 45		50,000
TOTAL			400,000
Wire-rod Mill			
Wire rod in coils	5.5 - 6.0diam		80,000
	6.0 - 10.0		20,000
	10.0 - 12.5		10,000
Reinforcement steel	6 - 12.0		20,000
TOTAL			130,000
GRAND TOTAL			530,000

CONSTRUCTION MATERIAL IMPORTATION

Total material importation envisaged for the steel plant is 561,000 tons and 10,000 m^3 of construction bricks.

Annual breakdown

MATERIAL	1979	1980	1981	1982	1983	1984	TOTAL
Steel structures	1.0	34.3	68.0	52.4	17.3	7.0	180.0
Refractory Bricks	-	15	20	40	15	-	90.0
Reinforcement	5.0	10.0	20.0	20.0	15.0	-	70.0
Cast iron Tubes	0.2	0.6	1.0	1.0	1.0	0.8	3.6
Steel Tubes	3.0	4.5	6.0	1.5	4.0	-	25.0
Cables	0.5	2.0	3.0	3.0	2.0	0.5	12.0
Tech. Equipment	4.5	15.0	40.0	65.0	56.0	1.0	181.0
TOTAL	13.7	81.4	158.0	188.9	110.3	9.3	561.0
Including Construction brick x 1000 m^3	1.0	1.5	2.0	3.5	1.5	0.5	10.0

ANNEX III

DESIGN SPECIFICATION

[TENDER DOCUMENT]

CONTENTS

DESIGN SPECIFICATION

I. APPROACH CHANNEL AND HARBOR

Scope. Adequate all weather channel access to the berths shall be provided including main channel for two-way traffic, turning basin, access fairways to the berths if required, and navigation aids for safe traffic under all conditions including night traffic. Detailed items to be included are as listed below:

A. Approach Channel

1. Dredge depth shall match existing Bonny River depths at the site, presently approximately 9 meters at MLLW.
2. The minimum channel width (toe of slope to toe of slope) shall be 250 meters.
3. Channel curvature shall be such that adequate sight distance is provided.

B. Turning Basin

1. The turning basin shall be 9 meters in depth at MLLW.
2. The size shall be adequate to permit unassisted turning of ships of the design size within the harbor. The turning basin shall be a minimum of two times the length of the design ship plus adequate clearance to channel banks, harbor structures and berthed ships.

C. Berth Fairways (If required)

1. Fairways to berths shall be of adequate size to permit one way tug assisted traffic to and from the berth.
2. Fairways shall be located to provide ample clearance to channel banks, harbor structures and berthed vessels.

D. Harbor Hydraulics

1. Channels and basins shall be properly sized and oriented to minimize adverse effects of waves and currents.

2. It is the Contractor's responsibility to obtain the required hydrographic data for his design.

E. Navigation Aids

Navigation aids shall be provided as necessary to enable ships to travel safely and rapidly under all conditions to their points of designation. They shall consist of floating and/or fixed water structures and/or shore mounted range light installations and shall be equipped with the necessary beacon lighting, bells, sound warning devices and radar relectors and shall require minimum maintenance.

Marine navigation lights shall be provided at each end of all piers, wharves, mooring dolphins and other fixed structures as required in order to outline their limits.

F. Dredging

The dredging under this contract shall match the existing Bonny River depth which is 9 meters at MLLW. All structures shall be designed and constructed for a future dredging depth of 12 meters at MLLW. Approach channel, turning basin and berth fairways shall be designed and dredged in such a manner and of such size that future dredging to 12 meters depth at MLLW will not involve widening of these areas or any additional work on the slopes.

II. GENERAL CARGO FACILITY

Scope. Three (3) General Cargo berths shall be provided. Each general cargo berth shall be 250 meters long, capable of accommodating a design vessel of 35,000 dwt contiguous to a wharf extending the full length of the berth with a minimum apron width of 100 meters. Each berth shall be serviced by a paved, open-stacking area of 25,000 square meters minimum in addition to the wharf area, and preferably contiguous to the apron. Provision shall be made in the design for each berth to be serviced by a railroad spur parallel with the wharf face. In all cases adequate allowance shall be provided for continuous flow of two way vehicular traffic to, from and within all the berths and supporting

facilities comprising the port. The apron shall contain a transit shed of 7000 square meters (175 m x 40 m) located 40 meters from the face of the wharf. Each general cargo berth shall also contain in addition to its open stacking area a warehouse facility having the same dimensions as the transit shed. Details of facility components are as follows:

A. Design vessel

1. Beam 30 meters
2. Draft 11 meters
3. Displacement 35,000 dead weight tons

B. Berth Characteristics

1. Length 250 meters
2. Width 35 meters
3. Dredge depth 9 meters at MLLW, design dredge depth 12 meters at MLLW
4. Capable of tug assisted approach
5. Berthed ship shall not encroach upon channels, fairways and turning basins or operations of other ships
6. It is preferred that all general cargo berths be adjacent to one another and form a straight and continuous wharf face.

C. Wharf Characteristics

1. Length 250 meters
2. Apron width 40 meters
3. Deck Elevation +3.5 meters

D. Open Stacking Area

Each berth shall be supported by an open paved stacking area of 25,000 square meters, preferably contiguous to the apron. The open stacking area shall be level and shall be constructed so that the time of acceptance all major settlements have occurred.

E. Railroad Spur

Provision shall be made in the design for a standard gage railroad spur flush with the deck surface parallel to wharf face and within

reach of ship's gear. A railroad spur shall also be provided to the warehouses.

III. CONTAINER FACILITY

Scope. One container berth 250 meters long capable of accommodating a design vessel of 40,000 dwt and contiguous to a wharf exten full length of the berth with a minimum apron width of 40 meters shall be provided. Initially the berth shall be serviced by a paved and drained open stacking area of 100,000 square meters minimum in addition to the wharf area, and preferably contiguous to the apron. Adequate allowance shall be provided for continuous flow of two way vehicular traffic to, from and within all the berths and supporting facilities comprising the port. Details of the facility components are as follows:

A. Design Vessel

1. Beam 30 meters
2. Draft 11.5 meters
3. Displacement 40,000 dead weight tons

B. Berth Characteristics

1. Length 250 meters
2. Width 35 meters
3. Dredge depth 9 meters at MLLW, design dredge depth 12 meters at MLLW
4. Capable of tug assisted approach
5. Berthed ship shall not encroach upon channels, fairways and turning basins or operations of other ships
6. It is preferred that all container berths in the future be adjacent to one another and form a straight wharf face.

C. Wharf Characteristics

1. Length 250 meters
2. Apron width 40 meters minimum
3. Deck Elevation +3.5 meters

D. Special Requirements

1. Railroad Spurs

Provision shall be made for standard gage spur to properly transfer material from connecting networks to the stacking area. The spur shall not interfere with traffic flow or operations within the open stacking area. In addition, provide a standard gage railroad spur flush with the deck surface parallel to the wharf face within the reach of the container crane.

2. Open Stacking Area

The berth shall be supported by an open paved and drained stacking area of 100,000 square meters, preferably contiguous to the apron. The open stacking area shall be level and shall be constructed so that at the time of acceptance and use all major settlements have occurred. The open stacking area shall be paved adequately to support containers.

3. Container Crane

Provide for container crane installation at some stage within the construction period. The gage to be in accordance with the manufacturer's specifications.

4. Electric Power

Provisions shall be made in the open stacking area to accommodate refrigerated container units.

IV. ROLL ON - ROLL OFF (RO/RO) FACILITY

Scope. One Roll on - Roll off berth shall be provided. The RO/RO berth shall be 250 meters long and capable of accommodating a design vessel of 40,000 dwt contiguous to a wharf or pier of sufficient dimensions to receive ramps of RO/RO ships with adequate width for two way vehicular traffic. The apron shall be a minimum 215 meters long and 30 meters wide. The facilities shall include a fixed or movable ramp as required for accommodating wheeled (vehicular) cargo from bow and/or stern ports of

the ship. If required, dolphins with provisions for pedestrian access may be used for mooring the design ship. The berth shall be serviced by a paved and drained open marshalling area of 100,000 square meters minimum, preferably continuous to the pier or wharf. Adequate allowance shall be provided for continuous flow or two way vehicular traffic to, from and within all the berths and supporting facilities comprising the port. Details of facility components are as follows:

A. Design Vessel

1. Beam 30 meters
2. Draft 11.5 meters
3. Displacement 40,000 dead weight tons

B. Berth Characteristics

1. Length 250 meters
2. Width 34 meters
3. Dredge depth 9 meters at MLLW, design dredge depth 12 meters at MLLW
4. Capable of tug assisted approach
5. Berthed ship shall not encroach upon channels, fairways and turning basins or operations of other ships.

C. Wharf or Pier Characteristics

1. Length 215 meters minimum
2. Width 30 meters
3. Deck elevation +3.5 meters. If necessary for operations, deck elevation may be modified.

D. Special Requirements

1. Stern (Bow) Load Ramp

Provide a fixed or movable ramp as required for accommodating wheeled (vehicular) cargo from bow or stern ports of the ship. The configuration of the ramp shall be adequate to allow vehicles to travel safely and rapidly between the ship and the wharf or pier and shall slope to an elevation compatible with

ship's ramps through all of the tide cycle.

2. Bollards and Cleats

Provide adequate bollards and cleats to hold the ships snug to the ramp.

3. Dolphins

Provide all necessary dolphins to properly berth the design vessel. Include fender systems if dolphins are to be used for breasting. Include nominal fendering protection if dolphin is used for mooring only.

4. Incorporation into Container Facilities

Consideration should be given by the Tenderers to incorporate the RO/RO facilities into the required container facilities, provided it can be shown that RO/RO traffic flows will not interfere with container operations. If the Tenderer's layout calls for contiguous berths at the same elevation, a railroad spur shall be provided.

5. Open Marshalling Area

The berth shall be supported by an open paved and drained marshalling area of 100,000 square meters, preferably contiguous to the apron. The open marshalling area shall be level and designed so that at the time of acceptance and use all major settlements have occurred.

V. BULK CARGO FACILITY

Scope. One bulk cargo berth shall be provided. The bulk cargo facility should preferably be isolated. The bulk cargo berth shall be 250 meters long capable of accommodating a design vessel of 60,000 dwt., contiguous to a wharf or pier extending a minimum length of 200 meters. The wharf shall be oriented to allow easy access for loading or off-loading of bulk cargo. Facility shall include dolphins with provision for pedestrian access as necessary for mooring the design ship. The berth

shall be serviced by a level paved stockpile area, capable of storing the cargo carried by two design vessels and it shall contain a perimeter railroad spur. Access from the berth to the stockpile area shall be capable of providing continuous flow of two-way vehicular traffic. Stockpile area shall also be accessible to existing and future rail and roadway networks. Details of facility components are as follows:

A. Design Vessel

1. Beam 35 meters
2. Depth 11.5 meters
3. Displacement 60,000 dead weight tons

B. Berth Characteristics

1. Length 250 meters
2. Width 38 meters
3. Dredge depth 9 meters at MLLW, design dredge depth 12 meters at MLLW
4. Capable of tug assisted approach
5. Berthed ships shall not encroach on channels, fairways and basins or operations of other ships.

C. Wharf or Pier Characteristics

1. Length 200 meters minimum
2. Wharf (apron) 40 meters
3. Deck Elevation +3.5 meters

D. Special Requirements

1. Dolphins

Provide dolphins as necessary to properly berth vessel. (Minimum of 4 dolphins required with two 100 ton bollards and two 1 meter cleats per dolphin). Include fender systems if dolphins are to be used for breasting. Include normal fendering protection if dolphin is used for mooring only.

2. Stockpile Area

The berth shall be supported by an open stockpile area with a hardened surface capable of storing the cargo of a minimum of two design vessels. The area shall be level and designed so that at the time of acceptance, all major settlements have occurred. The area shall be designed in such a way as to allow for future expansion to handle four different commodities.

3. Railroad Spur

Make provisions for a standard gage railroad spur to loop the storage area with common access to the main railway network.

4. Crane

Provide for crane installation at some stage within the construction period. The gage to be in accordance with manufacturer's specifications.

VI. SERVICE JETTIES

A. Scope. The Contractor shall incorporate in his design and layout provision for three service jetties 30 meters long by 5 meters wide. The design load shall be 15 KN/m^2 with a 15 ton bollard pull.

VII. GENERAL REQUIREMENTS FOR BERTHING FACILITIES

A. General

1. The Contractor may propose any practical and reasonable type of structure to serve as wharfs or piers, except that the structure to serve as wharfs or piers, except that the structure shall minimize the adverse effect on the hydraulic regime of the site, that it will be operationally safe and it shall be essentially maintenance free.

2. Where this Specification does not describe the standards and criteria to be used for the design and construction, the Contractor shall carry out the Works to the highest possible and practical standards, bearing in mind that the Works are to

be constructed at a site exposed to corrosive tidal waters and subject to the effects of weather, waves, wind action and tidal currents, and other environmental conditions.

3. The Contractor must conduct a site reconnaissance for suitable fill material.

4. The Contractor shall consider future expansion in his layout of berths and facilities.

B. Design Loadings

For Tenderer's guidance the following minimum design loadings are suggested. The Tenderer is expected to confirm these loadings in relation to his design and bears full responsibility for loads ultimately selected.

1. Vertical

(a) Uniformly distributed live load of 50 KN per square meter.
(b) Truck loading at least equal to HS-20-44 per AASHTO Specifications.
(c) Railroad Loading at least equal to E-72 as per A.R.E.A. Specifications.
(d) Mobile crane loading (Rated Capacity)
- 70 tonnes plus 20% impact factor for general cargo berths
- 100 tonnes plus 20% impact factor for bulk cargo berth.

2. Horizontal

(a) Bollard pull = 100 tonnes
(b) Ship impact = reaction force from fenders
(c) Traction and braking as per AASHTO and A.R.E.A. Specifications

3. Natural

(a) Wind on ship (50 m/sec 1700 N/m^2)
(b) Current as required per berth layout
(c) Tides - maximum high tide 2.5 meters
(d) Wave Height 1.0 meter

4. Special Loadings

(a) Gantry Crane

- Vertical - 2 bogies at 16.00 meter spacing per rail.
- Wheel loads per attached Diagram No. 1 or per
- manufacturer's specifications.
- Horizontal - Wind - 205 KN/wheel
- Traction and braking - 25% of wheel load

(b) Conveyor System for the Bulk Cargo Berth

Wharf foundations shall be designed for future installations by others of a conveyor system parallel to the wharf face and located 30 meters from the face of the wharf. Anticipated loads from the conveyor system will be equivalent to a 30 KN/m line load.

5. Loading Combinations

(a) All structural elements shall be designed for the governing combination of dead load, live load, natural loads and operating load.

(b) Notwithstanding that certain specific design and loading conditions are quoted in this Specification, the Contractor shall assume full responsibility for their accuracy in relation to actual conditions at the Site and such information as may be available to him from time to time.

C. Wharf Fixtures

1. Fenders

(a) Fenders shall be designed for a 10 degree approach angle of the design vessel at a velocity of 0.25 meters per second normal to the wharf face with a maximum allowable hull pressure of 350 KN/square meter.

(b) Fenders shall be spaced to eliminate contact of the hull with the wharf structure at full deflection assuming a maximum hull curvature of 30 meter radius.

(c) Fender systems shall be designed so that maximum stand-off between the ship's hull and the wharf face is 2 meters.

2. Bollards and Cleats

Provide 100 ton capacity bollards at 30 meter spacing alternating with 1 meter cleats at 30 meter spacing along the wharf face except as specified for the Bulk Cargo Berth.

3. Paving

Aprons shall be paved with suitable wearing surface designed to accommodate the given loadings with minimum long term settlement.

4. Drainage

Apron surfaces shall be pitched to allow the runoff of storm water without ponding. Adequate scuppers and basins shall be provided to discharge these flows.

5. Carbs

Provide wheel stops at wharf face.

D. Utilities

1. Service Points

Provide a minimum of two service points per berth, located for the convenience of the using vessels. Each service point should provide for telephone, electricity, and potable water service. For the purpose of the power requirements for the port, electric powered harbor cranes shall be assumed.

2. Sanitary Facilities

Provide sanitary facilities for dock workers within walking distance from the apron.

3. Lighting

Apron areas and staging or marshalling areas shall be adequately illuminated for night operations.

4. Sewage

Provide one sealed sewage manhole per berth connected to an external system.

5. Fire Protection

Provide fire protection as further described in the section SITE WORK. In addition provide hydrants to adequately service the berthed ships.

VIII. SITE WORK

A. Paved Areas

Access and transportation about and through the site shall be provided for vehicular, rail and pedestrian traffic. All roads, parking areas, sidewalks or areas subject to vehicular or pedestrian traffic shall be paved.

1. Road and Parking Area Layout

(a) The main access road shall provide for a minimum 10.5 meter roadway in each direction, and shall contain a median and a sidewalk. Secondary roads shall have a total minimum width of 10.5 meters. Traffic islands shall be provided to control turning movements within the paved areas.

(b) Parking areas are to be curbed, and shall be provided with sufficient capacity for the buildings they service, and shall be so situated as to complement the overall security of the facility.

(c) All paved areas shall be provided with painted markings adequate to control traffic flows and parking.

(d) All roadways and parking areas shall have adequate lines, grades and turning radii sufficient for the anticipated vehicle usage.

(e) All buildings shall be provided with paved roads for vehicular access and paved sidewalks for pedestrian access.

(f) A lorry park shall be provided outside the main entry. It shall have the capacity for a minimum of 200 spaces. Entrances and exits should be kept to a minimum.

2. Design Loadings

(a) All roadways shall be designed to conform to HS-20-44 loading per American Association of State Highway and Transportation Officials (AASHTO) or any other approved standard.

(b) All drains, pipes, culverts, ducts, or other areas which may be subjected to vehicular traffic shall be capable or any other approved standard.

3. Drainage

All paved areas shall have positive drainage and all runoff shall be carried through and off the site. Drain sizing and inlet capacities shall be designed to preclude flooding of paved areas during times of heavy rainfall. No ponding will be allowed. Sanitary sewage and other waste material shall not be discharged into the drainage system. Roof drains will be incorporated into the system.

B. Security System

A perimeter security system shall be installed to protect the entire terminal area. Controlled access shall be provided to and along the perimeter. The system shall include but not necessarily be limited to a 3 meter high (minimum) wall with barbed wire on top. The system shall have low maintenance costs and be capable of being manned by a minimum number of personnel.

C. Fire Alarm

A general evacuation fire alarm system shall be provided in all facilities throughout the installation. Pull boxes shall be spaced no further than 60 meters apart, and shall be installed adjacent to all exterior entrances and/or exits. The fire alarm system

shall be connected to the fire station, chief security officer and the PABX room in the Administration Building.

D. Railroad

A quotation shall be inserted in the Tender for the installation of a standard gage railroad system within the Port area. However, this item of work for the installation may or may not occur during this contract period. The decision on whether the railroad shall be constructed as part of this contract will be made at the time of award.

The general railroad requirements are as follows:

Standard gage rail service shall be provided from the property line to the general, container and bulk cargo facilities in the terminal. The property line terminous should be so located as to facilitate connection with the proposed connection of the terminal line to existing rail line beyond the site limits. The system shall accommodate inbound and outbound traffic flows to and from all berths and storage areas. A railroad yard shall also be provided. All construction shall be of adequate line and grade, and as specified in the Manual for Railway Engineering published by the American Railway Engineering Association or other approved standard.

E. Landscaping

All paved areas in the vicinity of buildings or subject to erosion shall be covered with compacted topsoil and springs of living grass or other erosion control measures. The grass shall be supplemented with shrubs and flowers.

F. Retaining Walls and Steps

Retaining walls and steps shall be provided throughout the site as needed.

G. External Lighting

1. The external lighting shall include the illumination of the following:

   administration area
   operational area
   main road and the secondary roads
   stacking and workshop areas
   berths
   parking areas
   perimeter security system

2. The illumination of the main road, the secondary road, the workshop areas and the stacking areas shall provide average luminance level of 20 lux.

3. The illumination of the aprons shall provide an average luminance level of 25 lux.

4. The illumination of remote or isolated parking areas shall provide an average luminance level of 10 lux.

5. The illumination of the perimeter security system shall provide a minimum of 10 lux at a distance of 5 meters outside the perimeter fencing/wall.

6. The control for all external lighting shall be by means of a combination of time switches or photo-electric cells as applicable.

7. The supply cables to external lighting shall be underground. Cables crossing paved areas shall be run through ducts.

8. The illumination levels are given for the Tenderer's guidance only. The Tenderer is expected to confirm the adequacy of the suggested illumination levels.

H. Bridges and Culverts

Bridges and/or culverts shall be provided on the site as needed to carry vehicular, railway or pedestrian traffic over rivers and streams. Vehicular bridges shall be designed to support the

equivalent of an AASHTO HS-20-44 loading. Railroad bridges shall be designed to support the equivalent of Cooper's E-72 loading per American Railway Engineering Association (A.R.E.A.) Specifications or other approved standard.

I. Water Supply System

Potable water shall be supplied by locating and drilling suitable boreholes to a satisfactory water bearing acquifer. The necessity of water purification or water purification facilities shall be determined by the Contractor by testing and analyzing the quality of the boreholes water supply. The boreholes shall have sufficient capacity to accommodate a population of at least 5000 with capability to expand in the future to serve a population of 10,000 at a minimum water pressure of 170 KN/m^2. The potable water distribution system shall be capable of supplying the entire project complex, with at least two service connections to each berthing area for the convenience of the using vessels. The necessity of elevated and/or below ground storage facilities for potable water supply shall be determined by the Contractor.

J. Fire Protection System

The water necessary for the fire protection system may be either from fresh or salt water supply. If salt water supply system is used, continuous pressure shall be provided. The Contractor shall provide all necessary fire hydrants or standpipes at a spacing so that any potential fire can be reached from at least two hydrants, each serving not more than 90 meters of hose which shall include hydrants and service connections along the wharf, berthing and storage areas. Hose connections from hydrants shall be a minimum of 65 millimeters in diameter. The fire protection system shall be looped or closed and shall be capable of delivering a water supply of at least 95 liters per second for a minimum of four (4) hours, with a minimum water pressure of 275 KN/m^2.

K. Sanitary Waste Disposal System

A sanitary waste disposal system and a suitable sewage treatment

plant shall be provided to accommodate a population of at least 5,000, with capacity to expand in the future to service a population of 10,000, and to serve the proposed wharf, berthing areas and all other proposed project facilities. Each berth area shall be provided with one sealed sewage manhole connected to the proposed waste disposal system with a capacity to receive pumped sewage flow at a rate of 7 liters per second. The waste disposal system shall have a minimum velocity when flowing full of at least 0.60 meters per second. The type and method of sewage treatment shall be determined by the Tenderer.

L. Power Supply and Distribution System

The power plant shall provide the base load to all port facilities, thus it should be rated for continuous operation. The capacity of the power plant shall be such to give complete coverage for the first stage development. For any subsequent development, a realistic estimation based on data for the first stage should be considered for the provision of space in the powerhouse. Power plant shall be powered by diesel engine with the speed not exceeding 1000 RPM. Generating voltage could either be at high voltage (11,000 volts) or medium voltage (415 volts) with facilities for transformation. Power station electrical equipment (switchgear and control panels) shall be rated for 11,000 volts with a breaking capacity of 350MVA. The switch panel arrangement shall allow extensions to be made for future needs. As a general information or guidance, NEPA specifications should be obtained for purpose of marrying the power plant to the utility supply.

For the purposes of estimating the power requirement for the port, electric powered harbor cranes shall be assumed.

The Tenderer shall submit sufficient information for the furnishing and installation of exterior lighting. Transformer types, sizes and locations for the distribution of 230/415 volt, 3 phase, 50 Hz (CPS system and the types, sizes and locations of emergency generators for 100% back up of all essential equipment and lighting shall also be furnished.

IX. BUILDINGS

A. General

Using these general guidelines, the Contractor shall provide all architectural and engineering services in connection with the design and construction of the buildings as indicated in the General Schedule of Buildings hereinafter.

B. General Schedule of Buildings

1. Administration Building

The Administration Building shall be located outside the security fenced area.

The Administration Building shall have an overall size of 27 by 27 meters and shall be at least 18 meters high. It shall consist of a ground floor and 4 upper floors.

The building shall be equipped with 2 elevators to service each floor; and cafeteria, canteen and all sanitary facilities for at least 300 people. The entire building shall be air-conditioned.

Space allocations shall be made for the following departments; General Administration, Accounting and Revenues, Library Facilities, Wages, Traffic, Internal Audit, Welfare Officer, Estates, Industrial Relations, Personnel, Port Manager and Port Operations. Meeting, Lecture Rooms, Archives, Storage, Vault, Secretarial Space, Typing Pools, Library and other facilities required shall be considered in the building layout.

2. Emergency Clinic

The Emergency Clinic shall be a single story structure of approximately 400 square meters with an adjacent ambulance garage for 3 vehicles. The building shall be fully air-conditioned.

The building shall include a two-section waiting area, reception, sick bays, injection room, two consultation areas, storage

space, drivers' room, tea kitchen, locker room, rest area for doctors and nurses, storage for drugs and all sanitary facilities.

3. Fire Station

The Fire Station shall have a minimum floor area of 440 square meters. Garage and maintenance area shall be adjacent to it and sized to serve 5 fire engines.

Space allocations shall include separate offices for the Fire Chief and the Deputy Fire Chief, general office space, secretarial area, archives, recreation and lecture rooms, equipment storage, tea kitchen, locker room and all sanitary facilities.

The building shall be fully air-conditioned.

4. Police Station

The Police Station shall comprise a total area of 700 square meters.

The building shall be fully air-conditioned. Offices for the Superintendent, administration, investigation, charge and station departments; arrest cells, record and equipment storage, common areas and lecture room, locker room and all sanitary facilities shall be included in the station layout.

5. Port Engineer's Office

The Port Engineer's office shall have a total floor area of 720 square meters and shall be two floors high. The design shall be based on two additional floors in the future. The building shall be fully air-conditioned. This building will have office space for the Chief Port Engineer, his Superintendents, engineering staff, drawing office, typing pool and secretarial help. Archives, conference rooms, storage space, tea kitchen and all necessary sanitary facilities shall be part of this office. Provisions for one future elevator shall be included.

See Article 33 "Permanent Site Office" under General Specifications for timing of construction and furnishing of this office.

6. Port Engineer's Workshop

The Port Engineer's workshop shall be a one-story building with a floor area of 2,000 square meters and approximately 5-1/2 meters high.

See Article 33 "Permanent Site Office" under General Specifications for timing of construction.

7. Port Engineer's Store

The Port Engineer's store shall be a one-story facility of 1,800 square meters approximately 3 meters high. The store shall be located adjacent to the Port Engineer's Workshop.

8. Central Mechanical Workshop

The Central Mechanical Workshop shall have an overall size of 3,000 square meters and shall be 5 meters high.

9. Warehouses

The three Warehouses each shall have an overall size of 175 x 40 meters, and shall be 6 meters high at eaves with a 10 meter canopy for the full length. A lean-to shall be suitated at one end of each building, size 40 x 4.5 meters and contain offices and toilets. Offices shall be air-conditioned. The warehouses shall have 4 meters high solid perimeter walls.

10. Transit Sheds

The three Transit Sheds each shall have an overall size of 175 x 40 meters and shall be 6 meters high at the eaves with a 10 meter canopy. A 40 x 4.5 meter lean-to shall be situated at one end of each building containing toilets and showers. At the opposite end of the building and within the transit sheds, offices and stores shall be provided.

The office area shall be two floors high and air-conditioned. The transit sheds shall be of construction that can be readily dismantled and relocated.

11. Shipping Agent's Office

A shipping agent's office comprising 1500 square meters shall be provided with provisions for future expansion for commercial offices. Air-conditioning and sanitary facilities shall be provided.

12. Main Entry and Exit and Gatehouse

The gatehouse comprises a single story building approximately 20 x 6.5 meters, and shall be located adjacent to the five lane entry and five lane exit roadway to the Port area. Each entry and exit lane shall have an associated control cabin and stop barrier. The control cabins shall be situated on raised concrete islands between the lanes.

The whole control area with the exception of one entry and one exit lane shall be covered by a canopy, 5-1/2 meters high at its lowest point. The area around the control cabins shall be provided with crash barriers, turn-stiles, gates, lights and audible sirens.

13. Labor Call Office

The Labor Call Office shall be a one story structure with a floor area of 200 square meters. It shall contain office space for the Office Chief and his assistant, counter area, secretarial area, record storage and sanitary facilities. The building shall be air-conditioned.

14. Canteen for Officers and Staff

The Canteen shall be a one-story building of 500 square meters and shall contain kitchen, cold storage, restaurant and sanitary facilities. The building shall be air-conditioned.

15. Customs Facilities

The Customs Facilities shall consist of the following:

a) Custom's Long Room 1,500 square meters
b) Custom's Preventative Office 250 square meters

Sanitary facilities shall be included as required and all office space shall be air-conditioned.

16. Control Tower and Harbormaster's Office

The Control Tower shall have two glass-enclosed areas at the 34 and 37 meter levels, accommodating the Chief Pilot, the Harbormaster, together with the staff necessary for harbor's day-to-day waterside activities. The total floor area shall be 800 square meters. The tower shall be equipped with elevator servicing all floors, emergency stairs, sanitary facilities, locker room and shall be air-conditioned. It shall be located 40 meters behind the face of the wharf and shall command a view of all berths.

17. Port Central Stores

A 2,500 square meter facility shall be provided.

18. Weigh Bridges

Two weigh bridges located near the operating area shall be provided. Load capacity 80 Tonnes each.

19. Miscellaneous Buildings and Facilities

A petrol station, ground level fuel tanks for ships, incinerator, public toilets shall be provided, all suitably sized to handle the port needs.

C. Materials

All materials used shall be of the highest quality, durable, fire restant and shall be moisture-resistant under tropical conditions.

D. Design Loads

Design loads shall conform to the appropriate British Standards or other Standards approved by the Engineer but shall not be less than the loads listed below.

Roof Loading	
Live Load	100 kg/m^2
Floor Loading	
Live Loads	
Office Space	250 kg/m^2
Corridors, assembly areas, stairs, canteen	500 kg/m^2
Storage, light	600 kg/m^2
Storage, heavy	1,200 kg/m^2
Wind Load	100 kg/m^2

E. Structural System

Every building and all structural parts thereof shall be of sufficient strength to support the estimated or actual imposed loads, including lateral forces, without exceeding the allowable working unit stresses and without excessive deflection.

In addition to technical data, detail drawings, and assembly drawings, the successful Tenderer shall submit to the Engineer complete structural calculations prepared by a registered structural engineer.

Every facet of design shall be covered from a complete analysis of the system under vertical and lateral loading to the design of the individual members, including analysis of the joints, deflections, and camber calculations.

F. Expansion and Contraction

Consideration shall be given to expansion and contraction and all solutions shall be related to the system. The design shall incorporate necessary methods for controlling expansion and contraction effects.

G. Water Supply and Building Sewer

Adequately sized and located potable water distribution system and sewage collection system shall be provided to and from all plumbing and kitchen fixtures. Disconnect valves shall be provided at each fixture. Domestic hot water heaters shall be provided where required.

H. Electrical Systems

Power distributed to the various buildings will be 230/415 volt, 1 and 3 phase, 50 Hz (CPS). All materials shall have a voltage rating equal or greater than the voltage applied. Protective or operating equipment shall be rated according to the current requirements for the circuits or equipment.

Protective devices for building services, feeders, branch circuits and motors shall be molded case circuit breakers mounted in separate enclosures or in panelboard cabinets to suit the application.

All conduits whether exposed or concealed shall be heavy gage galvanized steel. All boxes and other conduit accessories shall be of the type suitable to the type of conduit employed.

I. Lighting Design Schedule

The given illumination levels are for the Tenderer's guidance only. The Tenderer shall confirm the adequacy of lighting.

Occupancy	Type	Levels
Office Areas	Fluorescent	350 - 400 Lux
Kitchen Areas	Incandescent	200 - 250 Lux
Mess Areas	Incandescent	200 - 250 Lux
Storage Areas	Incandescent	50 - 100 Lux
Medical Treatment Area	Fluorescent	350 - 400 Lux

J. Air-Conditioning

Air-conditioning shall be provided as specified for individual buildings.

X. REQUIRED TENDER SUBMITTALS

A. General

1. The Tenderer shall submit with his Tender three (3) complete sets of preliminary construction drawings, specifications, details and sketches as described in this section.

2. A General Layout Plan showing all major elements of the Works including the harbour, terminal facilities, all roadways and railroad tracks, parking areas, buildings, utility stations and all required site structures shall be submitted with the Tender.

B. Berthing Facilities

1. The Tenderer shall submit with his tender his recommended layout for the terminal facility indicating piers, wharves, buildings, access roads, stacking areas and major utility stations. The layout shall include recommended traffic flow to, from and within the facility and recommended layout, traffic flows and space utilization for aprons and supporting stacking areas.

2. The Tenderer shall submit with his tender his recommended layout for the harbor indicating turning basins, channels, berths, fairways and major navigation aids. The layouts shall include recommended traffic flow, channel widths and dredge depths.

3. The Tenderer shall submit with his tender sketches indicating details of anticipated types of structures to be used for piers, wharves, mooring dolphins, stacking and storage areas, access causeways and other major structures.

4. The Tenderer shall also include with his submittal a discussion of any adverse oceanographic or hydraulic conditions anticipated for his proposed configuration. The discussion shall include an estimate of annual maintenance dredging requirements for harbors and channels, and an estimate of the amount of downtime (if any) per year which may be experienced at the berths due to adverse

hydraulic conditions within the harbor.

C. Site Work

1. Paved Areas

(a) Roads and Parking Areas

The Tenderer shall submit with his Tender plans, typical cross-sections and details for all roadways, parking areas, sidewalks, curbs, barriers or other paved areas within the facility.

(b) Drainage

The Tenderer shall submit with his Tender drawings showing layout, preliminary sizing and typical details of the proposed drainage system.

2. Security System

The Tenderer shall submit with his Tender drawings showing the layout, typical details, control devices and any supplemental information that will fully describe the operation of the system.

3. Railroad

The Tenderer shall prepare his port layout to include an internal railroad network to accommodate a standard gage system. The decision on whether the railroad will be constructed as part of this contract will be made at the time of award.

The Tenderer shall submit with his Tender a plan showing the proposed layout, typical cross-sections of the roadbed and ballast or other support system and typical details of the rails and ties to be used.

4. Lighting

The Tenderer shall submit with his Tender drawings showing lighting layout, typical supports, types and capacity of luminaries, locations, sizes and type of transformers and typical duct details.

5. Fire Alarm

The Tenderer shall submit with his Tender drawings showing the proposed layout of the system together with typical details of the appurtenances to be used.

6. Retaining Walls and Steps

The Tenderer shall submit with his Tender plans showing the proposed location of any wall and/or steps, together with typical details.

7. Bridges and Culverts

The Tenderer shall submit with his Tender drawings showing plans, typical cross-sections and details of all culverts and bridges to be used in the Works.

8. Water Supply System

The Tenderer shall submit with his Tender drawings showing bore-hole location, water purification facilities (if any), distribution system and typical details.

9. Fire Protection System

The Tenderer shall submit with his Tender drawings showing the Fire Protection System, hydrant spacing, pump location, size and types and typical details.

10. Sanitary Waste Disposal System

The Tenderer shall submit with his Tender plans showing the sanitary waste disposal system, location and type of the sewage treatment plant and typical details.

11. Power Supply and Distribution System

The Tenderer shall submit with his Tender drawings showing type, size and location of power plant, emergency generators, the distribution system and typical details.

D. Buildings

1. Architectural

Preliminary plans, elevations, cross-sections and typical details indicating space allocations and layout, major materials and finishes shall be submitted with the Tender documents.

2. Structural

Preliminary drawings in sufficient detail to indicate structural systems, foundation type, major materials, corrosion protection and design loads shall be submitted with the Tender documents.

3. Electrical

The Tenderer shall submit with his Tender drawings and typical details showing type, size and location of all major electrical installations within the building.

4. Water Supply and Building Sewer

The Tenderer shall submit with his Tender sufficient information describing the piping distribution system and sewerage system. Tenderer shall indicate manufacturer and type of materials for plumbing fixtures proposed for use in the Works.

5. Air-Conditioning

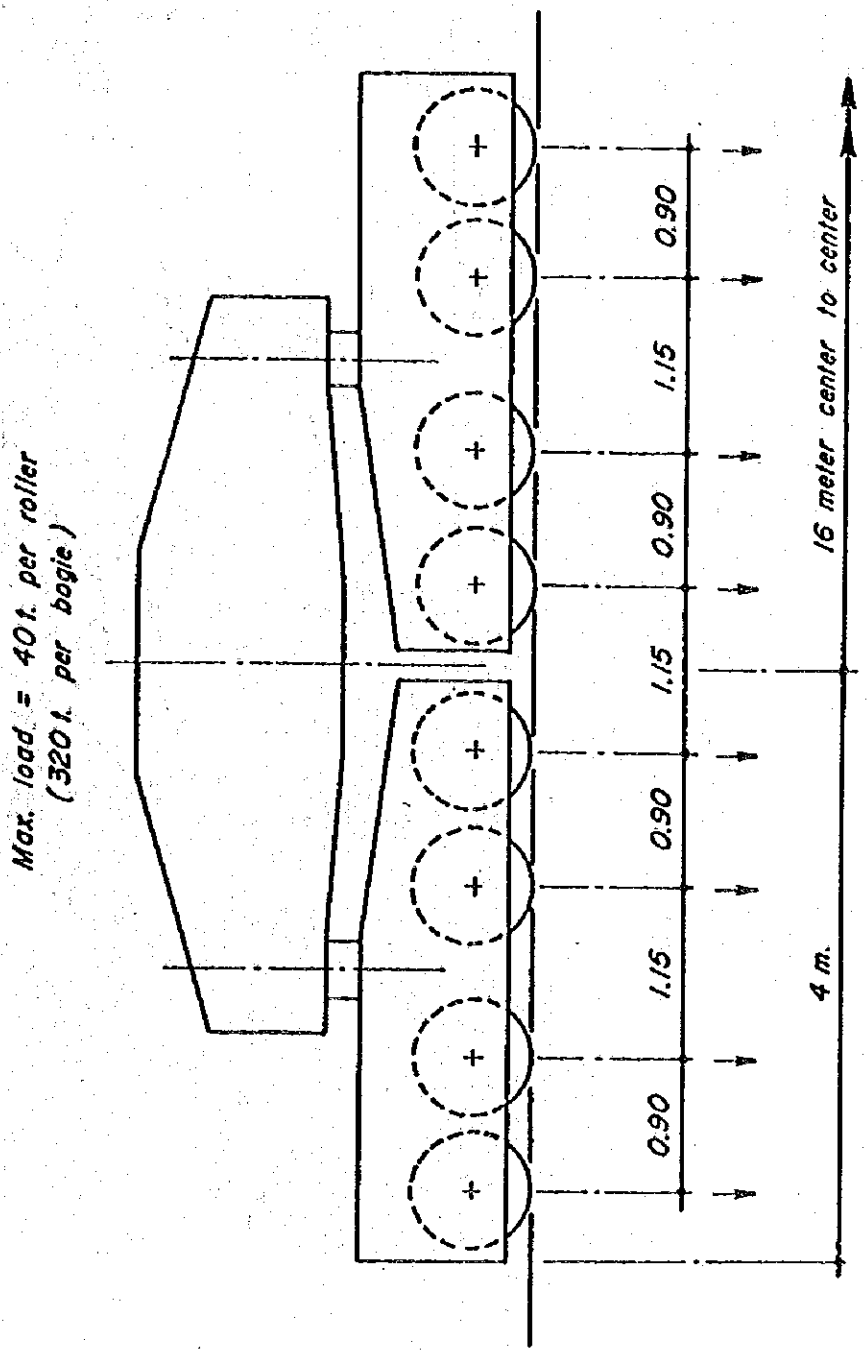
Tenderer shall indicate the parameters used for the specification of unit air-conditioning:

Outdoor conditions (temperature and humidity)
Indoor conditions
Wall, roof and glass "U" factors (or equivalent information)

Tenderer shall supply information about the equipment manufacturer, weather protection, maintenance and servicing consideration.

E. Materials

Tenderer shall submit with his Tender specifications for all major materials indicating type, quality, grade and supplier of materials proposed for use in the Works.



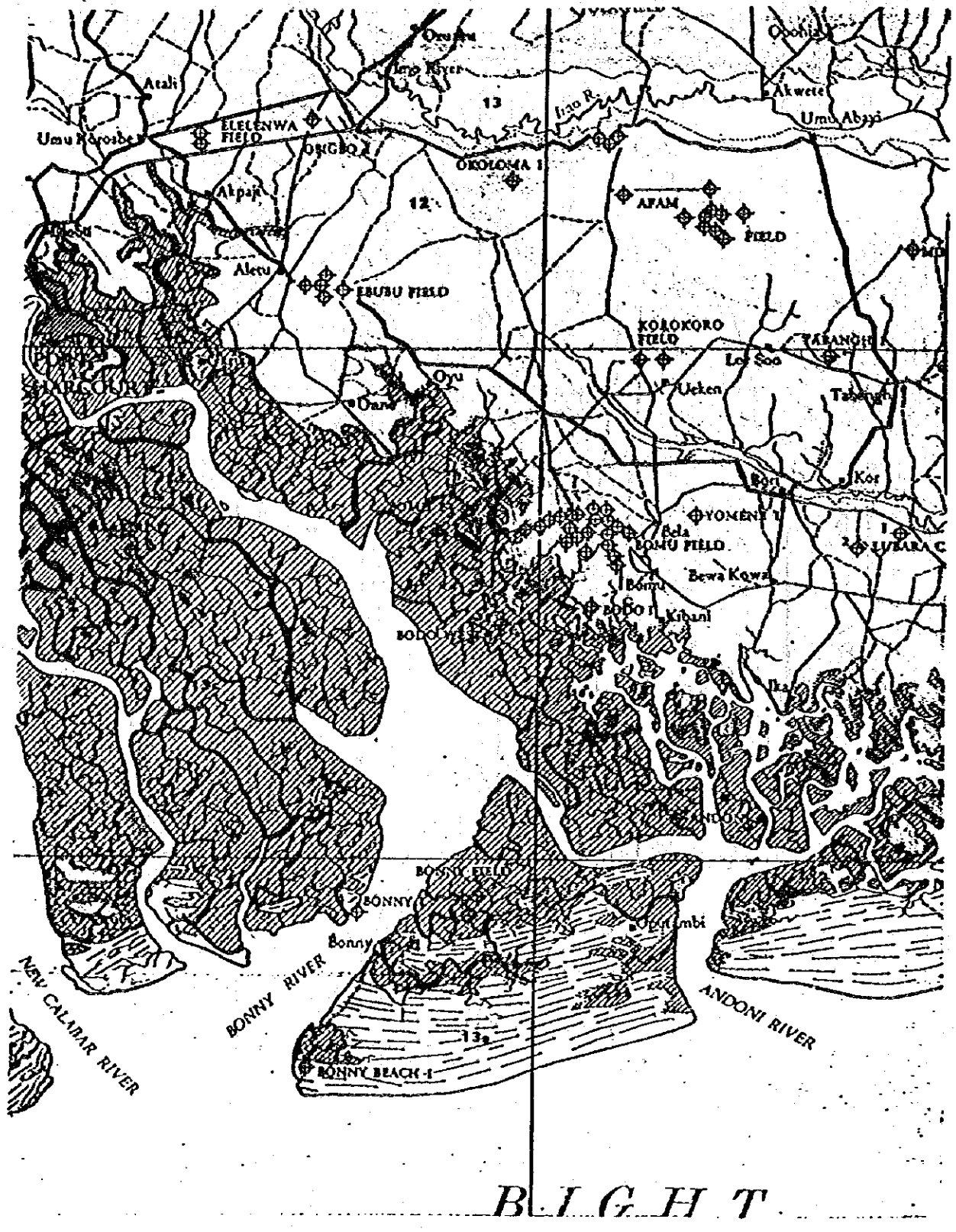
8 WHEEL CONTAINER CRANE BOGIE

(2 required per rail)

Crane rail gauge 22.5 m. c.c.

DIAGRAM NO. 1

ANNEX IV GEOLOGIC MAP

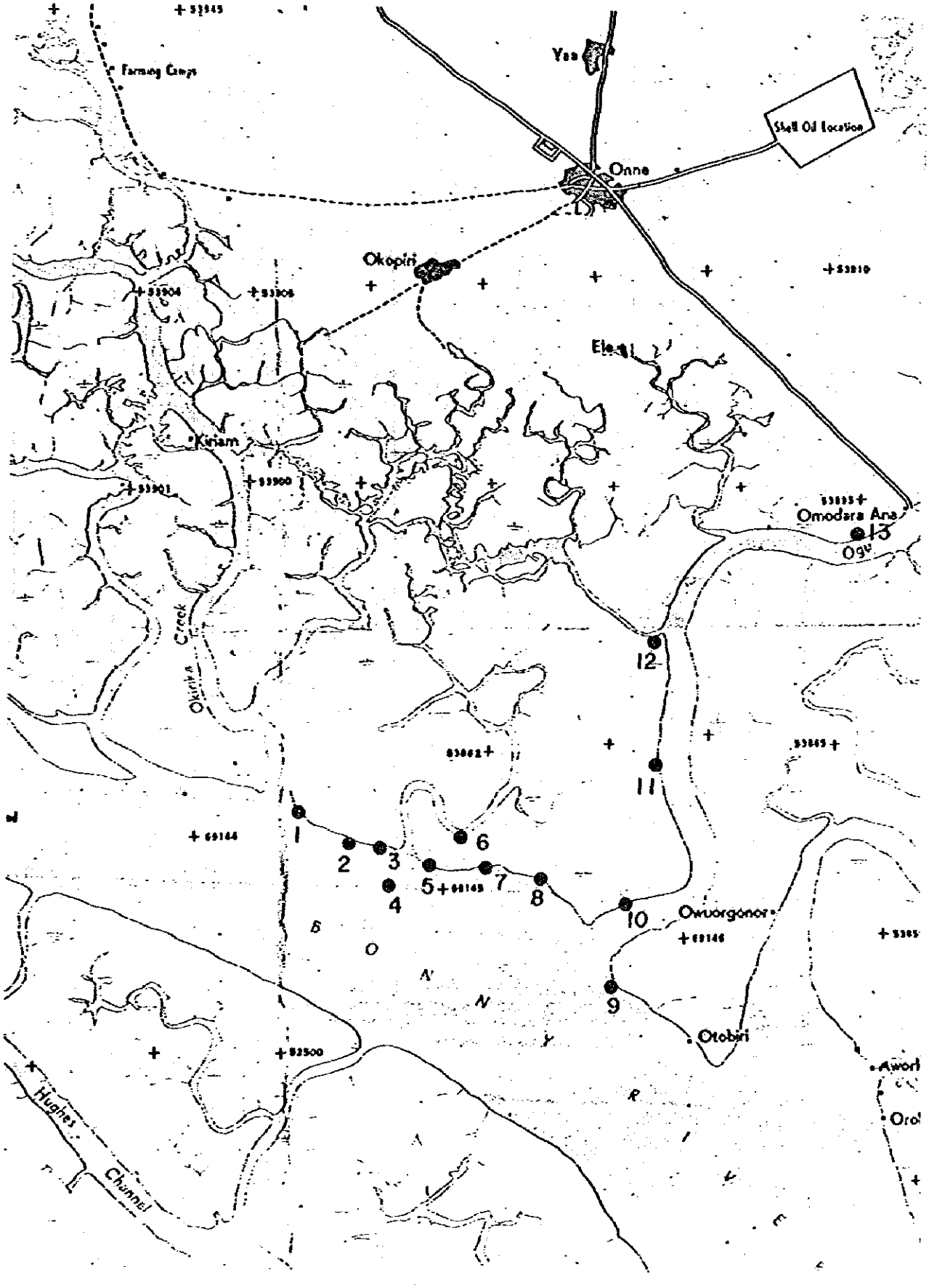


13c Mangrove Swamps

13e Abandoned Beach Ridges

T2 Coastal Plains Sands

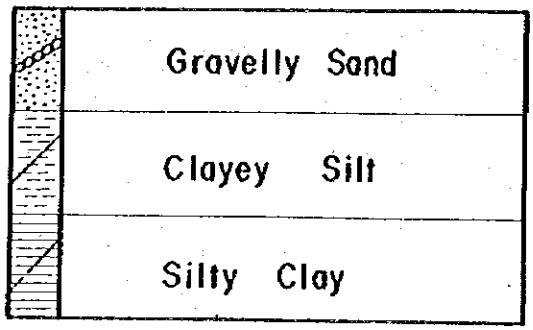
ANNEX V BORING LOCATION



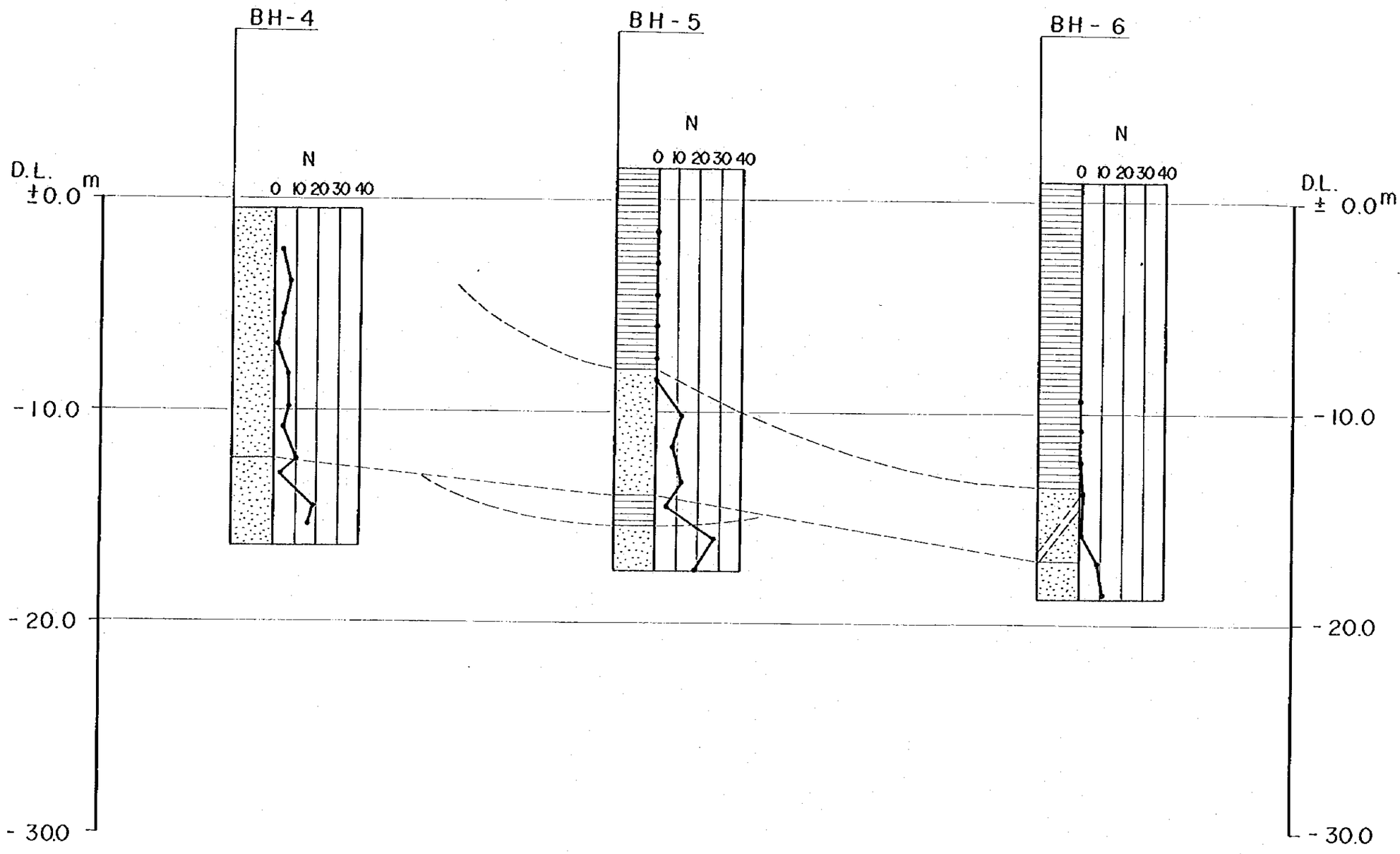
SOIL MARKS

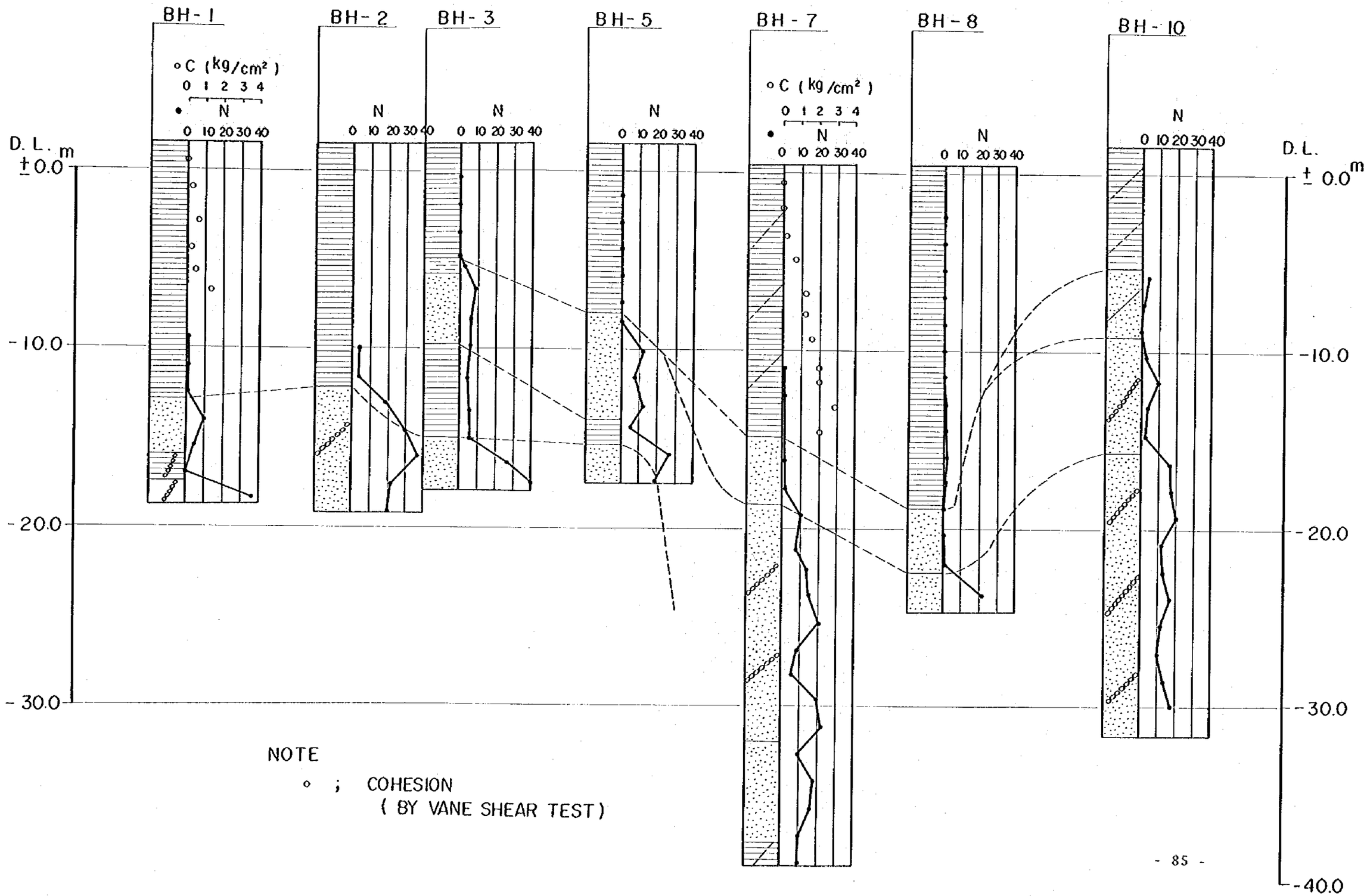
MAIN MARK	SUB - MARK
Gravel	Gravelly
Sand	Sandy
Silt	Silty
Clay	Clayey

EXAMPLES



V-1 PROFILE DATA




BH-1
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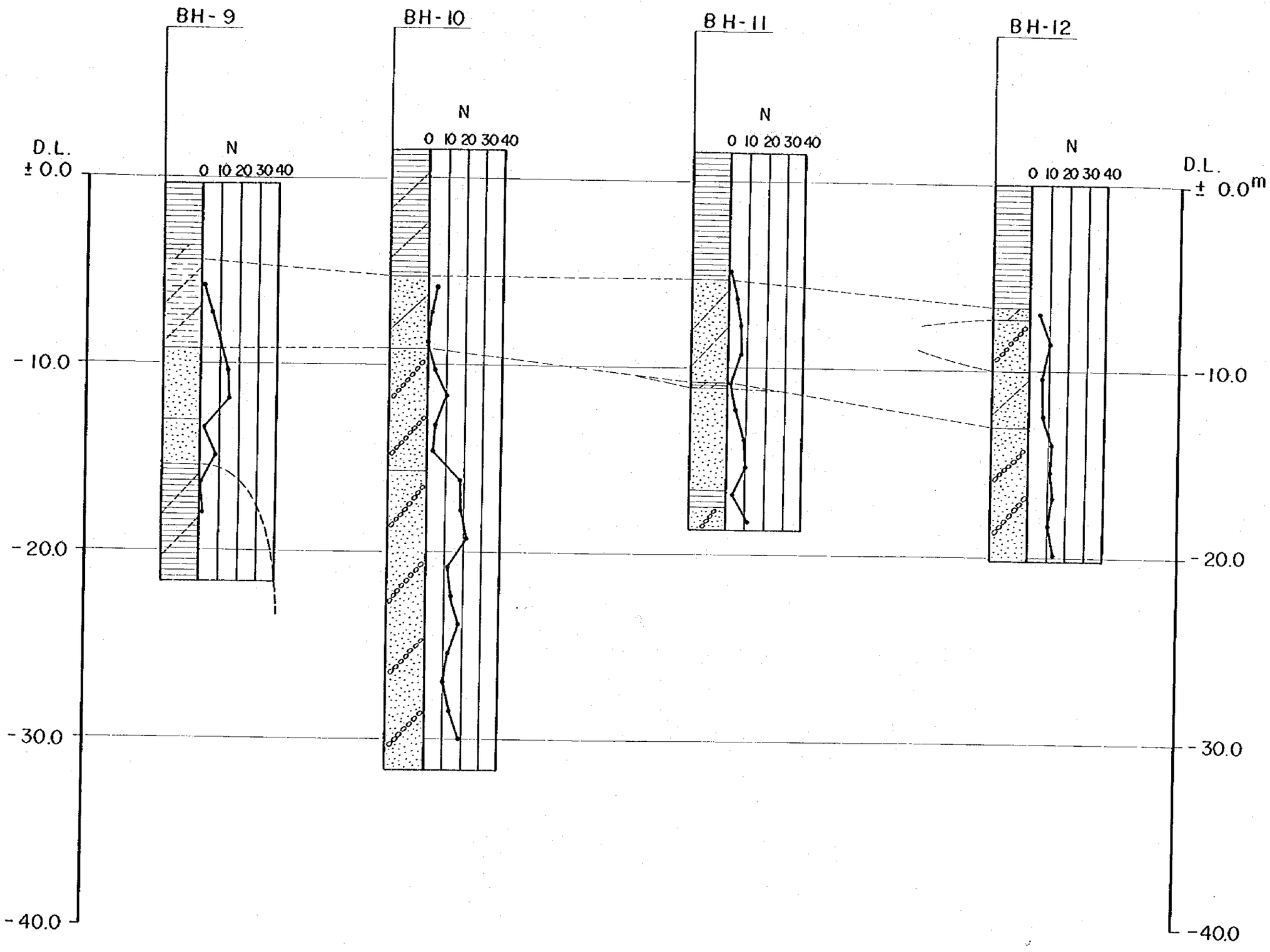
(BY VANE SHEAR TEST)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BH-10
BH-11
BH-12
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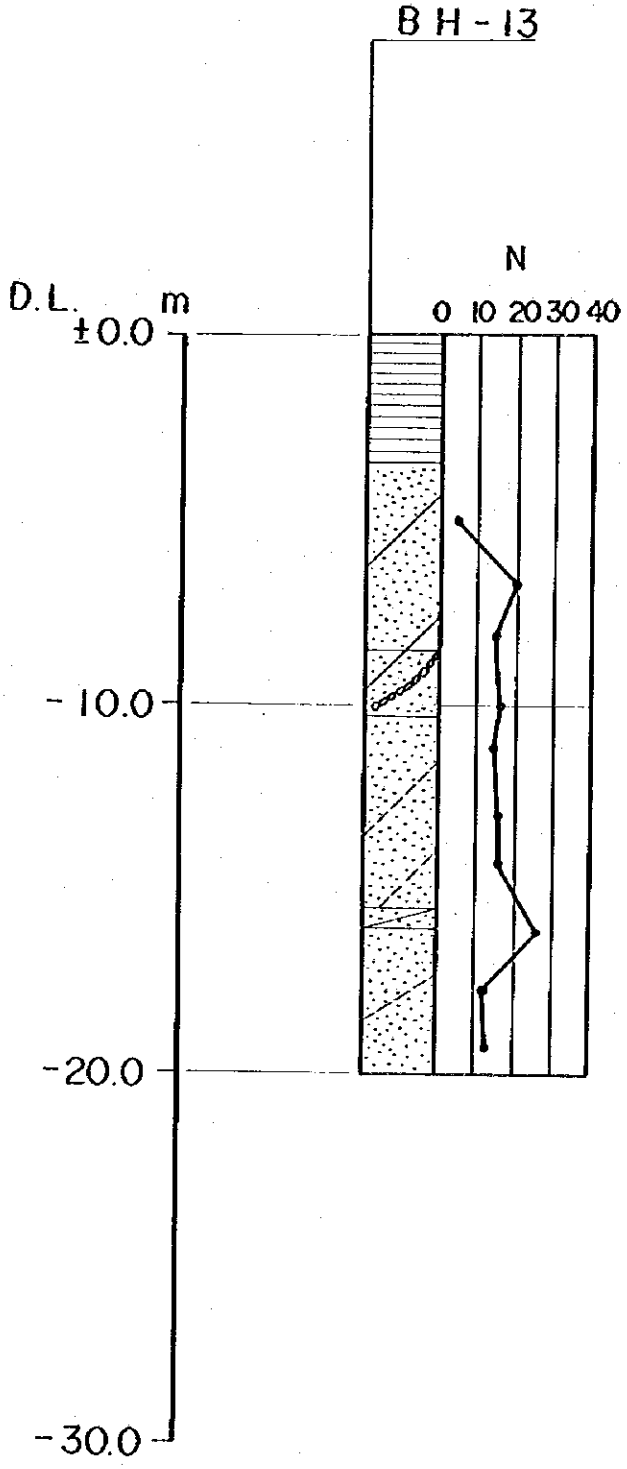
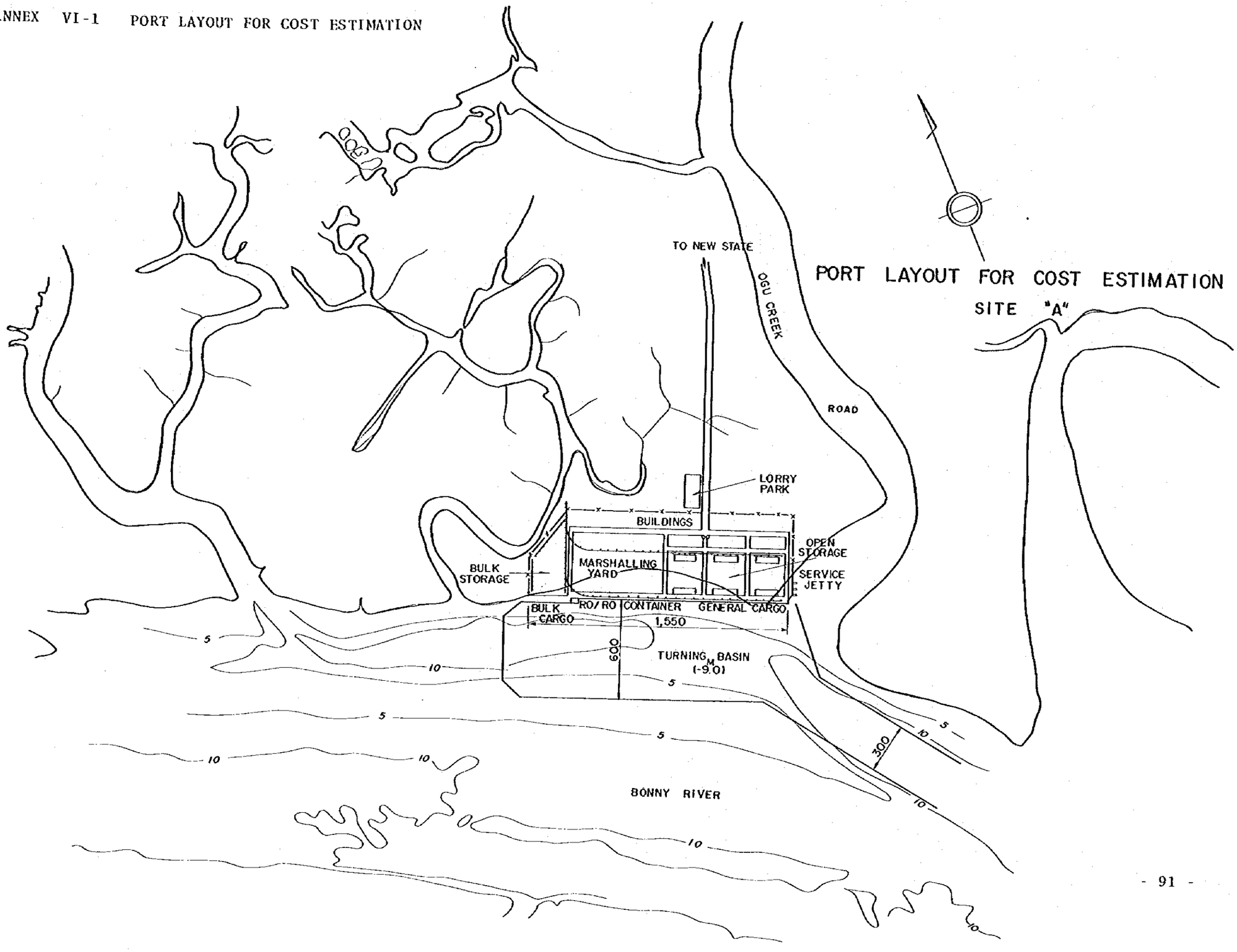
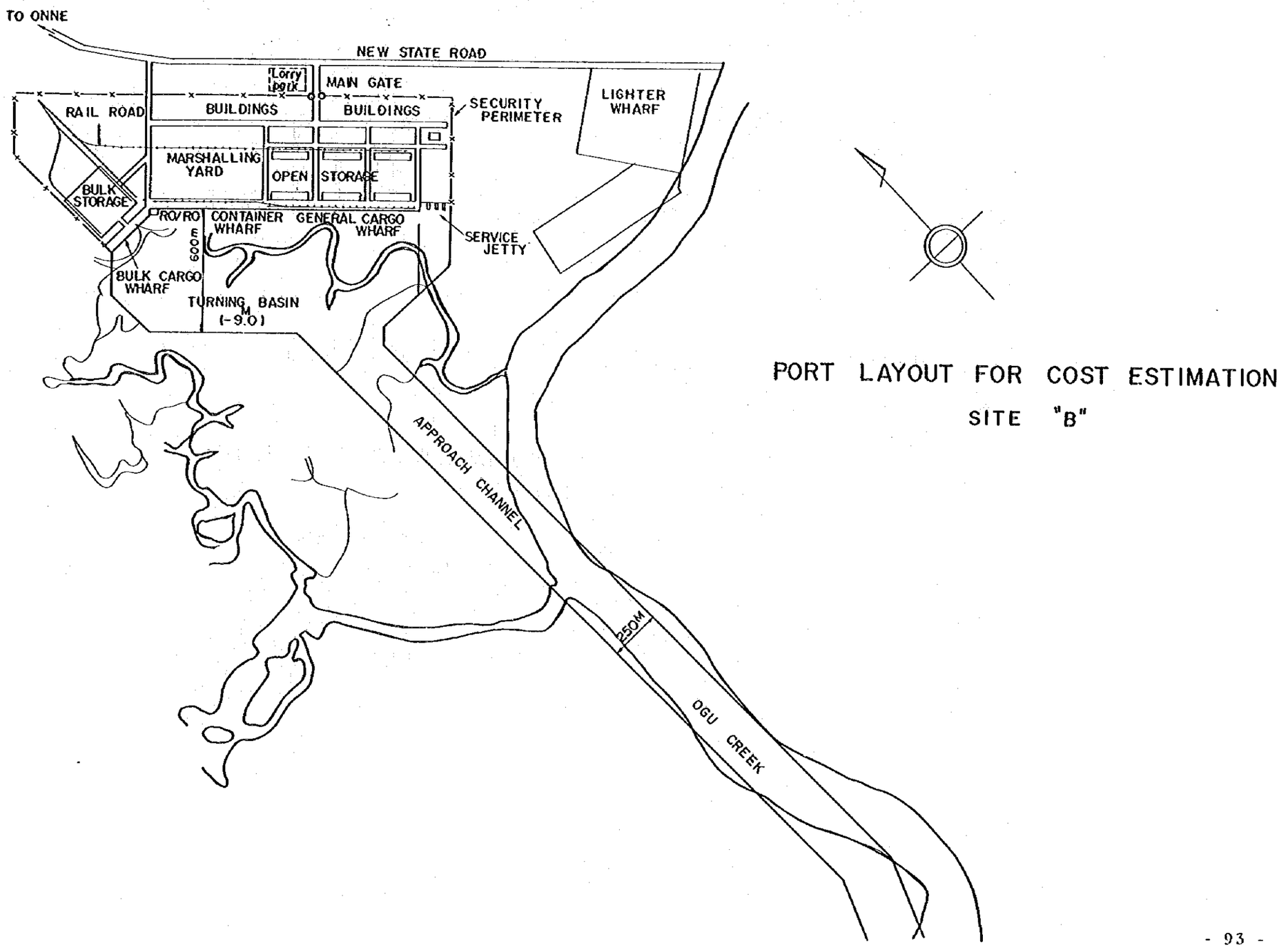
V-4 PROFILE DATA



ANNEX VI-1 PORT LAYOUT FOR COST ESTIMATION



ANNEX VI-2 PORT LAYOUT FOR COST ESTIMATION

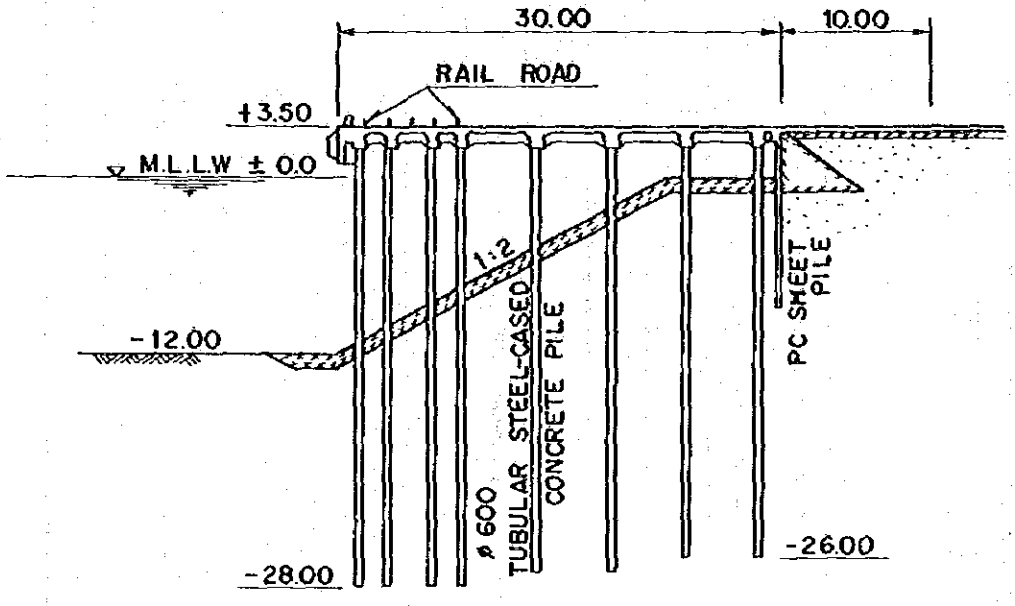


PORT LAYOUT FOR COST ESTIMATION

SITE "B"

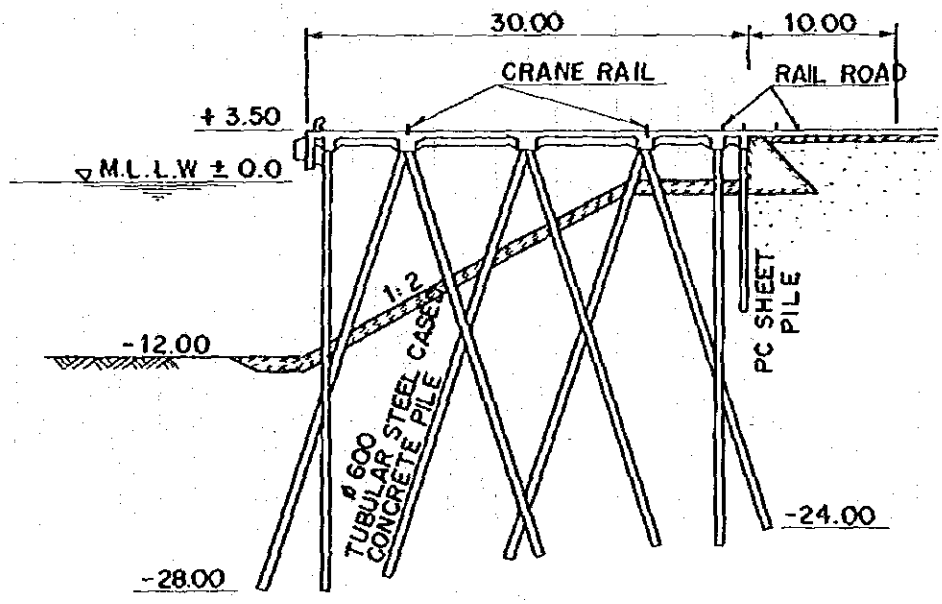
ANNEX VI-3 STANDARD SECTION OF GENERAL CARGO WHARF

S= 1/500



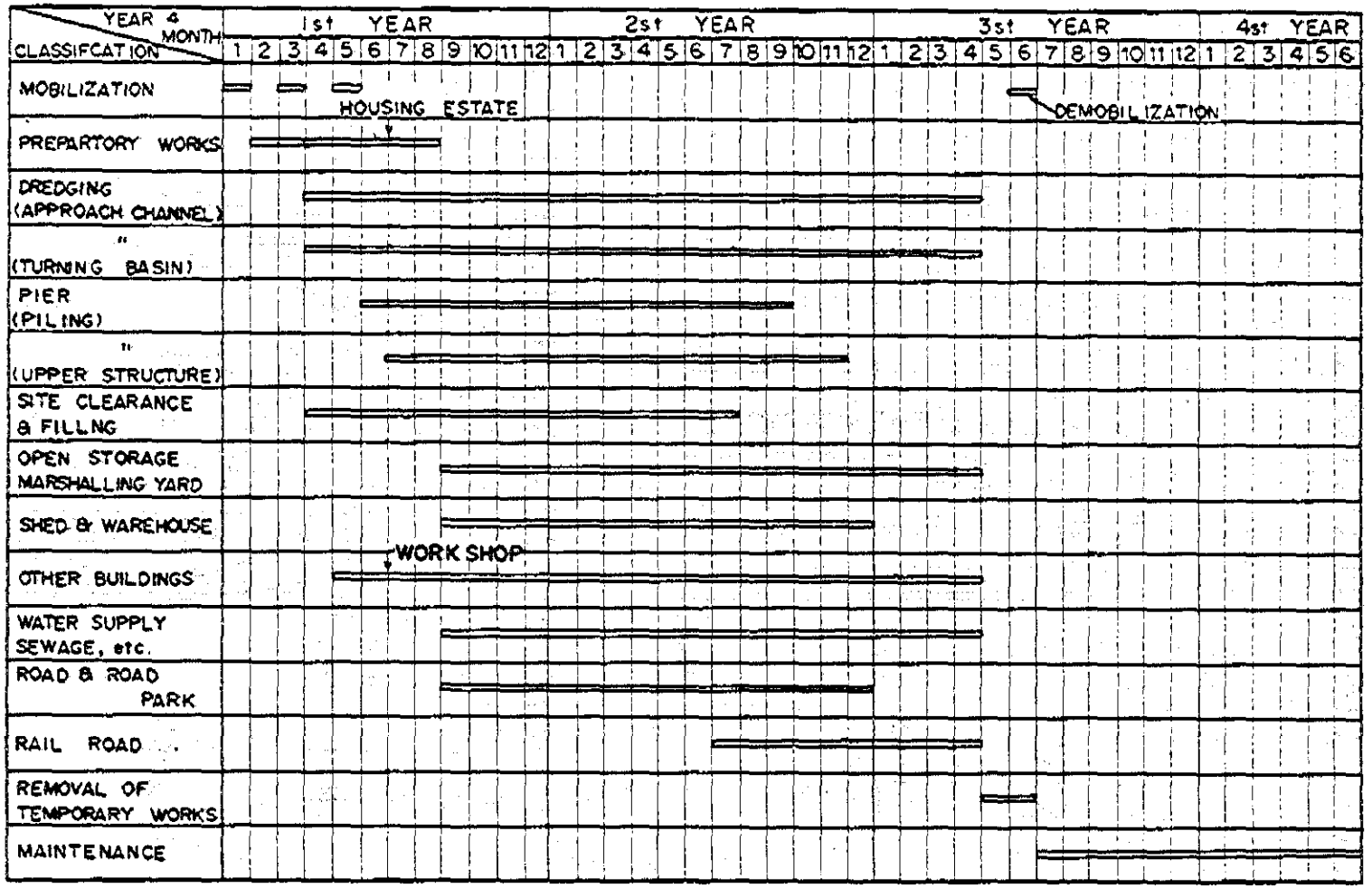
STANDARD SECTION OF CONTAINER WHARF

S = 1/500



ANNEX VI-4

WORK SCHEDULE



ANNEX VII-1

INTERNAL RATE OF RETURN

ONNE NEW PORT PROJECT

(Unit ₦ 10,000)

Year	Investment Cost	Economic Benefits	Discounted Value at 19%		Discounted Value at 20%	
			Investment Cost	Economic Benefit	Investment Cost	Economic Benefit
1 1978	4,194	0	3,524	0	3,495	0
2 1979	6,222	832	4,394	588	4,321	578
3 1980	4,139	1,845	2,456	1,095	2,395	1,068
4 1981		2,167		1,081		1,045
5 1982		2,490		1,043		1,001
6 1983		2,813		991		942
7 1984		3,136		930		875
8 1985		3,458		860		804
9 1986		3,458		723		670
↓						
12 1989	416		52		47	
13 1990	416		43		39	
↓						
22 1999	2,038		44		37	
23 2000	2,038		37	3,803	31	3,345
↓						
32 2009	416		2		1	
33 2010	416		1		1	
↓						
42 2019	2,038		1		1	
43 2020	2,038		1		1	
↓						
51 2228		3,458				
Total	24,371	165,435	10,555	11,114	10,369	10,328

	19%	20%
E. B	11,114	10,328
I. C	10,555	10,369
	559	Δ41

$$19\% + \frac{559}{559 + 41} \fallingdotseq 19.9\%$$

ANNEX VII-2

Benefit

(Unit ₦ 10,000)

Year	Construction of lighter wharf	Lighter handling charge	Waiting time	Coal	Total
1978	0	0	0	0	0
1979	64	108	660	0	832
1980	115	220	1,095	415	1,845
1981	142	275	1,335	415	2,167
1982	169	331	1,575	415	2,490
1983	196	387	1,815	415	2,813
1984	223	443	2,055	415	3,136
1985	250	498	2,295	415	3,458
1986	250	498	2,295	415	3,458
⋮	↓	↓	↓	↓	↓
2028	250	498	2,295	415	3,458
Total	11,909	23,676	109,515	20,335	165,435

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