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INTEGRATED ATLANTIC COAST PORT STUDY
MASTERPLAN LIMON/MOIN

VOLUME I
SUMMARY REPORT

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INTEGRATED ATLANTIC COAST PORT STUDY

MASTERPLAN LIMON/MOIN

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Abbreviations:

MOPT	Ministerio Obras Públicas y Transportes
JAPDEVA	Junta de Administración Portuaria y de Desarrollo Económico de la Vertiente Atlántica
RECOPE	Refinadora Costarricense de Petróleo, S.A.
OFIPLAN	Oficina de Planificación Nacional y Política Económica
CODESA	Corporación Costarricense de Desarrollo
FECOSA	Ferrocarril de Costa Rica

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1. Resume and General View on the Results of the Study

The German Agency for Technical Cooperation (GTZ) favoured the Rhein-Ruhr Ingenieur-Gesellschaft mbH, Dortmund, with the order to carry out an integrated harbour study Atlantic Coast Costa Rica - Masterplan Limón/Moín on November 11, 1979.

In order to guarantee an optimal execution Rhein-Ruhr Ingenieur-Gesellschaft mbH carried out the study in cooperation with the companies Port and Transport Consulting Bremen GmbH and Deutsche Eisenbahnconsult GmbH.

Prof. Dr.-Ing. Ole Burkhardt of the Franciscus Institute of the Technical University Hanover was called in as expert for oceanographic investigations.

The present study is the result of traffic engineering, harbour operational and technical investigations on the integrity of the ports of Limón and Moín and their reasonable extension.

Furthermore, it was investigated whether further development possibilities for these harbours as well as for other harbours at the Atlantic Coast seem to be reasonable considering a period exceeding the forecast target i.e. the year 2000.

As far as the development of further harbours at the Atlantic Coast is concerned the result of the investigation is that no further banana harbours shall be constructed but the handling shall be concentrated in Limón and Moín.

Merely Cahuita or Puerto Viejo shall be taken into consideration for a future development of fishing ports. This requires, however, detailed studies which shall supply information especially on kind and size of fish shoals (lobster) and how to utilize them optimally.

Moín should not be envisaged as fishing port since the harbour of Moín and the bordering terrain shall be reserved for a possible extension within the scope of the development of an industrial zone.

If a trans-continental oil pipeline will be laid the berthing place in the bay of Moín could be located approx. 2.5 km off the coast at an adequate water depth by means of a single mooring buoy.

The development of the harbours of Limón and Moín mainly depends on how the containerization of bananas will progress. 2 cases are considered in the study:

Case A : Low containerization of bananas

Case B : 100% containerization of bananas in the year 2000.

The result of the study for case A is that the facilities, which still exist or are under construction now, with the following installations will be sufficient for a period covering the study target i.e. reaching until the year 2000:

Limón: Proyecto Alemán with a container berthing place (berth 11) and a combined ro-ro / general cargo berthing place (berth 10), Muelle 70 with a combined break bulk / general cargo berthing place (present berthing place 8).

Moín: Banana handling with 2 berthing places (banana pier), 1 petroleum handling berth possible combined with bulk cargo handling (fertilizer) and special liquid bulk and a ro-ro ramp.

In order to secure the handling expected for this period the following additional measures are necessary:

- Limón:
- technical rehabilitation of Muelle 70 (corresponding to Chapter F - 2.2.6)
 - modification of the road traffic network and harbour connections (corresponding to Chapter F - 2.2.2, drawing F - 2.2;2.3)
 - modification of railway connections (corresponding to Chapter F - 2.2.1, drawing F - 2.2)
 - erection of a new central workshop (corresponding to Chapter F - 2.2.3, drawings K - 1.3.1 and 1.3.2)
 - installation of sufficient harbour lighting and navigational aids (corresponding to Chapter H, drawing H - 1)
 - providing of additional handling equipment (corresponding to Chapter E)
 - improvement of handling organization by harbour operational measures as for example the increase of gang productivity (corresponding to Chapter E)
 - sufficient training of harbour operation staff especially in view of future container handling (corresponding to Chapter G)

Moín: Completion of harbour facilities under construction now, (corresponding to Chapters F - 2.3 and K - 2), especially

- breakwater
- access channel (dredging)
- road and railway connections
- water supply and discharge
- power and communications network
- harbour buildings (as described in detail in the structural pre-design)
- lighting and navigational aids
- deviation of the discharge of Rio Moín
- sufficient training of the staff for the elevators for banana handling
- construction of a ship yard with berthing pier for harbour owned boats.

Moreover, it deems necessary to adopt the present harbour organizational structure to the new situation. In order to guarantee an integrated national port policy and the organizational integration of Limón and Moín it is recommended to establish a National Port Authority with its domicile in San José as well as a Port Authority in Limón.

As far as the allocation of responsibilities in the port is concerned, the elimination of the activities of the forwarding agents, a limitation of the stevedoring companies to the ship's side is anticipated while the Port Authority should take over the public services of the port as well as the shoreside operations. By this, a clear allocation of responsibilities of the entire port guarantees an uncomplicated integration of the new container terminal (Proyecto Alemán) and also meets the requirements of the transport chain.

Besides the measures of Case A it will be necessary, in case of an increased containerization of bananas as assumed for case B, to extent the container handling possibilities until 1995 at the latest.

It is proposed to carry out these measures (see drawing F - 2.2 and Chapter F) in the harbour of Limón and not in Moín since

- the handling system including the related new make-up of the organizational structure as well as repair and maintenance organization started with the Proyecto Alemán can be continued
- cheapest extension possibility
- contrary to Moín much more extensive extension possibilities in the future
- thus increasing development of Limón to a container and general cargo harbour, the so-called "Common Port" which is exclusively operated by the Port Authority, and development of Moín to a "Special Port" for special commodities as petroleum, fertilizer, special liquid bulk and other special goods which will result from the establishment of the industrial and the free trade zones with the possibility to operate individual facilities by private users (Recope, Abonos Superior S.A., Químicos Holanda Costa Rica S.A)
- thus it is guaranteed that both harbours will not become competitive harbours but will be developed as integrated ports
- the increase in container handling and the required extension of capacities are contradictory to the topographical possibilities of an extension of the harbour of Moín which is limited by the Moín river
- the cost-benefit analysis shows that the extension of the harbour of Limón would be of greater benefit in economic view than the relocation of container handling to Moín.

Finally, as the Masterplan study outlines possible development schemes of the ports of Limón and Moín and sets a rational development framework into which successive construction projects can be fitted as the traffic increases, the authorities concerned should maintain a permanent ability to recognize changes in demand in order to re-assess the development program. The Masterplan should have a continuous existence as a reference document. It should be modified, for instance, to take a new look at the future situation (in the present rapidly changing stage in shipping and also economic development) or as a result of events in the course of the forecast period which make a review desirable.

2. Present Situation of the Atlantic Coast

(Chapter B, Volume II, Drawing B-1.2)

There are five deepwater anchorages serving Costa Rica:

Port Limón and Moín on the Caribbean Coast, Caldera, Puntarenas, and Golfito on the Pacific Coast.

Except of Golfito, which is naturally protected, all other anchorages are exposed to the sea and have only the partial protection of natural shoreline features such as islands, peninsulas and coral shoals.

Port Limón is the principal port of the Republic. It is situated at latitude $9^{\circ}59'49''$ N, longitude $83^{\circ}00'48''$ W. A good anchorage in the lee of Uvita Island, with water approaches of 14.5 to 18 meters depth is available at the port.

Limón is known as a harbour place since the XVth Century, after having been discovered by Christopher Columbus on his fourth voyage in 1504. Now, the port of Limón handels about 88 percent of the country's sea trade and 60 percent of the total foreign trade.

Port Limón is connected by rail to the nation's capital at San José, a distance of 165 kilometers; road via Siquirres, Turrialba and Cartago with a length of about 176 kilometers; a new highway of about 130 km length is expected to be in service by the end of 1981.

Port of Moín has a tanker terminal with one berth and one ro-ro ramp, two banana berths are under construction. The terminal serves the Recope Refinery, and it is situated at latitude $10^{\circ}00'30''$ N, longitude $83^{\circ}05'10''$ W. Furthermore, there are single mooring buoys connected with ca. 1.1 km pipelines for oil and gasoline in the Bay of Moín. River shipping in Costa Rica has traditionally been confined to the San Juan, San Carlos, Sarapiquí and Frio Rivers on the Caribbean, and the Tempisque and Grande de Tarcoles Rivers on the Pacific. Use of river transport has declined in recent years in proportion to improvements in highway access. River transport remains of significance only on the San Juan River.

Coastwise shipping along the Caribbean Coast has no more commercial significance. Improvements of canalization in the coastal lowlands between Moín and the Nicaraguan border and construction of the Moín river terminal allow river and littoral transport service for that region.

Also, improvements on rural and highway access, especially to the south (i.e. Panamanian border) shift cargo transport to landside transportation means.

Description of Structural Facilities in the Ports of Limón and Moín

Port of Limón

The present harbour facilities at Limón include 3 piers and one breakwater. Two berthing places including storage areas are presently under construction. The three piers - in the order in which they started operation - are named as follows:

1. Muelle Metalico
2. Muelle Nacional
3. Muelle Setenta

Muelle Metalico, in its original shape, was put into operation in 1904, thus being the oldest pier in the harbour. Mainly banana export is handled via this pier, but also general cargo and, in smaller quantities, liquid bulk.

Muelle Nacional was the second pier in the harbour of Limón starting operation in 1954. It has one ro-ro ramp and one berthing place for coasting motor vessels, and is also used for harbour-owned boats, such as tug boats, pilot boats, etc.

Muelle Setenta, which started operation in 1972, serves now for handling general cargo and break bulk.

A detailed description of these structural facilities will be given in the following.

Muelle Metalico

Muelle Metalico is an all-steel construction having a T-shaped form. It has one access bridge and berth facilities located at right angles to it. The access bridge runs from north-west to south-east and consequently the berthing place from north-east to south-west. The length of the access bridge is 330 m. Its original width of about 11 m was extended by 10 m over a length of 140 m on the north-east side following the increasing mechanization of banana handling.

The total length of the berthing place amounts to about 320 m at a width of approx. 23 m. To enable railway service between access bridge and south-west part of the pier, the transition area between bridge and pier is extended correspondingly. Muelle Metalico offers 3 berthing places (Puestos 1 to 3) with the following length:

P1	=	160 m
P2	=	160 m
P3	=	122 m

While Puesto 1 serves for banana handling, Puestos 2 and 3 are used for general cargo, break and liquid bulk. During the dredging works carried out in the course of the preliminary work going on until April 1980, the 3 berthing places are being dredged to a water depth of -10 m (NMM). As a result of the age of construction numerous members of the substructure have been collapsed due to high corrosion. The use of this pier is therefore very limited.

Muelle Nacional

Muelle Nacional is a steel structure projecting into the harbour basin in south-east direction. The length of the pier is 120 m, its width approx. 13.5 m. To use the pier as ro-ro facility, a ro-ro ramp was built subsequently at the top of the south-east side and was extended in 1978 to permit berthing for new ship sizes.

The ramp's loading capacity is 10 tons. The water depth at Muelle Nacional is very low. It is some 6 m at the ro-ro berthing place, decreasing gradually towards the shore, and is about 2.50 m at the root. The berthing places at the longitudinal north-east pier side therefore can only be used by tug and mooring boats (Puesto 5) and at the longitudinal south-west side of the pier only by coastal motor ships and mooring boats.

In the area of Puesto 5, there are berthing dolphins in the front of the pier. The dolphins consist of 8 Peiner profiles arranged in 2 rows of 4 piles each. On the berthing side a 120 m high metal plate is welded onto the construction with some rubber tyres hanging on each dolphin.

Muelle Setenta

Muelle Setenta is the newest pier in the harbour of Limón. Contrary to the other piers, it is an all-reinforced-concrete construction, projecting as finger pier into the sea in south-east direction.

With its length of 325 m and a constant width of 17 m, the pier offers 3 berthing places, i.e. Puestos 7, 8 and 9. After completion of the dredging works, the water depth at Puestos 7 and 8 having a berthing length of 176 m and a depth of 10 m (below sea level) and at Puesto 9 having a berthing length of 90 m and a depth of 6 m (below sea level).

Muelle Setenta can be served with both rail-bound vehicles and mobile handling equipment. The quay equipment includes bollards installed at every third or second beam at the top of the pier. The fender system consisting of rubber tyres of the "Bridge Stone" type BS 500 K is screwed onto the front sides of the crossbeam by 6 heavy anchor bolts.

The fender mooring system has proved to be unsuitable. The bolts which are too close to the crossbeam edges are torn out heavily due to ship impact. The damaged fenders are now being replaced by heavy tractor tyres fastened onto the bollards.

Container Terminal (Proyecto Alemán)

The container terminal presently under construction shall be described here only very roughly. It is scheduled for taking up operation in early 1981. Being situated under the protection of the breakwater, it extends in southeast direction. The width of the terminal from pier edge to breakwater will amount to approx. 130 m. The terminal will be equipped with a ro-ro ramp. The length of the 2 berthing places (Puestos 10, 11) will amount to approx. 420 m. The water depth at Puesto 10 will be 10 m and will be used mainly for general cargo and ro-ro handling.

Berthing place 11, mainly meant for container handling, will have a water depth of -11 m (NMM). Access to the terminal is possible not only for track-bound vehicles but also for trucks or mobile industrial handling equipment.

Fenders, bollards, supply lines etc. shall be according to the latest standards.

Storage Sheds

The harbour of Limón has presently 7 storage sheds (Bodegas 1 to 7). All sheds have rail connection. The shed structures are not uniform, they reach from massive walls with timber roofs over steel skeleton constructions with brickwork filling to reinforced concrete structures with steel roof trusses and steel frame construction. Where the walls are not massive or consist of brickwork the wall facing is of corrugated sheet or Eternit. Except shed no. 1, all sheds are single storeyed, shed no. 1 is double-storeyed. The upper floor is used as office room.

All sheds are provided with gates in the side walls and partly also in the front walls, i.e. either slide gates or roller gates.

Other Buildings

In addition to the handling and storage sheds, there are the following buildings in the harbour area:

- main office
- office building of the project management Proyecto Alemán
- guard house
- stevedore and warehouse administration building
- workshop
- storage shed for local handling (at present used for construction purposes)
- cafeteria

The main office is situated at Avenida 1, at the harbour entrance. It is a 3-storey massive structure with flat roof and staggered on the frontside. A conference room is added on the east side on top of the roof. The management's office is situated in the building.

The office building of the project management of Proyecto Alemán is located at the east end of Avenida 1. It is a 2-storey building. The lower floor is a massive construction, the upper floor a timber structure.

Guardhouses are located at each access to the 2 piers where all incoming and outgoing vehicles are checked.

There are various 1- and 2-storey timber buildings between Muelle Nacional and Muelle Metalico along the shore accomodating harbour operation departments, stevedore administration etc.

The main workshop building (Taller mecánico) with vehicle workshop, locksmith's shop, mechanical and electrical workshop is located at the western harbour access in the extension of Calle 8. The building is a steel structure.

Finally, there is a storage shed which is presently used for the Proyecto Alemán. It is located directly opposite the Parque Varga at Avenida 1. This shed was constructed together with Muelle Metalico some 75 years ago. The station buildings are also located in the harbour area west of the main harbour access.

Open Storage Areas

Approx. 20.000 m² are available in the harbour as open storage areas. The main open storage areas are located west of Bodegas No. 1/7. Most of these areas are not paved. Further open storage areas are located east of the main harbour access between Muelle Metalico and Muelle Nacional. These areas have meanwhile been paved.

Traffic Connections

There is a shunting yard in the harbour extending in east-west direction from the western harbour entrance to the main harbour access. Its length is approx. 750 m at a width of approx. 60 m. There is a track connection between shunting yard and the individual pier facilities and storage sheds.

At present the harbour has 2 access roads, the main access road being situated in the extension of Calle 1 and the western access road. Both harbour accesses are connected by a harbour road leading up to the Proyecto Alemán. The road is paved on its entire length.

Port of Moín

Approx. 7 km of Limón a new harbour is being constructed at the mouth of the Moín river. Only 1 off-shore handling plant for liquid bulk has been available so far in the bay of Moín. It is connected with the Recope Refinery by 4 pipelines. In particular, there are 1 pipeline 20" for crude oil (length 1,238 m) 1 pipeline 8" for fuel oil, 1 pipeline 6" for kerosene and 1 pipeline 6" for gasoline, each 1,088 m long.

After completion of the harbour facilities which, according to the present state of planning, comprise a so-called oil pier, a ro-ro ramp and a so-called banana pier, oil handling will be moved to the oil pier. Until now the harbour has been protected by a southern breakwater. There are plans for the construction of a northern breakwater since the southern breakwater does not provide protection against the main wave direction.

Oil Pier

The oil pier runs in south-east direction and has a length of 218 m and a width of 26.20 m. The slab consists of reinforced concrete with a steel pile foundation.

50 % of the piles are of the "Frodingham Bore Pile No. 4" type whereas the remaining 50 % are of the "Rodange Box Pile" type. The pile lengths vary between 25 and 27 m. The design load of the piles amounts to 65 t.

Ro-Ro Ramp

The design of the ro-ro ramp is similar to that of the oil pier. It has a Randage pile foundation whereas the slab consists of reinforced concrete. The inclination of the ro-ro ramp is 4.47% at a length of 26 m. The height, related to NMM, varies between 1.82 m and 2.89 m. The effective width off-shore is 25.5 m, and 2.10 m on-shore. The ro-ro ramp, just as the oil pier, has been structurally completed by now.

Banana Pier

The banana pier extending southward shall have a length of approx. 404 m at a width of 26.20 m and a water depth of 12 m (below sea level) according to the present state of planning. It has a Randage pile foundation. The quay construction is designed to be supported on transversal beams at a distance of 3.6 m, longitudinal beams on the seaside and landside prefabricated beams between the transversal beam, a reinforced concrete slab and a top slab of concrete separated from the reinforced concrete slab by means of a bituminous coating. The total length of the quay slab is divided into 3 parts by expansion joints.

On-Shore Facilities

There are presently no facilities in the harbour of Moín determined for harbour operations. The buildings, existing in the harbour area, belong to the site installation.

Five pipelines with diameters of 20", 20", 8", 6", 6", are being laid through the harbour area to the future oil discharging tower.

Extension of the Northern Breakwater

The design concerning the extension of the northern breakwater in Moín has been drawn up and submitted by Rhein-Ruhr Ingenieur-Gesellschaft mbH at an earlier date. The report deals with the problem by which length the northern breakwater of the Port of Moín, now under construction, must be extended and here it has to be designed so that the significant wave height

$$H_{1/3} = 0,3 \text{ m}$$

at the berths designed for banana handling is exceeded on no more than 18 days a year on an average.

As result of the above mentioned report a breakwater length of 190 m can be regarded as sufficient.

Traffic Infrastructure

Road

At present, the city and the port of Limón are directly connected with the hinterland by the new road to Siquirres (Highway 32) and further on to San José (Highway 19). Highway 32 was completed in 1976 and is in a very good condition.

The harbour in the situation as experienced by the Consultants in Autumn 1979 has three entrances:

- the main channel, in prolongation of Calle 1 from the Avenida Central
- in the western part of the harbour, in prolongation of Calle 8, between the workshop (Taller Mecánico), and the former Tropicore
- in the eastern part of the harbour at the beginning of the breakwater (entrance to construction site of Proyecto Aiemán)

All these entrances to the harbour are connected by a port road giving direct access to all piers.

There is no adequate road connection between the port of Moín and Highway 32, Limón-Siquirres. The existent road No. 240 from Moín via Empalme Moín to Highway 32 and that from Moín via Portete to Limón are in poor condition and not suitable for heavy truck traffic. Recommendations concerning future access routes to the two ports are made in Volume III, Chapter F.

Railway

At present, railways link the port of Limón and San José, the capital of the country, with the Río Frío and Estrella region, where the major banana plantations lie. A marshalling yard is planned for an area about 1.5 km south of Moín, with lines leading to the harbours of Moín and Limón.

The Ferrocarril de Costa Rica intends to rehabilitate all lines in the Limón/Moín region by 1982; that is, to replace the ballast bed and the rails. The Moín-Siquirres line is to be electrified. The present workshops for maintenance and repairs in Limón are to be moved to Moín, next to the new marshalling yard.

In 1980, it is planned to remove temporarily the passenger station of Limón outside of the city. When carrying out the planning and rehabilitation of the Limón port, the passenger station is once again to be located near the city centre of Limón.

The tracks and switches in the port of Limón are no longer in keeping with safety and operating requirements. The building of a central marshalling yard in Moín will allow the track facilities for the port to be simplified.

Water Supply of the Harbours of Limón and Moín

Harbour of Limón

The water supply of Limón and thus also of the harbour represents a great problem especially during the dry season. It can be assumed that at present the water demand is covered only by about 60 %. During bunkering of ships it could be recognized that entire town districts were without water. This lack of water can easily lead to catastrophes in case of fire. For this reason, the fire brigade of Limón desires a larger number of permanently installed seawater hydrants. The distribution network itself appears to be sufficient. For new supply possibilities, see chapter J, volume III.

Harbour of Moín

Up to now, the pier facilities in the harbour of Moín do not include any water supply equipment. The harbour construction site itself is presently supplied by a well from which the water is pumped to a distribution tank and from there to the various consumers. There is no external water supply system to the harbour. The present water supply is not sufficient to cope with the expected future demand of the harbour area. Concerning the possibilities of supply, see chapter J, volume III.

Energy Supply of the Harbours of Limón and Moín

Harbour of Limón

The harbour and the city of Limón are presently being supplied via a dead end line (34.5 KV/60 Hz) from the power station adjacent to the oil refinery Recope. Current undulation amounts to ± 10 %. During the rainy season mains failure often occurs due to fallen poles etc. The power supply up to now cannot be considered satisfactory because of the frequent main failures.

There are plans to install a ring supply with connections to Limón and Moín. When this system is completed the supply problems will be eliminated.

Harbour of Moín

Up to now the harbour of Moín is not connected to the general power supply system but has its own power station. It is envisaged to connect the harbour of Moín to the new ring supply system to be constructed.

3. Traffic Analysis and Traffic Forecast
(Chapter C, Volume II, Drawing C-1)

Traffic Analysis

In the course of the past years the harbour of Limón has become the most important one in Costa Rica. Thus, in the last years about 60 % of the total foreign trade of Costa Rica was done through the harbour of Limón. Taking shipments by sea only into consideration, which amount to nearly 90 % of the total export trade in Costa Rica, one arrives at the following results:

Limón / Moín	64 %
Puntarenas	23 %
Golfito	13 %

According to the nature of the goods transhipped at the harbour of Limón, the latter may be considered as specialized in the export trade of bananas which, having amounted to 723,000 tons in 1978, was estimated at 82 % of the export trade of Limón or 65 % of the whole trade of Limón.

Crude mineral oil is unloaded at the "Recope" refinery facilities at Moín, and the tankers must actually remain at anchor in the bay of Moín.

Traffic Forecast

Existing traffic forecasts (Immediate Study - RRI/PTC/DEC, SYSTAN-forecast, JAPDE-VA-forecast) were revised as far as their plausibility is concerned and at the same time modified in accordance with the latest research works. The year 2000 was taken as the aiming year. The period of forecast was divided into different parts, wherein the lapse of time comprising up to 1990 should, to a certain extent, be liable to be included in the considerations.

The projects surpass this and go as far as 2000. However, they are to be simply understood as forecasts in the long run. Finally, it should be mentioned that structural modifications regarding export and import trade through the harbour of Limón were not taken into consideration. Structural modifications are in this connection, the different ideas for projects regarding an Industrial Zone at Moín.

Banana Export

One of the main development policies of the Government is to achieve an increase of the export rates in the near future. The project for development in the banana export comprises the following points, among others:

- a program regarding increase of production, producing now less than 2,000 boxes per hectare a year up to 2,500 boxes per hectare a year
- a program regarding extension of the cultivated area, aiming at the gradual and regular development of banana cultivation area. It concerns not only the extension of existing farms but also the formation of new areas, mainly in the region of Siquirres in a near future and the region of Sixaola in a long term.

According to these plans a production increase of about 50 % until 1990 will be possible, and as a result of this a performance of 1,089,000 tons (equivalent to 60 million boxes à 18.14 kilos) has been estimated for 1990.

Because of the idea of shifting the Banana-export to Europe and the Eastern side of the United States from Golfito (Pacific coast) to Sixaola (Atlantic coast), estimated up to 10 mio. boxes from 1990 to 2000, i.e. in the year 2000 there will be about 1,270,000 tons of bananas exported (equivalent to 70 mio. boxes) via Limón.

The construction on a new road to Bri-Bri and other improvements of the infrastructure of the southern Atlantic coast it was assumed, that the export of bananas of the Sixaola-region will be handled via Limón and not via Almirante (Panamá).

Table 1: Banana Export by Company and Total (in tons)

Year	Standard Fruit	Bandeco	Cobal	Total	
				(in tons)	(in mio. boxes)
1979	390,000	281,000	71,000	742,000	40.9
1980	410,000	296,000	74,000	780,000	43.0
1985	500,500	361,000	91,500	953,000	52.5
1990	571,500	412,500	105,000	1,089,000	60.0
1995	571,500	412,500	214,000	1,198,000	66.0
2000	571,500	412,500	286,000	1,270,000	70.0

General Cargo

The export trade volume has not been changed essentially in comparison with the Immediate Study. The results of analysis on macroeconomics carried out by ECAT-researches were the basis for a forecast of the other exports (except for bananas) and imports. One can count on a doubling of exportations (net balance of export products) up to 1990.

Special considerations were made upon the coffee export. Nowadays, nearly 10 % of the coffee export is handled via Paso Canoas, Panama; this percentage is containerized coffee. It was assumed that in the moment of implementation of container-operation in Limón this percentage will be shifted from Panama to Limón. A partly shifting of coffee export from Puntarenas to Limón was taken into consideration, as most of the coffee export is directed to Europe (72 %) and to the Eastern side of the United States (~ 14 %).

Nowadays the percentage of the total coffee export via Limón is approx. 60 %; an increase up to 80 % in 1990 is to be assumed. This means that the percentage of coffee export within the whole export trade will grow until 1990 and decrease from that year onwards, as the coffee production will not increase considerably any more.

As far as the export trade concerns general cargo (including export of meat, rice and cacao), it will not increase considerably before 1985 as at the moment there are no new plans for factories or enterprises for export trade. From 1990 onwards the export trade including the export of industrial products will increase due to the fact of increasing industrialization.

Table 2: Export Trade (in tons)

Year	Coffee (tons)	Total (tons)
1978	54,597	155,483
1980	75,000	175,000
1985	94,000	210,000
1990	100,000	260,000
1995	102,000	330,000
2000	105,600	400,000

Import Trade (Paper, Iron, Silicates, Fertilizers, General Cargo)

The percentage of paper import between 1976 and 1979 varied between 23.5 % and 27.5 % of the total import trade. A percentage of 25 % is assumed until 1990, as the consumption of paper in Costa Rica (especially for newspapers and cardboard production used in banana wrapping) will remain at the same level. From 1995 this percentage will decrease because of the implementation of a new paper factory.

The percentage of iron import between 1976 and 1979 varied between 9.0 % and 17.5% of the total import trade. Until 1990 a percentage of up to 12 % of the total import trade is assumed due to continuous development and growing industrialization of the country.

Since 1978 silicate-sand is imported via Limón because of the commencement of operation of a glass factory in Loyola near Cartago amounting to 6 % to 7 % of the total import trade. It is planned to enlarge this factory (producing not only bottles but also window glass), so that imports of silicate will increase not only proportionally but also absolutely, up to 10 % of the total import trade in 1990. Slight reductions from 1990 to 2000 in import of silicates might be possible.

Until 1976 bagged fertilizers were imported as well as fertilizers as bulk goods (11 % of the total import trade). Since 1977 fertilizers as bulk are imported via Puntarenas, and only bagged fertilizers are still imported via Limón amounting to 4.5 % of the total import trade. If no alteration is assumed this percentage may be maintained (minimum forecast). ABONOS SUPERIOR, however, is interested in importing fertilizers as bulk goods in a dimension of 100,000 to 150,000 tons per year to be bagged in Limón / Moín and distributed in Costa Rica. This possibility has to be seen as maximum-forecast for import of fertilizers.

The rates of general cargo imports decreased until 1979 down to 55 % of the total import trade. A future slight reduction seems to be realistic due to a higher industrialization. The forecasted figures for general cargo (including container-traffic and ro-ro traffic) are slightly reduced in comparison to the figures of the Immediate Study.

Table 3 : Import Trade (in tons)

Year	Iron	Paper	Fertilizer ¹⁾	Silicate	General Cargo	Total (in tons)
1978	31,200	83,976	15,095	(14,563)	203,676	348,510
1980	47,000	119,500	21,500	33,000	249,000	470,000
1985	63,500	144,500	(S) 29,000	47,000	271,000	555,000
			(G) 52,000			578,000
			(G) 60,000			606,800
1990	79,000	165,000	(S) 26,500	66,000	284,000	620,500
			66,000			660,000
			101,000			695,000
1995	82,000	159,500	(S) 28,500	65,500	348,000	683,500
			71,000			726,000
			151,500			806,500
2000	85,000	154,000	(S) 31,000	61,000	393,000	724,000
			77,000			770,000
			152,000			845,000

S = bagged fertilizers

G = fertilizers as bulk goods

In drawing C - 1 in the annex of this summary the traffic analysis and forecast is graphically presented.

1) The import figures for fertilizer consider three cases:

- bagged fertilizer
- conservative forecast for bulk fertilizer
- forecast according to investment options of Abonos Superior S.A.

Degree of Containerization and Modal Split Road/Rail

(Chapter D, Volume II, Drawing D-1)

At present only one container-line (Sea-Land) and two ro-ro lines (CCT and Panatlantic) are calling Limón/Moín. These three lines are carrying approx. 44 % of the incoming and outgoing cargo, which can be regarded as subject of containerization.

Taking into consideration:

- the above degree of containerization at present,
- additional container lines after completion of the container-terminal
- additional semi-container-lines which have to be expected in future,

the degree of containerization will increase to more than 80 % (including ro-ro) of the total general cargo in the year 2000.

As far as the bananas are concerned, the aspect of containerization has been analyzed. Bandeco is to be expected to containerize already in the short/medium run due to its merger with Reynolds (= Sea-Land). The other two banana-companies Standard Fruit and United Fruit do not foresee significant containerization even in the year 2000.

As the Consultant doubts in these statements, two alternatives have been worked out:

Case A = no substantial containerization of bananas for Standard Fruit and United Fruit (only approx. 5 % in the year 2000)

Case B = 100 % containerization of bananas in the year 2000.

This is shown in drawing D-1 in the annex at the end of the summary report.

It should be mentioned that both alternatives are equal up to the year 1990; the differences apply only to the years 1995 and 2000.

The measures taken by FECOSA regarding rehabilitation of the Atlantic railway-network play a decisive rôle in assessing the development of future railway transportation.

Reductions of travelling time, especially regarding the transport of bananas from the farms to the ports of Limón and Moín, were taken into consideration as well as a greater punctuality and a greater reliability of the railway operation.

Containerization of import and export goods will have a great influence on the modal split as well as ro-ro traffic. Most of this traffic will be handled by truck if the railway is not able to offer a suitable and effective operation.

The modal split of the conventional banana trade will not change essentially; when containerization commences a higher percentage of the containers will be carried by trucks on the road. Later on - from 1990 onwards - this percentage decreases due to the above mentioned improvements of FECOSA.

Considering, that coffee is going to be containerized completely in future, the conventional trade will decrease, especially if one considers the percentage of the total export trade volume. Modal split concerning the container traffic will change in favour of the railway-from 1985 onwards - due to the improvements of FECOSA.

The following modal split figures have been worked out for export- and import trade goods:

Table 4: Modal Split of Export and Import Trade

	mode of transportation	Export trade in tons / year									
		1980		1985		1990		1995		2000	
		%	tons	%	tons	%	tons	%	tons	%	tons
Ro-Ro traffic	road	100	53,000	100	63,000	100	78,000	100	99,000	100	120,000
	railway										
container traffic	road	90	32,000	90	79,000	70	89,000	60	101,000	60	130,000
	railway	10	3,000	10	9,000	30	39,000	40	68,000	40	86,000
conventional cargo	road	35	30,700	50	29,500	50	27,500	50	31,000	50	32,000
	railway	65	57,000	50	29,500	50	27,500	50	31,000	50	32,000

	mode of transportation	Import trade in tons / year									
		1980		1985		1990		1995		2000	
		%	tons	%	tons	%	tons	%	tons	%	tons
paper	road	85	93,000	85	110,500	85	123,000	85	117,500	85	111,500
	railway	15	16,500	15	19,500	15	22,000	15	21,000	15	19,500
iron	road										
	railway	100	47,000	100	63,500	100	79,000	100	82,000	100	85,000
fertilizer	road			30	24,200	30	30,000	30	45,000	30	46,000
	railway	100	215,000	70	56,600	70	71,000	70	105,000	70	106,000
silicate	road	100	33,000	100	47,000	40	26,500	20	13,000	20	12,000
	railway					60	39,500	80	52,500	80	49,000
Ro-Ro traffic (general cargo)	road	100	74,000	100	81,000	100	85,000	100	101,500	100	118,000
	railway										
container traffic (general cargo)	road	90	45,000	90	103,000	70	97,000	60	103,000	60	127,000
	railway	10	5,000	10	1,100	30	42,000	40	69,000	40	85,000
container traffic (paper)	road	90	9,000	90	12,000	70	14,000	60	12,500	60	14,000
	railway	10	1,000	10	1,500	30	6,000	40	8,500	40	9,000
conventional general cargo	road	90	112,500	85	84,500	85	51,000	85	5,500	85	53,500
	railway	10	12,500	15	11,500	15	9,000	15	9,500	15	9,500

5. Anticipated Port Operation
(Chapter E, Volume II)

This section of the summary will give a short introduction of the main findings which are detailed and worked out in the a/m part of this study. Before entering the recommendations and findings some tables will display the anticipated port situation in the general view. Afterwards the different port facilities and commodities are described in particular.

Table 5 shows the cargo volume as it will develop in future for the Cases A and B. Table 6 gives an estimation of the number of vessel which will call at Limón and Moín up to 2000. Table 7 indicates the berthday requirements for the total port complex and the overall utilisation for Case A development. Table 8 displays the cargo assignment and the resulting pier utilisations induced by the relating commodities applicable for the Case A. Table 9 reflect the possible solutions if the Case B-1 (a) will be realized.

The description of the individual alternatives is given in section 6 of this summary.

Container Terminal

At the time being the container traffic of Sea-Land is handled provisionally at the oil-pier in Moín or sometimes also at Muelle 70. After completion of the Proyecto Alemán 1981 all container lines will be handled in the new terminal in Limón. When calculating the capacity utilizations of the new terminal the Cases A and B have to be evaluated separately.

Case A

According to the traffic forecast and the anticipated degree of containerization, the future container volume will be as follows:

1985 = 45,000 containers
1990 = 64,000 containers
1995 = 74,000 containers
2000 = 80,000 Containers

The calculations of the capacity utilizations come to the result that one berth for the container vessels as well as the projected storage area on the Proyecto Alemán will be sufficient up to the year 2000, taking into consideration that Sea-Land containers, transported on truck, will not be stacked in the new terminal but in the Sea-Land yard on highway 32.

As far as the container gantry crane is concerned, one crane will be sufficient up to the year 1985/1986 and the second has to be installed in 1986. This calculation is based on an hourly net-productivity of 16 moves (= containers).

Table 5: Cargo volume in 1,000 tons to be handled at Limón and Moin

Type of cargo	1985	1990	case A - low containerisation		case B - high containerisation	
			1995	2000	1995	2000
container	486.5	691.0	813.5	906.0	1,049.5	1,721.0
break bulk	144.0	163.0	200.0	238.0	200.0	238.0
general cargo	241.3	291.0	287.5	279.0	287.5	279.0
conventional banana	135.0	115.0	137.0	127.0	137.0	127.0
petrol liquid bulk	683.0	684.0	746.5	815.0	510.5	nil
chemical liquid bulk (*1)	965.0	1,170.0	1,350.0	1,500.0	1,350.0	1,500.0
fertilizer bulk (*2)	9.0	9.0	9.0	9.0	9.0	9.0
total cargo Limón/Moin	80.0	100.0	150.0	150.0	150.0	150.0
	2,743.8	3,223.0	3,693.5	4,024.0	3,693.5	4,024.0

Note: -*1 According data received from the private enterprise "Quimicos Holanda",

-*2 according data made available by the company "Abono Superior"

Table 6: Number of vessels to be expected in Limón and Moin

Type of vessel	1985	1990	case A - low containerisation		case B - high containerisation	
			1995	2000	1995	2000
container	170	190	205	230	310	415
break bulk (*1)	158	175	192	192	192	192
general cargo	241	291	288	279	288	279
subtotal Limón	135	115	137	127	137	127
conventional banana	704	771	822	828	927	1,013
petrol tanker	300	259	274	299	188	nil
chemical tanker	24	29	34	38	34	38
fertilizer bulk vessel (*2)	10	10	10	10	10	10
subtotal Moin	14	21	21	21	21	21
total Limón and Moin	348	319	339	368	253	69
	1,052	1,090	1,161	1,196	1,180	1,082

Note: (*1- each break bulk vessel is calculated at a shipment of 1,000 tons,

(*2- each fertilizer bulk vessel transports 7,000 tons

Case A - low containerisation of bananas.
 Table 7 : Berthday requirements and utilisation for the whole port complex Limón/Moin
 - based on 360 commission days per year and pier -

berth	type of cargo	1985	1990	1995	2000
Muelle 70	break bulk	146	152	137	131
	general cargo	62	36	69	79
	subtotal	208	188	206	210
Proyecto Limón berth 10	Ro-Ro	61	68	79	94
	general cargo	148	140	126	112
	subtotal	209	208	205	206
Proyecto Alvarán berth 11	container	173	133	153	166
	general cargo	-	-	18	7
	subtotal	173	133	171	173
total berthday requirements Limón		590	529	582	589
utilisation Limón		55%	49%	54%	55%
general piers	conventional bananas	269 (308)	263 (300)	282 (320)	307 (349)
Moin	petrol liquids	51	62	73	81
	chemical liquids	10	10	10	10
	fertilizer bulk	36	54	54	54
	Ro-Ro	7	7	11	11
	subtotal	104	133	148	156
total berthday requirements Moin		373 (412)	396 (433)	430 (468)	463 (505)
utilisation Moin		35% (38)	37% (40)	40% (43)	43% (47)
total berthday requirements port		963 (1,002)	925 (962)	1,012 (1,050)	1,052 (1,094)
total utilisation Limón and Moin		45% (46)	43% (45)	47% (49)	49% (51)

Note: in brackets the figures for low banana gantry productivity of 3,200 boxes/hour

1985	BERTH UNIT	CON-TAINER	RO/ BREAK RO BULK	GENERAL CARGO	BANANAS	PETROL LIQUIDS	CHEMICAL LIQUIDS	FERTILIZER	TOTAL
LIMON	PROYECTO ALEMAR BERTH 10 + RO/RO-RAMP	—	17	41	—	—	—	—	58
	PROYECTO ALEMAR BERTH 11	48	—	—	—	—	—	—	48
	MUELLE 70	—	41	17	—	—	—	—	58
MOIN	OILPIER AND RO/RO-RAMP	—	2	—	14	3	10	—	29
	BANANA PIER BERTH 1+2	—	—	—	(43) 37	—	—	—	(43) 37
UTILIZATION REQUIRED BY COMMODITY PER BERTH UNITS		48	19	41	58	37	3	10	

1995	BERTH UNIT	CON-TAINER	RO/ BREAK RO BULK	GENERAL CARGO	BANANAS	PETROL LIQUIDS	CHEMICAL LIQUIDS	FERTILIZER	TOTAL
LIMON	PROYECTO ALEMAR BERTH 10 + RO/RO-RAMP	—	22	35	—	—	—	—	57
	PROYECTO ALEMAR BERTH 11	43	—	5	—	—	—	—	48
	MUELLE 70	—	38	19	—	—	—	—	57
MOIN	OILPIER AND RO/RO-RAMP	—	3	—	20	3	15	—	41
	BANANA PIER BERTH 1+2	—	—	—	(44) 39	—	—	—	(44) 39
UTILIZATION REQUIRED BY COMMODITY PER BERTH UNITS		43	25	59	39	20	3	15	

1990	BERTH UNIT	CON-TAINER	RO/ BREAK RO BULK	GENERAL CARGO	BANANAS	PETROL LIQUIDS	CHEMICAL LIQUIDS	FERTILIZER	TOTAL
LIMON	PROYECTO ALEMAR BERTH 10 + RO/RO-RAMP	—	19	39	—	—	—	—	58
	PROYECTO ALEMAR BERTH 11	37	—	—	—	—	—	—	37
	MUELLE 70	—	42	10	—	—	—	—	52
MOIN	OILPIER AND RO/RO-RAMP	—	2	—	17	3	15	—	37
	BANANA PIER BERTH 1+2	—	—	—	(42) 37	—	—	—	(42) 37
UTILIZATION REQUIRED BY COMMODITY PER BERTH UNITS		37	21	42	49	37	3	15	

2000	BERTH UNIT	CON-TAINER	RO/ BREAK RO BULK	GENERAL CARGO	BANANAS	PETROL LIQUIDS	CHEMICAL LIQUIDS	FERTILIZER	TOTAL
LIMON	PROYECTO ALEMAR BERTH 10 + RO/RO-RAMP	—	26	31	—	—	—	—	57
	PROYECTO ALEMAR BERTH 11	46	—	2	—	—	—	—	48
	MUELLE 70	—	36	22	—	—	—	—	58
MOIN	OILPIER AND RO/RO-RAMP	—	3	—	22	3	15	—	43
	BANANA PIER BERTH 1+2	—	—	—	(48) 43	—	—	—	(48) 43
UTILIZATION REQUIRED BY COMMODITY PER BERTH UNITS		46	29	55	43	22	3	15	

*) Note: - Values are expressed in % of 360 commission days
 - Values in brackets indicate the utilization of banana facilities for low gantry productivity (3,200 b/h)

This statement is based on the maximum economic utilization of approx. 50,000 containers per crane and year.

The operational system in the container terminal is described in detail and contains the following most important items:

- use of the pure straddle-carrier-system between yard and quay, due to short operation ways and limited area;
- use of the pure chassis system only for Sea-Land containers (transported by truck), without storage of chassis on the terminal;
- stacking of containers in three blocks in parallel direction to the quay;
- clear location of the chassis take-over-area on the internal road.

Case B

If the bananas will be fully containerized in the year 2000 the container volume will be as follows:

1985 = 45,000 containers
1990 = 64,000 containers
1995 = 105,000 containers
2000 = 178,000 containers.

It is obvious that the Proyecto Alemán will not be sufficient for the handling of the above container volume between the years 1990 and 2000. The calculations lead to the result that already in 1992 the stacking area has to be extended by removal of the shed on the Proyecto Alemán or by reclamation of new areas.

In case the shed on the Proyecto alemán would be removed, the new area would only be sufficient up to the year 1995; then additional stacking area must be available combined with a second berth for container vessels. The new berth must also be equipped with two container cranes in the year 2000. Possible commodity distribution and utilization of the ports for the recommended port development scheme B-1 (a) is listed in table 9.

ro-ro Berth

The ro-ro-vessels are berthed at present in Moín or at the Muelle Nacional in Limón. In future the ro-ro-ramp at the Proyecto Alemán will have first priority for these vessels as also adequate landside facilities (shed) will be available. Moín will only be used in future if the ro-ro-berth in Limón will be occupied, in order to avoid ship's waiting-time.

According to the traffic forecast and the anticipated portion of ro-ro from the total volume of general cargo, the following number of trailers has to be calculated within future:

1980 = 9,000 trailers
1985 = 10,000 trailers
1990 = 12,000 trailers
1995 = 14,000 trailers
2000 = 17,000 trailers.

The calculations of the capacity utilizations lead to the result that the berth in Limón will only be utilized to a relatively low percentage, i.e. approx. 17 % in 1980 and 29 % in the year 2000. This calculation is based on an hourly net productivity of 12 trailers.

The free capacity of the ro-ro-berth should be used with priority for the handling of general cargo, as higher productivities can be achieved at the Proyecto Alemán than at the Muelle 70.

As far as the storage area for ro-ro-trailers is concerned, approx. 6,000 squ.m. have to be provided in Limón as well as in Moín. This area will be sufficient for the storage of approx. 100 trailers including necessary operation ways for the trucks.

This area will be located near the Muelle 70 in Limón, as no space is available besides the new ro-ro-ramp. In Moín, however, this area is located opposite to the ro-ro-ramp.

Breakbulk and General Cargo

The breakbulk commodities and general cargo should be handled at the Muelle 70 and the berth 10 at the Proyecto Alemán. The operation method require an intermediate transport of the goods from the pier to the storage area and vice versa if the goods are handled at the Muelle 70. The lack of storage facilities behind the pier will be disadvantageous and must be compensated by the use of additional equipment of trailers and trucks as mentioned above.

With the implementation of a three-shift-system and the change of operation methods the productivity of the gangs will rise and make the port capable to handle the expected cargo volume (in 1000 tons):

Commodity	1985	1990	1995	2000
<u>breakbulk</u> *)				
iron	63.5	79.0	82.0	85.0
paper	130.0	145.0	138.0	131.0
bagged fertilizer	0.8	1.0	1.5	2.0
bulk silicate	47.0	66.0	65.5	61.0
<u>general cargo</u>	135.0	115.0	137.0	127.0

*) the commodity of bulk fertilizer is not included as it will be handled at Moín

Table 9 : Distribution of Pier Utilization and Cargo Assignment
- Case B (Alt. 1 a) -

	BERTH UNIT	CON-TAINER	RO/RO	BREAK BULK	GENERAL CARGO	BANANAS	PETROL LIQUIDS	CHEMICAL LIQUIDS	FERTILIZER	TOTAL
LIMON	PROYECTO ALEMAN BERTH 10 + RO/RO-RAMP	—	22	—	25	—	—	—	—	47
	PROYECTO ALEMAN BERTH 11	20	—	—	25	—	—	—	—	45
	MUELLE 70	—	—	38	9	—	—	—	—	47
	CONTAINER TERMINAL (NEW) 1 BERTH	24	—	—	—	—	—	—	—	24
MOIN	OILPIER AND RO/RO-RAMP	—	3	—	—	—	20	3	15	41
	BANANA PIER BERTH 1+2	—	—	—	—	(31) 27	—	—	—	(31) 27
UTILIZATION REQUIRED BY COMMODITY PER BERTH UNITS		44	25	38	59	(31) 27	20	3	15	

	BERTH UNIT	CON-TAINER	RO/RO	BREAK BULK	GENERAL CARGO	BANANAS	PETROL LIQUIDS	CHEMICAL LIQUIDS	FERTILIZER	TOTAL
LIMON	PROYECTO ALEMAN BERTH 10 + RO/RO-RAMP	—	26	—	25	—	—	—	—	51
	PROYECTO ALEMAN BERTH 11	20	—	—	25	—	—	—	—	45
	MUELLE 70	—	—	36	5	—	—	—	—	41
	CONTAINER TERMINAL (NEW) 1 BERTH	37	—	—	—	—	—	—	—	37
MOIN	OILPIER AND RO/RO-RAMP	—	3	—	—	—	22	3	15	43
	BANANA PIER BERTH 1+2	—	—	—	—	0	—	—	—	0
UTILIZATION REQUIRED BY COMMODITY PER BERTH UNITS		57	29	36	55	0	22	3	15	

Note: - Values are expressed in % of 360 commission days

- Values in brakes indicate the utilization for low gantry productivity (3,200 b/h)

The port of Limón must be able to handle the a/m goods preventing losses to the Costa Rican national economy. The measurements necessary to achieve this target are as follows:

- structural rehabilitation of the Muelle 70
- to work on the Muelle 70 with maximum 4 gangs due to limited traffic space
- to achieve by tariff policies a 100 % indirect cargo flow (expert for bulk silicate) to avoid direct handling
- implementation of port pallet system and intermediate truck/trailer transport on the Muelle 70
- provision of at least one forklift per gang ashore and one per gang aboard
- creation of a dangerous cargo yard of 500 squ.m. according to IMCO-regulations
- implementation of new shiftsystems, 3 shifts per 8 hours for ship-side operation and 2 shifts per 8 hours for the landside receipt and delivery of cargo.

Banana Handling at Moín

The banana handling shall be performed at Moín with two banana piers. This provision of berth space will meet the requirements up to the year 2000. Equipped with 5 gantries the utilization seldom will exceed the annual occupancy of 48 % even in case the elevators will work at the estimated low productivity of 3,200 boxes per gantry hour.

The number of elevators might cause a bottleneck. Therefore, it is highly recommended to install a fifth elevator with the completion of construction and start of operation. Thus the port will be able to guarantee an acceptable staytime in port, the reduction of waiting time at anchor and the provision of sufficiently performed operation.

In 1990 if the containerization of banana will be lower than estimated by the consultant (Case A) the sixth elevator must be purchased. If the Case B becomes true the operation could be continued with 5 elevators without any losses of shipstay-time.

Following measurement will be required making Moín a well operating banana terminal:

- implementation and installation of a gantry supply system adequate for the type of gantries
- provide rain shelter roof enabling to unload railcars also during rain

- guaranteeing the interchangeability of elevators between the piers
- establishment of well coordinated pre-planning system between the port operator, stevedore, banana company and Fecosa.

Liquid Bulk Handling at Moín

The petrol products imported by Recope and the low quantity of chemical products of "Quimicos Holanda" should be handled at the oil pier at Moín. The shipside operation should be performed by the private companies under supervision of the port authority.

The private companies like Recope have to provide all the safety measurements which are required for the operation of such kinds of goods.

Dry bulk Handling (fertilizer bulk)

The quantity of fertilizer bulk will reach 150,000 tons in 1990 which means a berthday requirement of approx. 50 days per 360 days.

Having installed adequate discharging facilities the fertilizer could be either handled at the oil pier without creating substantial berthing problems or could be settled at a third pier adjacent to the banana pier No. 2. In this case a third pier will be necessary and it could act as a dry bulk terminal although the utilization will be low in case that fertilizer will be the only commodity handled there.

Equipment and Workshop Facilities

To ensure a continuous port operation in future and to avoid any losses of operation output the equipment situation must be improved. Due to the operation requirements indicated in the previous chapters following measurements will be necessary:

- to provide the equipment as shown in table 10
- to establish a maintenance and repair organisation which guarantees the economic operational use of the equipment
- to construct a new central workshop for the rolling stock

These measures should be realized immediately and being completed with the operation start of the container terminal (Proyecto Alemán).

Together with a permanent training of the equipment drivers the a/m recommendations will lead to an improved port efficiency.

Table 10: Equipment

type of equipment	1985		1990		case A		case B		remarks
					1995	2000	1995	2000	
container gantry cranes	1		2		2		3	4	
straddle carriers	5		7		8	9	13	22	
banana elevators	5		6(case A) 5(case B)		6		5	5	at Moin
railcar pusher	3		3		3		3	3	for railcar shunting at Limón
<u>forklifts</u>									specification of lifting capacity see table below
break bulk (Muelle 70)	13		14		14	14	14	14	
general cargo(berth 10)	16		16		16	16	16	16	
empty container	2		2		2	2	3	4	
total	30		32		32	32	33	34	
<u>trucks</u>									five of these trucks will be used also for general cargo operation and require adaptability for Ro-Ro trailers and general cargo trailers.
Ro-RO (berth 10)	5		5		5	5	5	5	
break bulk (Muelle 70)	5		5		5	5	5	5	
total	10		10		10	10	10	10	
<u>trailer</u>									the trailers could also be used for container transport in case of LCL handling, the 15 trailers for general cargo are required if berth 11 will be used for general cargo vessels
break bulk	15		15		15	15	15	15	
general cargo	15		15		15	15	15	15	
total	30		30		30	30	30	30	
mobile cranes	2		2		2	2	2	2	
<u>forklift specification</u>									
3 tons	23		25		25	25	25	25	
7.5 tons	5		5		5	5	6	7	
15 tons	2		2		2	2	2	2	
total	30		32		32	32	33	34	

6. Port Development on the Atlantic Coast
(Chapter F, Volume III)

General

The development of the ports of Limón and Moín until the year 2000 will largely depend on the degree of containerization of bananas. As stated before two assumptions were made:

Case A : low degree of containerization

Case B : high degree of containerization up to 100 % in the year 2000

After starting operation of Proyecto Alemán and completion of construction, further operational and organizational measures are proposed for Case A development. Both ports Limón and Moín will then sufficiently be capable to handle the expected traffic volume beyond year 2000. Case B would require that new port facilities be available as early as in 1992 to ensure cargo handling in the ports of Limón and Moín. As nobody can tell at the present stage which development will eventually take place these two assumptions are to be considered an aid for those who are responsible to watch the development carefully and place the investments reasonably according to the actual necessities.

Rehabilitation and Extension of Ports of Limón and Moín up to the year 2000 -
Case A

(Drawings F-2.2, F-2.5)

The anticipated port needs according to the traffic forecast have been analysed and compared with the supply capacity of the then operating Proyecto Alemán. Required berths, storage facilities and operation-system to achieve the standards for a proper port operation have been determined. From this it was concluded that the port of Limón will work with an optimum overall utilization during the future period (1981 to the year 2000) of approx. 55 %. In order to reach and maintain this port utilization it is necessary, however, to increase the present inadequate port infrastructure and to supply the technical equipment that this progress will not be hindered. For the port of Moín, the most urgent measures are to finish the port structures and provide the necessary infrastructure as power and water supply, railway facilities etc.

Generally expressed, for Case A no new port facilities are needed but rehabilitation and extension of existing ones. The proposed measures must be started right away to ensure optimum cargo handling in the ports of Limón and Moín.

Preliminary designs for all structural measures inside the ports Limón and Moín have been worked out. A description is given in section 10 of this summary.

Development of the Ports of Limón and Moín up to the Year 2000 - Case B
(Drawing F-3.1)

If, due to the containerization of bananas, Case B should occur as predicted in the forecast, the port facilities in their present concept of the ports of Limón and Moín will not suffice the requirements as far as the container handling is concerned as early as in 1992. This means mainly measures for the extension of container storage area and the construction of new berthing places which subsequently can also result in a modification of the existing handling facilities for General Cargo and Break Bulk.

Generally, there are two possibilities for a new construction or an extension of the handling facilities for the future container traffic, i.e. the harbours of Limón and Moín. A construction of a new container terminal in Limón would merely signify an extension of the Proyecto Alemán, whereas a new construction in Moín would have far-reaching consequences for cargo handling in Limón.

When such expensive construction measures are concerned it goes without saying that not only operational and technical requirements have to be fulfilled but it must always be kept in mind in how far the harbour could be extended after the forecast period, i.e. beyond year 2000.

In view of the operational and organizational requirements worked out the following alternatives were established and analysed. The alternatives explained will offer reasonable solutions for the stated problematics:

- Alternative B - 1 a : Construction of a new container terminal with one berth in Limón.
- Alternative B - 1 b : Construction of a new container terminal with two berths and change of the Proyecto Alemán into a General Cargo and Breakbulk Terminal in Limón.
- Alternative B - 2 : Construction of a new container terminal with one container berth and one general cargo berth in Limón.
- Alternative B - 3 a : Construction of a new container terminal with one berth in Moín.
- Alternative B - 3 b : Construction of a new container terminal with two berths in Moín.

When evaluating the port development alternatives it was concluded that alternative B-1 (a) shows the most important advantages while the disadvantages carry no great weight. This alternative offers the lowest construction cost of the Limón development possibilities 1 (a) and 1 (b) and 2) and implies future extension capacity and develops Limón, as started with Proyecto Alemán, to a container and general cargo port, i.e. a common port. If in the years following 1995 operational difficulties due to the container handling separated by the General Cargo operation and its harbour basin will arise and may effect port efficiency, appropriate measures can be undertaken to extend the new 1 berth-terminal by a second berth analog to alternative B-1 (b). Most important, however, is, that the fully operating Proyecto Alemán stays as the basis for effective port operation at least 15 to 20 years.

Alternative 1 (b) shows operational advantages but makes the container terminal concept of Proyecto Alemán doubtful and requires tremendous investments in Limón for container handling.

The third alternative, B-2, is the most unfavourable solution for port development in Limón, slight operational disadvantages which might occur due to the separation of the 2 container berthes through the harbour basin are minor as there will be no possibility to an integrated future development. The necessary arrangement of the general cargo berth west of the new 1 berth-container terminal hampers any extension in this direction. Also, this alternative shows higher construction cost compared with alternative B-1 (a).

As stated before, any construction of container handling facilities in Moín would have far-reaching consequences for cargo handling in Limón, i.e. that the main traffic will be transferred to Moín with its limited extension possibilities whereas Limón with its far better development possibilities will decline in its importance. This applies in the same way to alternative B-3 (a) and 3 (b). Whereas alternative 3 (a) would merely be a compromise to introduce handling capacity for excess banana container, the logical way would be to consider alternative 3 (b) as a possible solution. Also it seems theoretically possible to operate 2 by more than 4 km separated container terminals simultaneously for the same customers (since all 3 banana exporting companies might call Limón for balance of trade with respect to empty containers), past experience and new constructed ports in many countries indicate the advantage of unitized terminals. Thus, only alternative B-3 (b) remains as a comparable solution to the proposition made for Limón.

Both alternatives for Moín must be put into operation 1992, whereas construction measures for the Limón alternatives must be finished earliest 1994/95. In addition, considerable investments must be taken for relocation of the Moín-River outflow, since the dam construction as proposed for now will lay in the future harbour basin of these alternatives. The cost comparison indicates relatively low construction cost estimates as valued against alternatives B-1 (a) resp. 1(b) but it should be kept in mind, that relocation costs of the river outflow are not included in this estimate. It is calculated that due to the early investment necessary to finish these alternatives, the economic benefits in terms of net present values (NPV - 1980) are lower as compared with the alternatives in Limón (the higher the NPV the more disfavoured the project).

This is illustrated in the following table:

Alternative	Construction Cost in Mio. US \$		NPV in Mio. US \$ 1980	Year of operation
	1979	1980 ¹⁾		
B - 1 (a)	50.5	84.6	11.9	1995
B - 1 (b)	68.8	115.1	11.8	1995
B - 2	53.8	86.7	12.3	1995
B - 3 (a)	35.1	58.8	12.3	1992
B - 3 (b)	54.8	91.8	19.5	1992

1) 15 % inflation, 4 % engineering and 40 % foreign exchange cost added, no local participation assumed.

1979 construction cost include contingency allowances, whereas 1980 prices are adjusted to inflation and foreign exchange components, imputed no local participation. The NPV considers the different years of investment allocation and construction start.

Taking the above mentioned into account, it is recommended to assign the cargo to the ports of Limón and Moín according to Alternative B-1 (a). It is obvious, that this division of cargo assignment guarantees the most economical combination of the two ports.

It is secured that there will be extension and development capacity for "general goods" either containerized or conventional resp. in break bulk in Limón and, what is equally important, this scheme offers the possibility to serve in Moín all future needs of prospective port users. Although, as discussed in Chapter C, future customers for the port of Moín could not be identified due to the very early stage of prospecting for industrial developments in this area, it is believed absolutely necessary to provide ingenious extension potential for such developments in Moín as a so-called "special port".

Based on the recommendations above, the Port Masterplan concept of the Limón/Moín area rests on an integrated development of the Port of Limón according to alternative B-1 (a) and a future utilization of the Port of Moín for specialized commodities.

In the following, the general conceptions of this selected development alternative is given.

Alternative B-1 a

- Construction of a new container terminal with one berth in Limón -
(Drawing F-3.1)

The container storage capacity of the Proyecto Alemán with 1044 TEU's will be reached by the year 1992. Taking into consideration the space requirements for 4,125 TEU's in total the new container terminal must allow a storage of 3,081 TEU's in two layers.

The required length of quay is determined by a container vessel of the 2nd generation, which will be expected also in the long run. This berth will be equipped with two container cranes up to the year 2000.

When establishing the new container terminal, the integration of a near-by parking area for ro-ro trailers is advisable. It is therefore recommended to provide the area next to the workshop, so that the ro-ro trailers have only short distance to the vessels, but being separated from the container traffic. The area needed for the entire terminal will be gained by land reclamation west of the Proyecto Alemán with pier being designed as deck-on-pile structure.

Between the new terminal and the Proyecto Alemán the width of the harbour basin must be at least 150 m at a depth of 11 m.

The whole terminal must be taken in operation by 1995, the designated ro-ro area, however, as soon as 1992 until 1994 this area will be used for container stacking.

As far as the entrance for the container terminal is concerned, it is advisable to establish centralized entrance gates for both container terminals. Due to the increase in number of straddle carriers the recommended workshop has to be extended by a third box for straddle carriers. This box should be directly adhered to the other two boxes. All other workshop facilities can remain as they are.

Concerning the coordination between both container terminals, long distances for personnel and equipment have to be covered due to the basin between the terminals if no exact coordination is guaranteed. We therefore recommend to clearly allocate the shipping lines to both terminals, so that a shifting of containers during the operation from one terminal to the other can be avoided. This allocation must be based on the expected container volume per shipping line and the time table of the lines. Personnel and equipment must be centrally assigned every day according to the operational requirements. When dividing the two container terminals in such a way separate chassis areas, separate rail connections as well as separate inventory control of containers must be available. In exceptional cases if a container vessel will be berthed at one terminal whereas the containers are stacked in the other terminal, the internal transportation must be performed with chassis and trucks.

As general cargo vessels will continue to berth at berth 10 some interference with the port operations is likely to occur.

Future Traffic Connection to the Hinterland

Railway

At present the port of Limón and San José, the capital of the country, and both most important banana plantations in the Rio Frio and Estrella region are linked by railway connections. For the future, a marshalling yard is planned in the area about 1.5 km South of Moín and from there a connection to the harbours of Moín and Limón. The planning and design of this marshalling yard, however, is not the subject of this study, but will be influenced strongly by the general concept of the larger area of Limón and Moín.

The new marshalling yard should serve as central shunting station for the area of Limón and Moín. An advantage is that a centralization of the shunting operations enables a more efficient employment of both personnel and equipment. Also avoided will be, as initially planned, a shunting station merely intended for banana handling, that means a very specialized one, which, in the event of any change in the handling system or containerization of bananas, would probably require reconstruction. Other functions of the central shunting station will be to operate all freight trains for the area of Limón/Moín, to classify banana waggons and prepare the waggons bound to the port of Limón; to collect and forward the empty waggons as soon as possible, furthermore, clean the empty banana waggons and let them continue fast, detect damages on waggons and have them repaired in the main repair shop.

The capacity of the central marshalling yard should be dimensioned such that it could receive about 10 loaded banana trains daily and send them to Moín harbour; and then collect and distribute the corresponding empty waggons.

Additionally, 2-5 goods-trains will come from San José and will be prepared to continue to Limón harbour. Likewise, the trains coming from Limón and going to San José will be arranged there.

The present single track linking Limón and Moín should be electrified and upgraded to twin tracks. By this, trains coming from Siquirres (and the Central Valley) could continue to Limón with the same traction vehicle, although increased goods and passenger traffic could be handled, which is doubted by using the single track in future.

Road

The city and the port of Limón are directly connected to the hinterland by the new road to Siquirres (Highway 32) leading the San José either via the old highway 10 or the new connection (highway 10 - Siquirres - San José) which is expected to be opened 1981. For the port of Moín a sufficient road connection to highway 32, Limón - Siquirres, is not available. The construction of this new connection is essential. The alignment could be similar to the planification made by BEL Ingeniería S.A.¹⁾ in August 1979. A one-level crossing with the Highway 32 seems to be sufficient; the trumpet-intersection proposed by BEL Ingeniería S.A. is not necessary in the first stage due to the relative low traffic load of the new connection road. Special lanes for the turn-off traffic are recommended in order to guarantee no hindrance for the through-traffic on the highway 32.

The road traffic between the two ports as well as to the container- and ro-ro-terminals (Pan Atlantic, Sealand, CCT) will be handled via this new road. The existing road connection Limón - Moín via Portete will be used in future only by private cars and vans. The existing road No. 240 from Moín via Empalme Moín to the highway No. 32 is not to be used for heavy traffic (trucks) because of the gradient and radii and environmental considerations.

Development of Additional Ports on the Atlantic Coast (Drawing F-6)

The National Development Plan 1979-1982²⁾ shortly mentions the development of new port facilities on the Atlantic Coast. Within the course of the study, the Consultants advise the following:

The necessity of an additional banana port can be neglected. Only small amounts of conventional exports arise due to containerization, furthermore the relative short distance of the plantations to Limón/Moín, extended rail-and road infrastructure and most of it the efficient installations in Limón/Moín, whose capacity could be extended, advocate this.

Regarding the question for tanker transloading facilities the following findings result:

1) BEL Ingeniería S.A., Consulting Engineers, San José, Costa Rica

2) Plan Nacional de Desarrollo 1979-1982

"Gregorio José Ramírez", San José, Costa Rica 1979

This would be the 2nd step towards further development of the port of Limón. As discussed before, this step would signify a change of the function of the Proyecto Alemán from a general cargo and container terminal into a general cargo and break bulk terminal, due to the following reasons:

1. If Alternative 1 (b) is implemented, Muelle Setenta would have to be demolished and a new place would have to be found for break bulk handling which could only be in Limón because a splitting of break bulk and general cargo handling between two separated harbours would not be reasonable and would be contradictory to common practise of harbour operation.
2. When due to a further increase in container traffic the 2nd step [1 (b)] will be implemented after the year 2000, a separation between two container terminals by a harbour basin and a general cargo pier can no longer be maintained.

From this results that in the long future the total container traffic could be concentrated in one terminal and the present container berth which is then free could be used for break bulk handling. That means, after completion of the 2nd step [1 (b)] the port of Limón will have one container terminal and one general cargo - break bulk terminal

These first two steps of the development of the port of Limón can be covered by the forecast and can thus be regarded as realistic if Case B occurs.

From the structural point of view the layout of the two alternatives is such that - except for the construction measures described in the previous chapters - no changes of the harbour protection facilities are involved. That means, first an extension of the breakwater which would forcibly be connected with high investment costs is not required.

In the event that a development is necessary beyond the second alternative, which cannot be foreseen at the present stage, the port of Limón offers excellent possibilities of extension provided that the existing breakwater is extended and a new one built from west to northeast providing protection to the harbour by two breakwaters.

This would permit the construction of further berthing places from north to south (Cieneguita). In this case the mouth of the Rio Cieneguita would have to be moved to avoid sedimentation of the harbour and to provide a continuous harbour area. This would also mean that new living space would have to be found for the population that has to give up its present residences due to the construction measures. It results from the planning documents for future projects received from OFIPLAN¹⁾ that the rehabilitation of this part of Limón has long been planned and there are also plans to create new living quarters east of the dead-end branch of the Cieneguita river.

1) Oficina de Planificación Nacional y Política Económica, San José

- a seaberth terminal at Moín would be an optimal
- the oil should be handled by a single buoy mooring system
- the seaberth should be sheltered against the predominant swell. This could be reached by a breakwater which later should be investigated by a model and cost-benefit-analysis.

The development of fishing activity (mainly lobster) should take place in Cahinita or Puerto Viejo, where at present small scale lobster fishery is operated. Promotion of the low income zone and future extension capability favour this location against Moín. A settlement in the Moín Bay is not possible, because the area around Moín harbour is planned to be used for industrial establishments, harbour and berthing places are designed for large vessels. But concerning this, as mentioned before, first of all the results of further studies should be awaited.

Masterplan Concept for the Ports of Limón and Moín

The difference between Case A and Case B is that they proceed from different assumptions as regards the development of container handling. Case B, therefore, implies essentially the allocation of the container handling operations to the ports of Limón or Moín and, as a consequence thereof, assignment of the handling of other types of goods. As such development would not occur before the year 1990, the Masterplan study can only outline possible development schemes of the ports of Limón and Moín. This is in conformity with what is generally practised when setting up a Masterplan: setting a rational development framework into which successive construction projects can be fitted as the traffic increases.

For this, the authorities concerned should maintain a permanent ability to recognize changes in demand in order to re-assess the development program. The Masterplan should have a continuous existence as a reference document. It should be modified, for instance, to take a new look at the future situation (in the present rapidly changing stage in shipping and also economic development) or as a result of events in the course of the current period which make a review desirable.

Port of Limón

(Drawing F-7.1)

The harbour of Limón as "common port" should be reserved in the future for the transshipment of containers, general cargo and break bulk as homogenous goods, as all necessary installations are existing by the realization of the Proyecto Alemán.

The alternative which would best meet the requirements of an increased container traffic and which at the same time would offer the best possibilities of development is Alternative 1 (a) which includes one berth in Limón. For Case B this is a first step towards a further harbour extension. This alternative is so designed that it can be extended to Alternative 1 (b) at any desired time, i.e. as traffic volume increases and/or operation requires; that means the construction of a second berth including storage areas.

Port of Moín
(Drawing F-7.2)

The future of Moín lies in its potential for spacial development associated with the realization of an industrial zone and other economical activities in the area between the present port and the RECOPE refinery. It would be unreasonable to expect that the industrial planning policies of the government will not be implemented only because such policies are presently not very precise and subsequently growth factors for traffic increase could not be established.

Therefore, this long-term plan for Moín will place more emphasis on what is desirable than on what the actual data seem to show to be likely. The role of the port includes especially the following tasks:

- to serve the nations need for supply with crude oil and special bulk commodities, which are to be handled at special terminals
- to assist in generating trade and regional development.

This land-use aspect in the neighbourhood of the port is very important since modern developments have made the need for ample land space and nearby port facilities for special uses much more imperative than it was the case in the past.

From the technical point of view, the future port of Moín presents itself as follows:

As there will be no banana handling operations at the banana pier of the port of Moín from the year 2000 if Case B comes true this pier can be used for other goods, such as industrial goods. According to the concept of the diversion of the Rio Moín in Case A, this pier can be extended by about 200 m, i.e. a further berthing place.

The possibility of future further extension are additional berthing places as discussed in connection with the possibilities of a container terminal in Moín. However, it has to be stated, that the extension in Moín would be restricted by the need of discharging the Rio Min at the root of the southern breakwater as any other place along the coast line would cause a silting up of the river mouth.

Summing up, the port of Moín shall in the opinion of the Consultants in future serve as a "specialized port" for industrial and bulk cargo.

7. Port Organisation
(Chapter G, Volume III)

The actual situation in the Port of Limón shows that many participants are involved in the important port activities. The Ministry of Transport (MOPT) is responsible for planning and financing of larger port facilities, whereas the Japdeva is responsible for the administration of the port, the port-internal transport of cargo, the storage of cargo, the performance of investments, the maintenance and repair as well as the economic development of the Atlantic slope. In addition to these two institutions three stevedoring companies are working in Limón being responsible for the shipside and shoreside handling of cargo, whereas the forwarding agents themselves are responsible for the landside delivery of cargo.

This complicated and unprecise allocation of responsibilities is disadvantageous due to the following reasons:

- no integrated port planning is guaranteed
- too many transfer points in the cargo chain
(no precise definition of cargo claims possible)
- insufficient cooperation between the partners in the port.

In order to guarantee an integrated national port policy and the organizational integration of Limón/Moín, it is recommended to establish a National Port Authority with its domicile in San José as well as a Port Authority in Limón.

As far as the allocation of responsibilities in the port is concerned, four logical alternatives have been evaluated with their advantages and disadvantages. These alternatives include the elimination of the activities of the forwarding agents and show different fields of activities for the Port Authority and the stevedoring companies.

This evaluation leads to the result that one alternative should be favoured choosing a limitation of the stevedoring companies to the ship's side while the Port Authority should take over the public services of the port as well as the shore-side operation.

This recommended alternative shows a clear allocation of responsibilities of the entire port, guarantees an uncomplicated integration of the new container terminal and meets also the requirements of the transport chain.

It can be stated that a decision on the port organisation will in any case be a decision on the medium/long run. Therefore, the existing problems (e.g. limitation of the stevedore's activities) should be solved now and should not be postponed by mixing the various alternatives. Due to the size of the port Limón/Moín and the aspects of flexibility in the ship's disposition, only one organizational system for the entire port must be valid;

A split-up of facilities with different organisation systems incur permanent problems. For that special reason it is also recommended to separate factories/ industries, which perform their operation independently from the Port Authority, from the public port area.

As far as the internal structure of the Port Authority is concerned, it is recommended to have one Director General as head of the Authority, assisted by six managers for the following departments:

- operation
- technique
- finances and administration
- marketing
- planning
- harbour master.

Such organization shows a clear separation of different fields and especially the creation of a marketing department implies a special emphasis on selling policies and advertising in future.

Regarding the administrative procedures it is recommended to generally stick to the existing procedures. However, it is necessary for the purchasing department to improve the period of availability for spare-parts especially. Based on the new proposed organization and several disadvantages of the existing port tariff a new tariff structure has been worked out including aspects of:

- value of cargo
- increase of productivities
- customer's calculation.

As far as the operational procedures are concerned most of the existing procedures can be performed also in future, provided that the following aspects will be observed:

- a central disposition shall be responsible for the disposition of berths, personnel and equipment;
- at the time of arrival of cargo in the port, the related documents must be available; otherwise the cargo cannot enter the port;
- the customs should reduce the cargo checks and the inspection should be performed on the original storage area.

Besides these operational procedures for general cargo and break bulk, new procedures have been established for the container-traffic, coping with modern international standards.

With regard to the completion of the new container terminal and the implementation of operational improvements, training programs for the supervision staff of the operational department become necessary.

It is recommended to have separate training programs for the container terminal and general cargo facilities. Both programs should consist of the following phases:

- training of Costa Rican personnel abroad
- preparation phase in Limón for the following management assistance on the spot
- management assistance phase in Limón for the implementation of operational recommendations and training of counterparts on the job.

B. Nautical Requirements
(Chapter H, Volume III)

To improve the nautical situation at Limón and Moín and giving the port complex an international competitive standard it is necessary

- to facilitate the navigation
- to provide sufficient maritime services to the ships.

Following measurement have to be undertaken:

- introduction of the buoyage system "A", ¹⁾ green to starboard, red to port
- layout of buoys in the harbour vicinities of Limón and Moín according to international requirements
- rehabilitation of the lighthouse Isla Uvita
- installation of a range light system at Moín
- out-fit of significant marks such as buoys and pier marks with passive radar reflectors
- supply of adequate tug boats of at least each 20 tons bollard pull
- improvement of radio station
- provision of maintenance and repair facilities for floating equipment and navigational aids
- demolishing of 45 m of berth 1 at Limón to provide a safe basin entrance for the Proyecto Alemán
- establishment of a harbour master department responsible for all maritime services.

1) the so-called system "A" has been approved by the United Nations and has been introduced in Africa, India, Australia, Europe and parts of East Africa.

4. Oceanographic, Hydrographic and Hydrological Investigations
(Chapter I, Volume III, Drawing F-7.2)

After problems had occurred during the construction work in 1977, various investigations and analyses regarding the planning and design of the Harbour of Moín in Costa Rica were conducted on behalf of RECOPE and MOPT as follows:

1. Hydrographical conditions in the area of Bahia de Moín, Expert's Opinion on the construction of a New Harbour by Prof. Burkhardt on behalf of RECOPE, February 1978.
2. Hydrological and coastal engineering aspects in the scope of the Integrated Atlantic Coast Port Study, Masterplan Limón and Moín, Immediate Study, by RRI/Prof. Burkhardt on behalf of MOPT, October 1978.
3. Expert's Opinion on the determination of the dredged volume in the Port of Moín/Costa Rica, by RRI/Prof. Burkhardt on behalf of BEL INGENIERIA S.A., November 1978.
4. Harbour of Moín, Extension of the Northern Breakwater, Final Design, by RRI on behalf of RECOPE, April 1979.

From these reports like from other studies, it becomes apparent that in the view of maintenance dredging the Rio Moín which flows into the harbour area directly south of the berthing places will play an important role in the future. Not only the possibility of reducing the expected sedimentation, but also ways and means of an effective wave protection at the berths have been discussed on the occasion of various expert meetings on site. Thus, the question of the expected wave movement had to be investigated and to be judged in close relation to an extension of the northern breakwater and a possibly necessary modification of the southern breakwater or even its removal.

The most important questions pending for further investigations are the following:

1. What structural measures will be required to prevent, as far as possible, the transportation of bedload and suspended matter from the Rio Moín into the access channel and the basin of the Harbour of Moín?
2. What would be the expected wave motion at a third berth which may be required additionally south of the two banana berths, already under construction?
3. Will the planned extension of the northern breakwater possibly reduce wave motion at the banana pier expected by the unfavourable effects of the southern breakwater to such an extent that it will no longer be necessary to remove the southern breakwater and would a modification of its head produce sufficiently favourable conditions?

To find an answer to the 1st question, in-situ measurements have been carried out the results of which are being explained in Chapter I, Volume III of this report. The measurements comprised in detail:

1. Tidal and current measurements in the area of the estuary of the Rio Moín and in the Bay of Moín;
2. Soil sampling from the sea bottom in the Bay of Moín;
3. Measurements of salinity and suspended load at certain selected locations in the area of the estuary and in the Bay of Moín;
4. Wind and precipitation measurements.

The answer to questions 2 and 3 which shall be treated in the first place are based upon studies already available (for time and cost reasons no wave measurements were carried out). (The structural design - design of breakwater and slope structures in the area of the berths to protect against wave action - will not be included in this study).

Thus, the question asked in the beginning can be answered as follows:

1. The high suspended load rates of the Rio Moín will lead to a sedimentation of the harbour basin and the access because the current velocities in this area are too low to carry the material over longer distances. As the harbour in its present stage acts like a settling basin it is recommended to create a new river mouth immediately west of the root of the southern breakwater. This measure has the effect that the surface water flows into the area of a natural, right-turning and largely constant roller current generated by the large-scale easterly coastal current. The prevailing current directions in the Bay of Moín prevent a penetration of bedload and suspended matter from the Rio Moín into the harbour. The guide dam of the Rio Moín in the estuary should be of a flood-free design to maintain the high scouring effect of the river. The southern breakwater will avoid that bedload carried locally by sea motion will get into the dredged harbour zones. Its function shall be at the same time to protect the steep - compared with the natural inclination of the sea bottom - sea-side harbour slope from erosion. (see Drawing F-7.2).

2. When the northern breakwater is extended by 190 m, which would be recommended in view of wave motion at berths 1 and 2, wave motion at berth 3 would be as follows:

At a permissible probability of 18 days per year on which the wave heights are exceeded, the mean significant wave heights are expected to be $H_{1/3}$ = about 0.55 m. A further extension of the northern breakwater would not be reasonable as the wave heights at the berth would decrease only insignificantly. Therefore it is recommended to permit higher waves than $H_{1/3}$ = 0.3 m or higher probabilities of days on which this height is exceeded, than 18 days. (The economic evaluation of this recommendation is given in Chapter L-6, Volume III).

3. When the northern breakwater is extended in the proposed manner unfavourable reflection effects of the southern breakwater which without this extension would lead to locally increased wave heights in the area of the planned future berths for banana handling will no longer occur. The southern breakwater has no unfavourable effect on the dominating wave directions, but its influence on the wave motion is also not exactly favourable. The NW-SE running tip at the breakwater head should be removed and the head be shaped in a round form.

Possibilities of Watersupply to the Ports of Limón and Moín

(Chapter J, Volume III)

During the studies undertaken in the course of the project, in general the following alternative possibilities for watersupply have been evaluated:

- In the vicinity of the harbour area of Moín several springs are located, which originate in the porous coral formations along the hillside. These springs could be captured, combined and after treatment conducted to a distribution tank.
- The present watersupply area of AyA¹⁾ for Moín and Recope could be used entirely for port needs, if possible extension of the Rio Banana supply area, i.e. direct treatment of surface water of the Rio Banana, would cover the need of the City and Port of Limón as well as adjacent residential and industrial areas. For this alternative, negotiations with AyA should start as early as possible.
- Extension of above-mentioned supply possibility 1 or 2 by additional capturing of 3 more springs along the Portete road between Moín and Limón.
- Construction of wells or infiltration galleries in the area of Zent in the Rio Chirippó Alluvium, about 23 km from Moín. This solution could, however, call for very high investment cost and therefore might be considered as not feasible.

The works undertaken have been based on existing data and in field work.

The geology of this area consists basically of a coral formation and underlaid by a thick clay formation. Both are called the Gatun formation. This coral layer is very porous with karstic features. Other areas are on a sedimentary formation which is almost impervious. Ground water in this area is of bad quality, and the wells have very low yield.

In the contact of the clay and coral formation, a lot of springs yield ground water of good quality. Because of the corals this water is hard. Due to the karstic features of the coral beds, this ground water can be contaminated by sediments, in short period after rainfall occurs, also can be easily contaminated by septic tanks and waste disposals of different types.

The main sources to get water are the following:

6) Infiltration Gallery

A gallery of 300 m length in the foot hills of the coral beds which are exposed in the Moín harbour, could yield probably a flow of approximately 35 lps. This data had been taken from short pumping test done in four trenches, in which each one gave a flow approximately 0.12 l per second per meter. The average water level in the trenches was of 3 m above sea level. For this reason the gallery could be done of 3 m deep without danger of saline intrusion. The water obtained could be contaminated in the future if the recharge area is not protected from urbanization development.

1) Institute Costarricense de Acueductos a Alcantarillado

II) Springs between Limón and Portete

The following data were obtained in the field and the measurement were done at the end of the dry season.

Spring	Distance from Moín Harbour (km)	Distance from Limón Harbour (km)	Flow lps
1	6	3	5
2	3	6	2.4
3	3	6	5.4

Spring No. 1 is probably contaminated with domestic waste.

The capture of spring No. 1 and No. 3 may demand more spences because of topographic reasons.

III) Moín Springs

This springs belong to AyA, Institute Costarricense de Acueductos y Alcantarillado, a national institution in charge of the water distribution in Costa Rica.

The springs, at 600 m from Moín harbour, are at the foot hills of the coral beds. The flow at the end of the dry season is of 40 lps. During the year it can yield up to 250 lps.

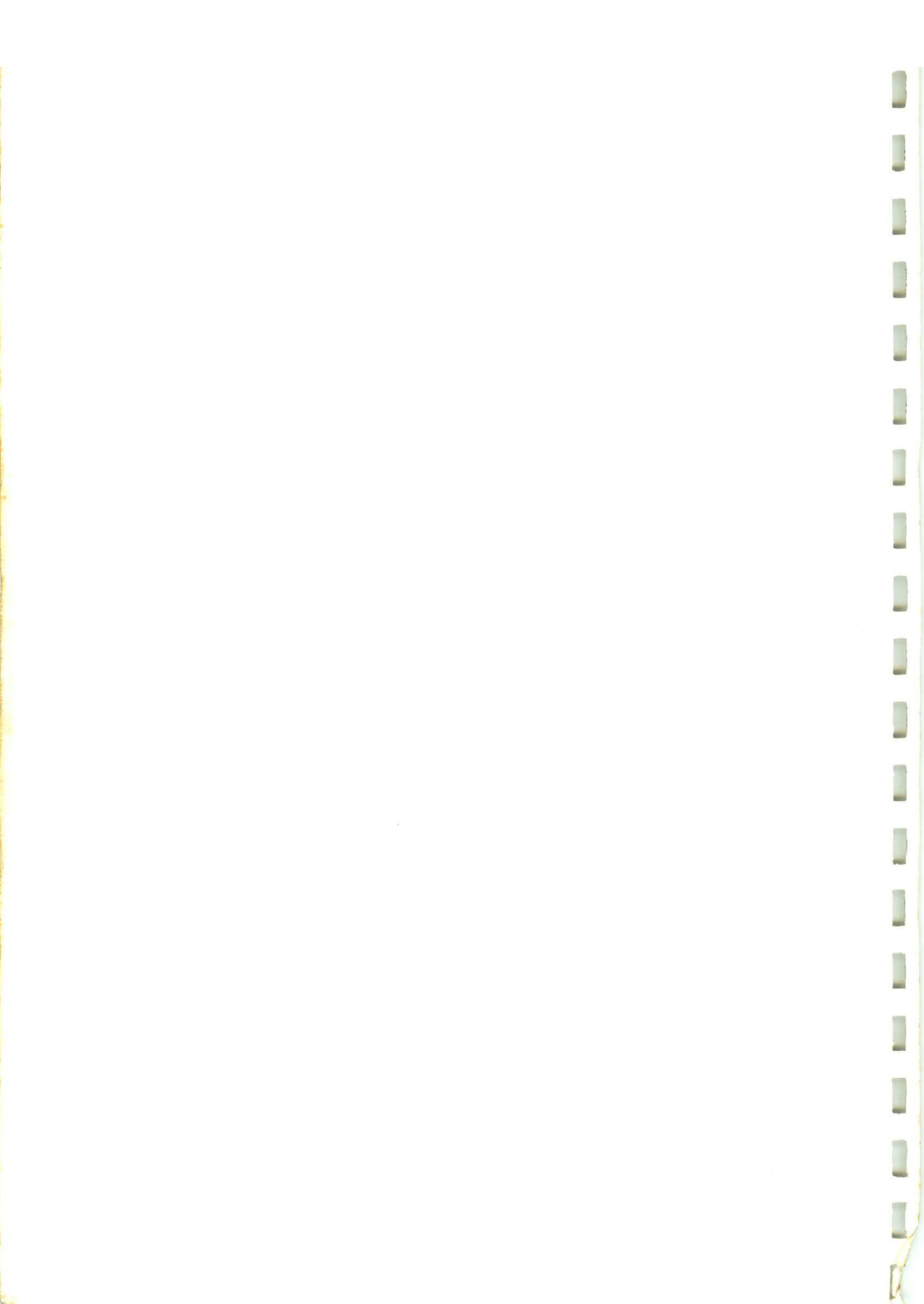
By recent informal talks with the AyA director, he agrees with the possibility of given the springs to the Moín harbour once the treatment plant of surface water from Banana River, in La Bomba, is constructed. This treatment plant, of 250 lps, will be ready at the end of 1980. However, to get the springs for Moín harbour it is necessary to negociate this alternative, with the AyA director.

IV) Wells

- a) In Zent, 30 km from Limón, alluvial formation has been developed. In this area, ground water is of good quality and there is enough water for the harbour area.
- b) Induced recharge wells in the Banana river alluvion of La Bomba, the site where wells of AyA for Limón City exist, are in operation. More than 60 lps of good quality water could be available in this area.

V) Surface Water

- a) Surface water treatment from Banana river. The minimum flow of the river is $3 \text{ m}^3/\text{sec}$. and its distance from Moín is approximately of 12 km.
- b) Other surface water treatment works can be studied in the area. These sources are the Blanco River and Moín River, but this possibilities could be very expensive because of the heavy contamination that they present.







Preliminary Structural Design for Case A of the Ports of Limón and Moín
(Chapter X, Volume III)

Port of Limón

Pavement and Fencing

For the surfacing of roads, ro-ro areas and break bulk areas, a cover of concrete slabs and concrete stones has been chosen. Whereas the roads will be provided with concrete slabs, the storage areas (incl. ro-ro stevedore areas) will be paved with concrete stones.

The total harbour area will be surrounded by a 2 m high fence after widening of Avenida 1.

Gate House at Western Entrance

The function of the gate house is to check all incoming and outgoing traffic at the west gate. The building is a single-storey building. The bearing structure consists of a reinforced steel skeleton filled with brickwork. The roof can be made either of timber or concrete alternatively. A rafter structure is chosen as roof structure which will be covered with corrugated asbestos cement. The brickwork will be plastered inside and rendered outside. The floor cover shall consist of stoneware.

Workshop

The repair hall shall be a steel structure which system shall be statically determined both in longitudinal and transverse direction. The distances between the outer axis in longitudinal and transverse direction amount to 68.5 m and 22.0 m resp. The stiffening of the hall in transverse direction shall be carried out by columns fixed in individual foundations and in longitudinal walls as at least 6°. The roofing consists of corrugated asbestos cement sheets which are fastened to steel purlins. The roof will be constructed without draining units. Corrugated asbestos cement sheets form the outer facing above the window rows. Below the window rows the outer wall is made of brickwork. The reinforced floor slab shall be embedded in a compacted gravel layer. All steel parts shall be protected against corrosion by adequate measures. Due to its future use the workshop is divided into 3 areas:

- large hall for straddle carrier
- 2-storey social building and storage
- hall for forklifts, trucks and trailers.

Rehabilitation of Muelle 70

In order to keep Muelle 70 operable as pier also in the future and to prevent damage to berthing ships rehabilitation measures shall be taken immediately.

The fender system including the fender supports are in an extremely desolate condition. For Limón as a swell harbour a soft fender type with low initial force and long way of compression should be applied. The southern front edges should be equipped with rubber or sisal corner fenders.

As far as the T-beams are concerned, the covering concrete on the bottom of the T-beam below the pier slab is scaling on about 25 % of the beams. The bearing capacity of the pier slab can be maintained in that the beams with damaged reinforcement are replaced by new prefabricated members. Longitudinal beams with reinforcement which is not damaged can be rehabilitated by sand blasting and applying air-placed concrete provided with chemical aggregates as protection against corrosion.

Partially the rails have loosened and move up and down when driven with heavy loads. Rehabilitation can be achieved by

- uncovering the rails and clamping plates
- unscrewing of anchoring bolts
- adjusting of rails according to height and track gauge
- boxing up with non-shrinking mortar.

At the western pier side a beam head is broken from the outer edge of the outer edge of the vertical double pile row in transverse direction up to the bottom of the edge beam support. Re-establishment of the former construction state can be achieved by concreting a new beam head. Prior to concreting, all loose, weathered and damaged concrete parts shall be removed.

Along the total pier edge the concrete axis is seriously damaged. An effective protection against further damage is by demolishing the concrete axis eye to approx. 0.15 m below top of pier slab. After adjusting the existing reinforcement a steel profile provided with claws shall be concreted as axis protection. The seaside boundary shall be a railway track on cement mortar supports anchored in the in-situ concrete slab.

Port of MoIn

Extension of Banana Pier

The railway alternative chosen implies an extension of the banana pier by 68.4 m. This alternative constitutes an optimum in both operational and economic aspects. The structural design of the pier extension could be carried out in correspondence with the report and the planning documents of the "Final Design of the Banana Pier" which have been drawn up and submitted by Rhein-Ruhr Ingenieur-Gesellschaft mbH. at an earlier date.

Railway Connection

For the alignment and fastening of the tracking system on the banana pier, Rhein-Ruhr Ingenieur-Gesellschaft mbH has also worked out already accurate planning documents in the scope of the "Final Design of the Banana Pier". Attention has to be paid when placing the tracks on the quay slab that the rail joints match accurately with joints of the concrete construction, that means that they are located directly beside them. The tracks outside the pier slab shall rest upon a ballast bed. On traffic areas, the tracks and switches shall be embedded in the pavement. To keep the rails open, a flange way rail should be installed as pavement boundary line.

Rain Shed on Banana Pier

In order to facilitate banana handling also during rain, the construction of a roof as rain protection on the banana pier has been proposed (see also Chapter F, Volume III). Each berthing place shall receive one rain roof. The main load bearing part of the building shall be a double-hinged frame with different heights of columns making the horizontal member sloping to one side. The roof is to be covered in a way that overlapping lengths of 0.20 m occur. The roof dimensions shall be as follows:

head clearance :	4.30 m
width :	15.24 m
length :	144.00 m.

Water Supply

The possibilities of an external water supply of the harbour of MoIn are described in Chapter J (Volume III). Concerning the cost factor a connection to the AyA springs seems to be most favourable. Since even in the dry season 40 lps can be gained the volume of the reservoirs can be kept relatively small if supply is provided from there. A second possibility would be to install an infiltration gallery at the slope in the port of MoIn. From this gallery the water will be led to a pumping station and then to the water tank. To allow an exact structural design of this possibility preliminary investigations are necessary.

As far as the infiltration galleries are concerned, the water of the sources will be led through perforated stoneware pipes into the discharge basin from where the water is led via tight pipes to the collecting manhole. In front of the collecting manhole a grit catcher is placed from which the water reaches the collecting room via an overflow. The collecting tank is provided with discharge pipe, overflow and drain pipe. The pumping room equipped with 2 pumps in order to have 1 stand-by pump in case one fails is located above this tank. These pumps will pump the water into the elevated tank.

For the water supply in the port of MoIn the following system was chosen:

- water feeding from the AyA springs or the infiltration galleries to an elevated tank
- water distribution in the port by gravity via ring lines and dead end lines.

Stormwater and Sewage

The water quantity which runs from the eastern slope to the port will be collected in a gutter to be constructed in trapezoid shape, led to corresponding collection pipes and discharged into the sea. The remaining feeding gutters shall be of rectangular shape and rounded off at the bottom. If necessary, these gutters have to be covered with I-profiles or railway tracks to allow crossing.

The waste water from the administration and the social building will be led to 3 septic tanks and after clearance drained into the ground. The waste water from the gate house will be led to one septic tank and after clearance drained into the ground.

Power Supply and Telecommunication

As far as the power supply for the port of MoIn is concerned, connection shall be provided at the 34.5 KV, 60 Hz overhead line which shall be laid at the main street in the vicinity of the administration building. The power demand results of:

- pier and outdoor lighting
- street lighting
- shed lighting
- elevators
- social building
- administration building
- ship yard etc.

The telephone system is designed for 5 direct exchange lines and 30 extensions with exchange installed in the administration building to supply:

- administration building
- gate house
- pier construction
- ship yard.

Pavement and Fencing

The pavement chosen for the service areas and the ro-ro handling areas are concrete slabs and concrete stone pavement. Whereas the roads will be provided with concrete slabs, the ro-ro stevedore areas will be paved with concrete stone. The total port area will be surrounded by a 2 m high fence.

Buildings

The premises in the port of MoIn consist of

- social building
- administration building
- gate house.

The repair workshop for the elevators will be integrated into the ship yard complex. All three buildings have mainly the same design criteria which will be explained shortly. The bearing structure consists of a reinforced concrete skeleton which shall be lined with masonry. The ceiling can consist of timber or concrete alternatively. A rafter construction has been chosen as the roof system which will be covered with corrugated asbestos cement.

Ship Yard with Berthing Pier for Harbour-wned Boats

Chapter F-3 (Volume III) gives the reason why the decision in this preliminary design has been taken in favour of a solution with a slipway. The crane proposed in this preliminary design is a rail-bounded crane, but an auto-crane can also be used alternatively. The following includes a brief description of the design of the ship yard facilities:

The slipway plant is designed in a way that slipped up ships can be:

- repaired on the slip trolley if minor repairs have to be done and
- shifted transverse and lowered again in case of bigger repairs.

The slip trolleys are constructed in a way that longitudinal and transverse shifting can be arranged without turning the ships or lowering them in intervals. The slipway shall have an inclination from top to bottom of 1:15 overcoming a difference in altitude of about 10 m.

The repair area shall have a width of 80.00 m and shall be about 40.00 m long in the towing direction. This area is covered by reinforced in-situ concrete slabs of about 50 sq.m each, founded in a compacted gravel layer.

The workshop shall be a light steel construction with isostatic systems in both the longitudinal and the transverse direction. The ground area of the two-span hall is about 20.00 x 70.00 m; the girder-to-girder distance is 6.50 m while the head clearance in the hall is about 5.00 m. Both aisles of the hall shall be equipped with an overhead travelling crane with crab of an 8 Mp lifting capacity.

12. Cost-Benefit Analysis
(Chapter A, Volume III)

To assess the economic feasibility of the rehabilitation and development measures of the ports Limón and Moín, costs and benefits are estimated for each year from the opening year of completion in 1982 up to 2000. Subsequently, the internal rate of return (IRR) for rehabilitation measures of Case A development is calculated and the net present value (NPV) for Case B alternatives so as to allow a comparison of the feasibility of the ports extension program with other projects.

When evaluating the extension program a breakdown into the two development cases is considered:

- low containerization of bananas (Case A)
- high containerization of bananas (Case B)

and the aspects of the different site locations of the alternatives.

Costs

The economic cost of the rehabilitation and alternative development measures are evaluated under the aspect of shadow pricing for labour, capital and foreign exchange. It was concluded, that for labour employed no shadow pricing is applied since the market wages for unskilled labour generally determine the opportunity costs of manpower. Shadow pricing for the capital represented in the foreign exchange component is applied as 40 % above the market rate (official exchange) to reflect its true value.

The costs and benefits are calculated at the price level of 1980, using an inflation rate of 15 % as experienced in the first half of 1979 in Costa Rica.

The investment costs of the development Case A are listed as follows. (These figures include structural, infrastructure and equipment purchase and maintenance cost and are summed up for the period 1981 - starting year of investment - and 2000):

Table 11:

Case A - Total Investment Costs¹⁾ (in 000 US \$)

(Period 1981-2000)			
	Limón	Moín	Total
equipment ²⁾	36,033	4,921	40,954
structures	10,265	2,766 ³⁾	13,031
infrastructure	5,377	-- ³⁾	5,377
total	51,675	7,687	59,362
			1980 NPV ⁴⁾ 3,050

- 1) includes foreign exchange price,
- 2) reinvestment and M/R-costs added
- 3) present construction measures of RECOPE/MOPT
- 4) 16 % discount rate.

A summary of the total construction costs as estimated for the port development alternatives in case of high containerization of bananas (Case B) is given in the following table, as well as annual M/R costs for structural elements. Equipment investment is not included in the cost estimate.

Table 12: Case B - Total Construction Costs¹⁾ (in 000 US \$)
And Net Present Value²⁾ (in Million US \$)

Alternative	Total	M/R	NPV 1980	Year of construction
<u>Limón:</u>				
(1) 1 container terminal (1 berth)	79,741	1,200	11.3	1990/94
(1b) 1 container terminal (2 berths)	108,562	1,628	12.5	1990/94
(2) 1 container-general cargo terminal (1 cont. berth, 1 general cargo berth)	81,707	1,225	11.6	1990/94
<u>Moín:</u>				
(3) 1 container terminal (1 berth)	55,435	831	11.6	1988/92
(3b) 1 container terminal (1 berth)	86,585	1,299	18.4	1988/92

- 1) includes foreign exchange price
- 2) 20 % local participation of initial construction

Benefits

The Masterplan Development Program results in two major kinds of benefits:

- Benefits due to rehabilitation measures on port operation and equipment after construction of Proyecto Alemán and the port facilities at Moín (Case A)
- Benefits of new construction of an additional container berth in case of high containerization of bananas (Case B)

The quantification of benefits consists of savings in

- congestion surcharge
- ship and cargo waiting time
- dwell time savings

Surcharge savings are based on the congestion charges presently valid for the European trade (east/west bound) and amount to US \$ 5.30 per freight ton.

Reduction in ship waiting time for berth and at berth has been valued in terms of anticipated daily ship operation costs, assuming that the costs per ship day of a 10,000 dwt, 8 year old trade liner are about US \$ 7,500, of a 2nd generation container vessel US \$ 20,000, of a banana vessel US \$ 8,500.

Dwell time savings are based on the assumption that the average stay in port after completion of said improvements will decrease from 15 days to 10 days and on the average value of imported general cargo of US \$ 680 per ton (1980).

For the cost-benefit comparison of Case A (Calculation of the internal rate of return) port cost savings, initially considered returns of waiting time savings of 50 % are excluded, since the consultants feel that it is very problematic to consider any immediate return to the Costa Rican economy.

The following internal rates of return (IRR) arrive:

Activity Case A	Internal Rate of Return (IRR)
<u>total port Limón</u>	19.9 %
Muelle 70	21.4 %
Berth 10	16.5 %
Berth 11	20.1 %
Moín (prolongation of 2nd banana pier)	21.0 %

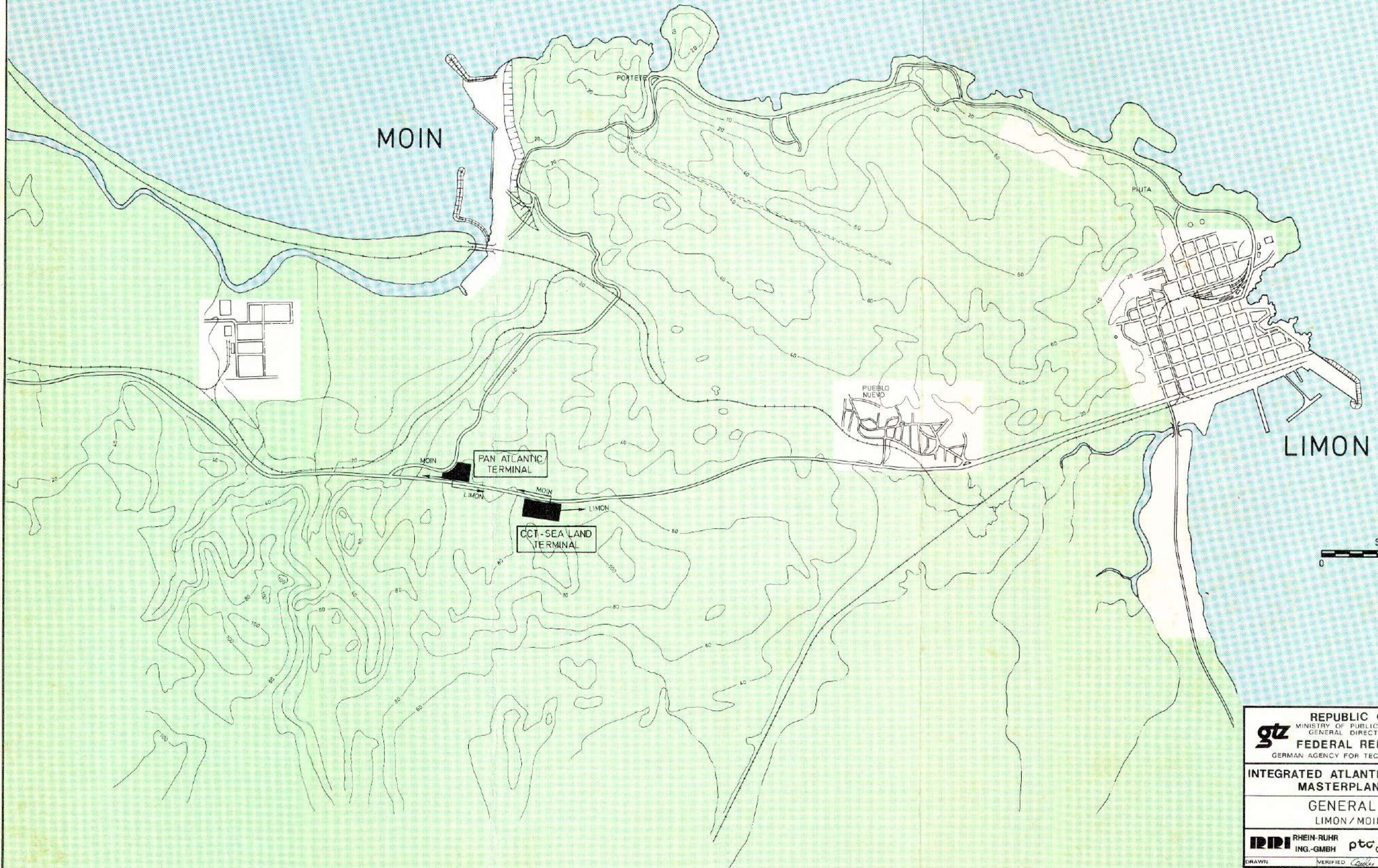
These IRR-values are relatively high compared with the recommended "cost of capital" rate (shadow rate of interest) of 16 % and indicate the economic advantage and necessity of the proposed rehabilitation measure for Case A development.

Benefit calculation for Case B development base on the assumption, that by the end of year 2000 almost no conventional handling will take place and the then existing facilities able to handle container are not sufficient to serve this new demand. The total loss of ship days due to insufficient supply of port facilities, expressed in daily port costs of a 2nd generation container vessel, are attributed only to max. one half to the Costa Rican economy. A total loss of 22,535 ship days from 1990 to 2000 could give a total saving of about US \$ 225 Million.

Since it is imputed that identical benefit will be created by all investigated development alternatives, the net-present value method (NPV) has been chosen to find the most advantageous alternative. The construction costs as estimated before are discounted to the base year 1980 for different portions of local participation. Thus the foreign exchange component of construction price increases from zero to 35 per cent.

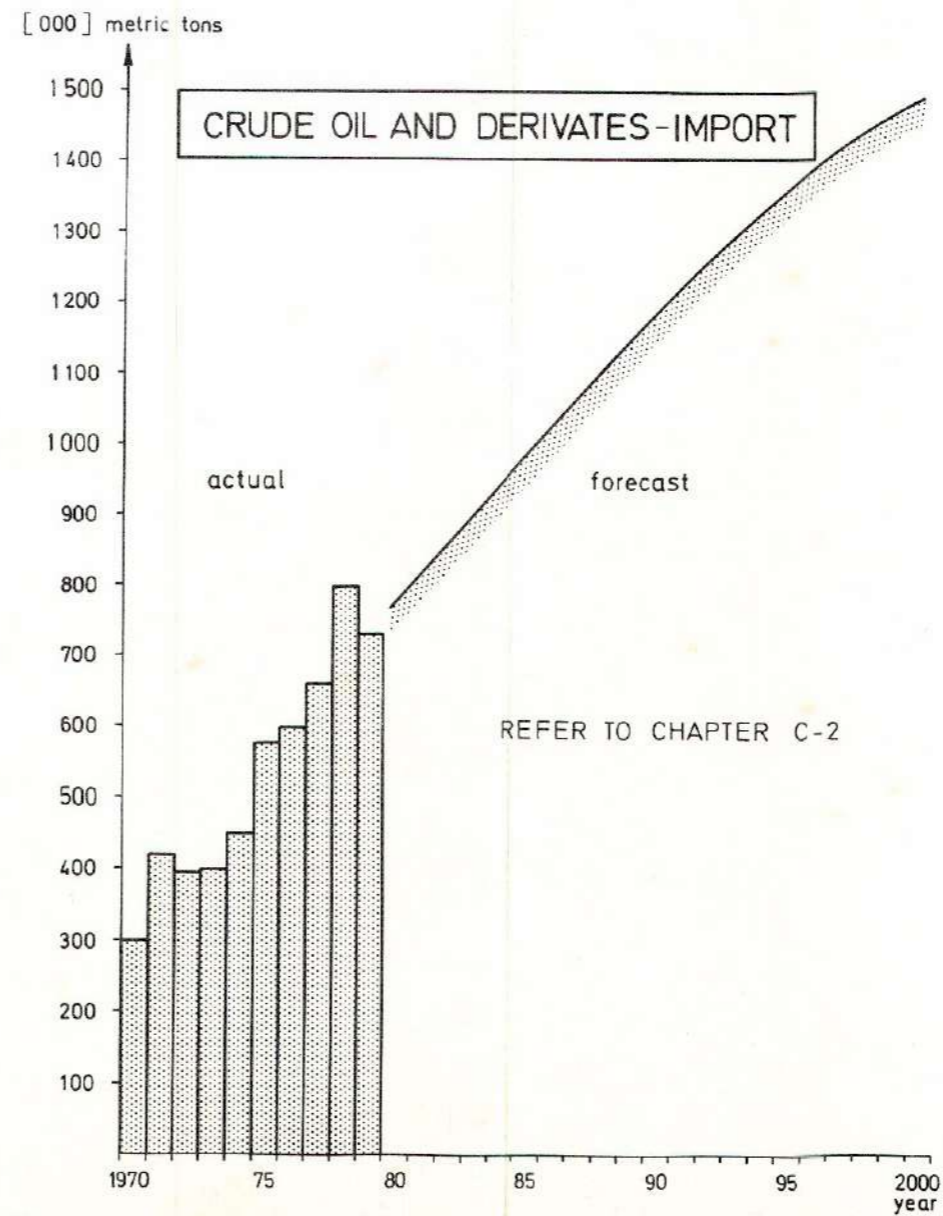
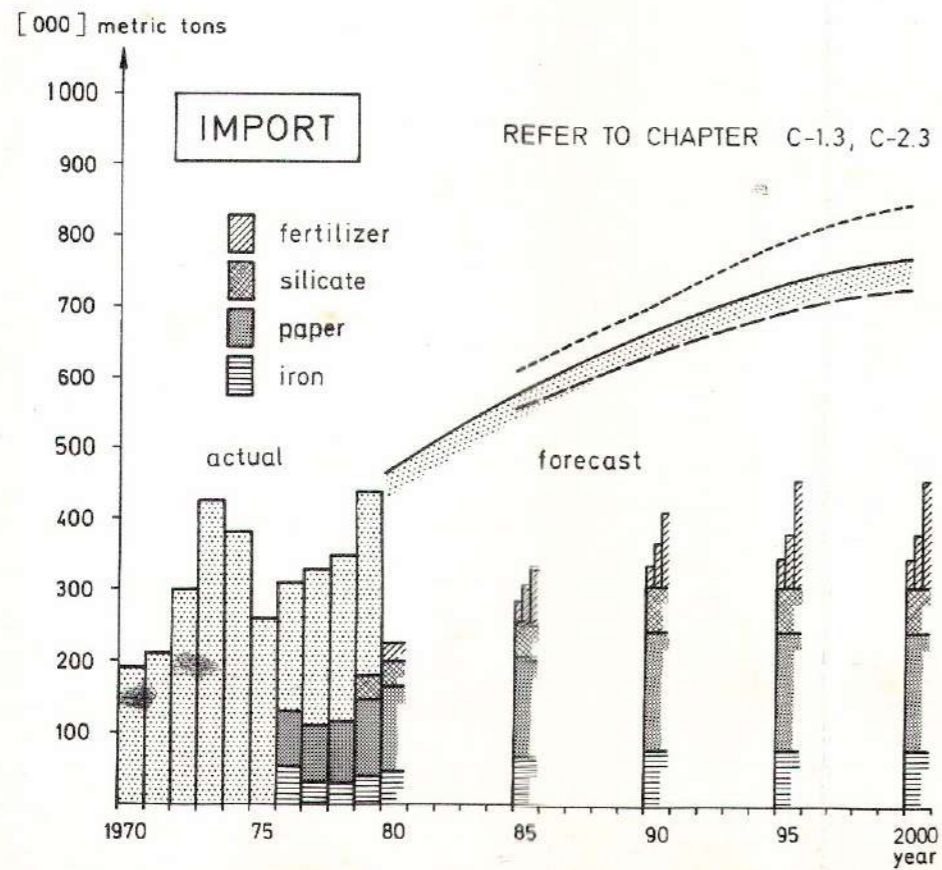
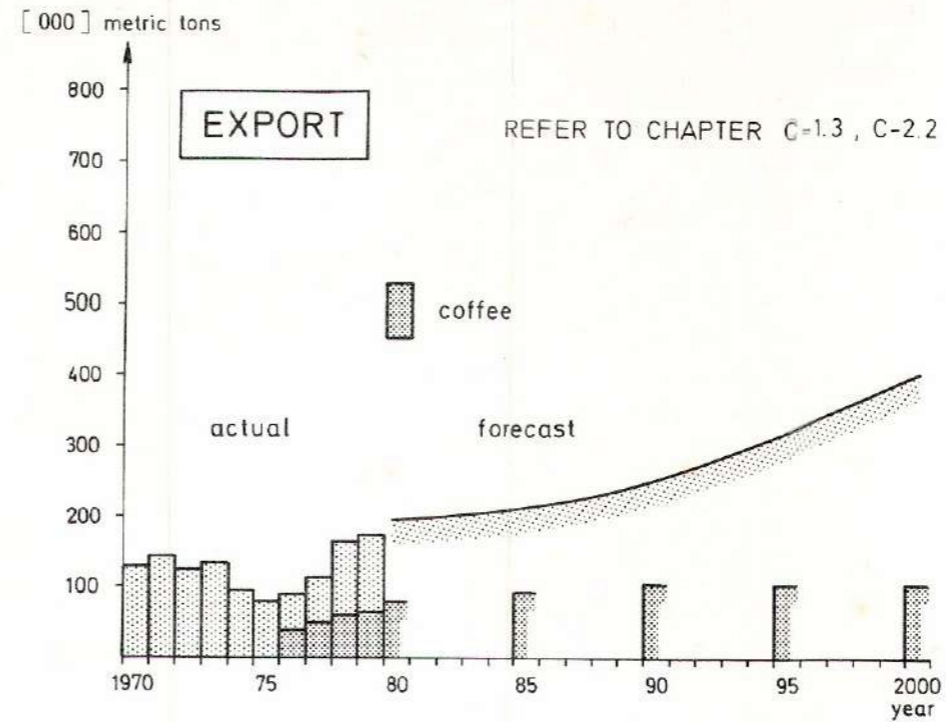
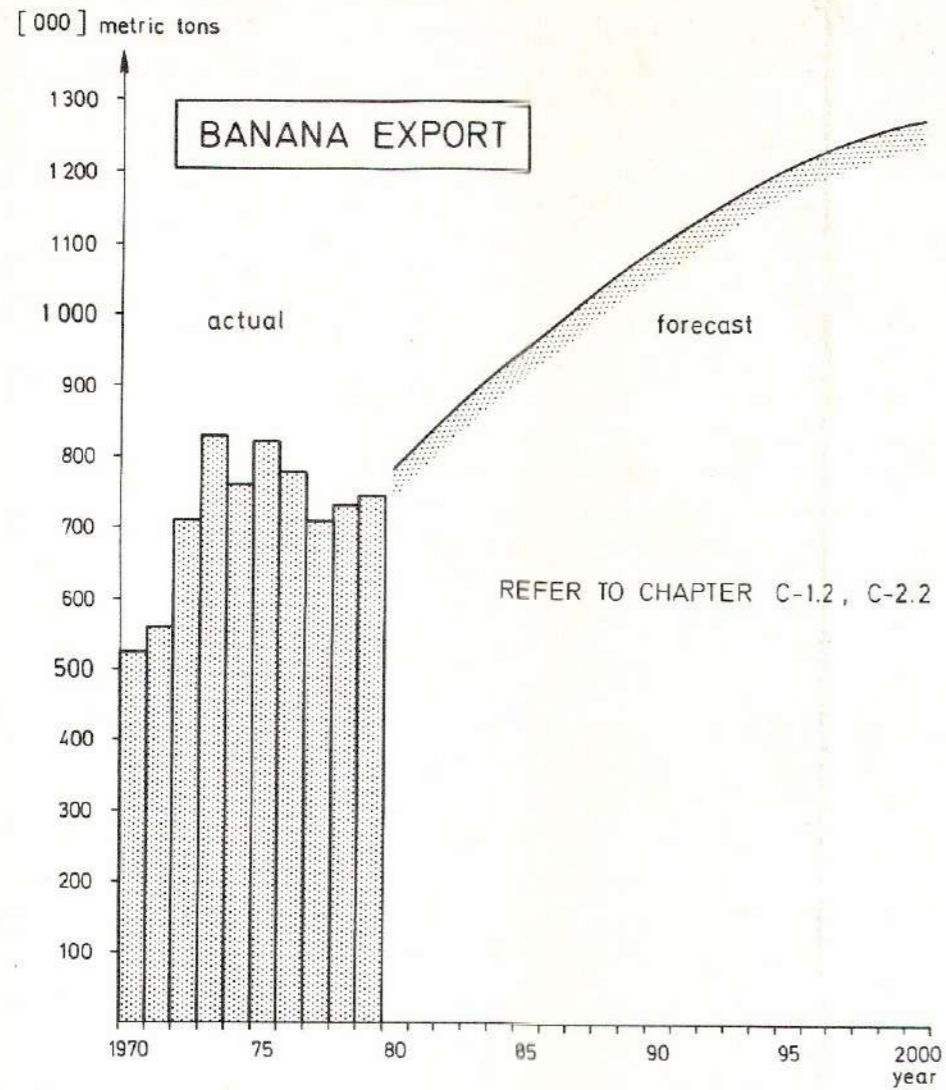
Comparing the alternatives, it is shown that alternative 1(a), 1 container berth in Limón, produces the most favourable net present value. Sensitivity tests by an increase in construction costs and local participation underline the viability of alternative 1 (refer to table 12).

MAR CARIBE

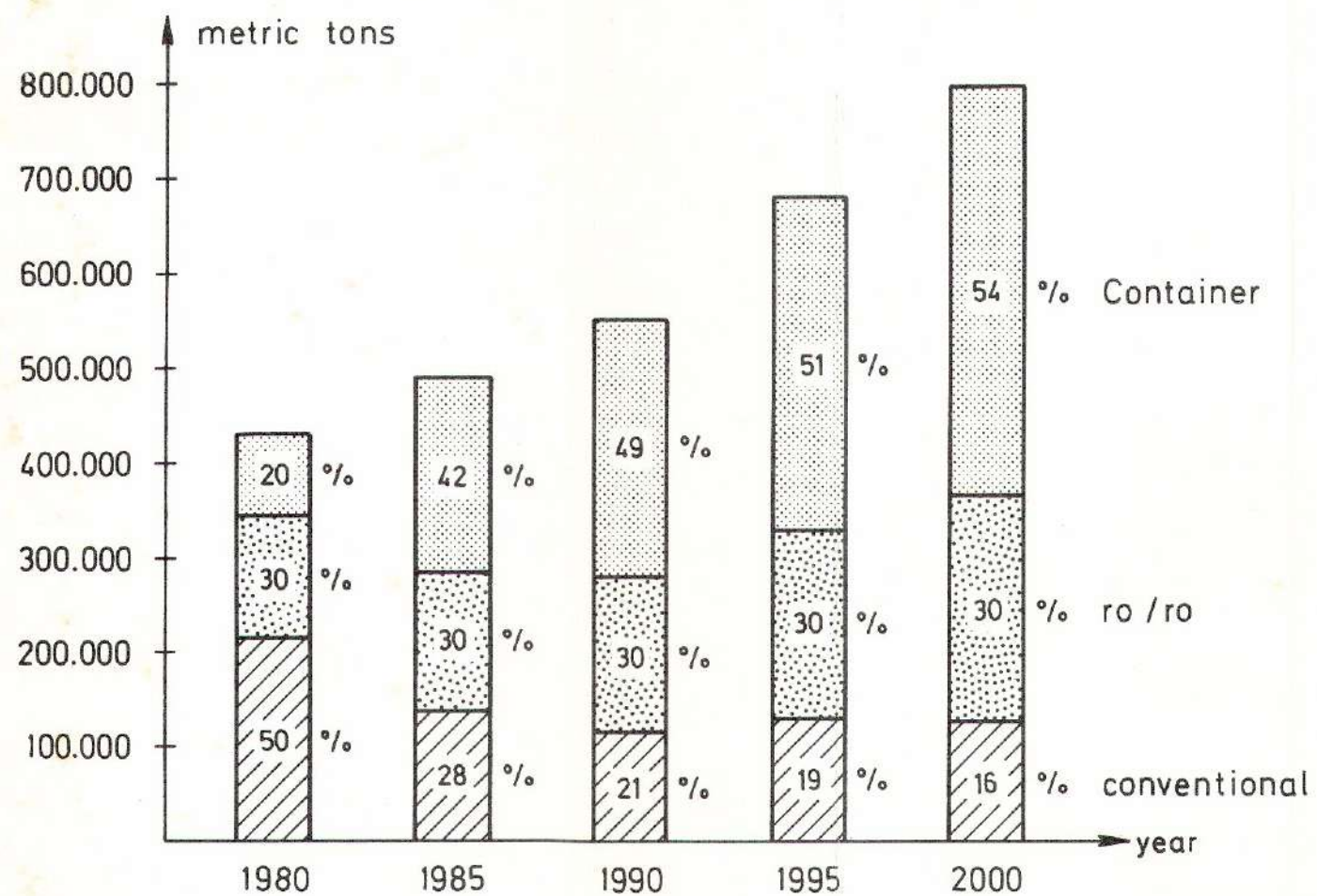


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INTEGRATED ATLANTIC COAST PORT STUDY MASTERPLAN LIMON / MOIN	
GENERAL VIEW LIMON / MOIN AREA	ANNEX B-1.2
IRPI RHEIN-RUHR ING.-GMBH	ptc PORT AND TRANSP. CONS. BREMEN GMBH
DECONSULT GMBH	DATE MAY 1980

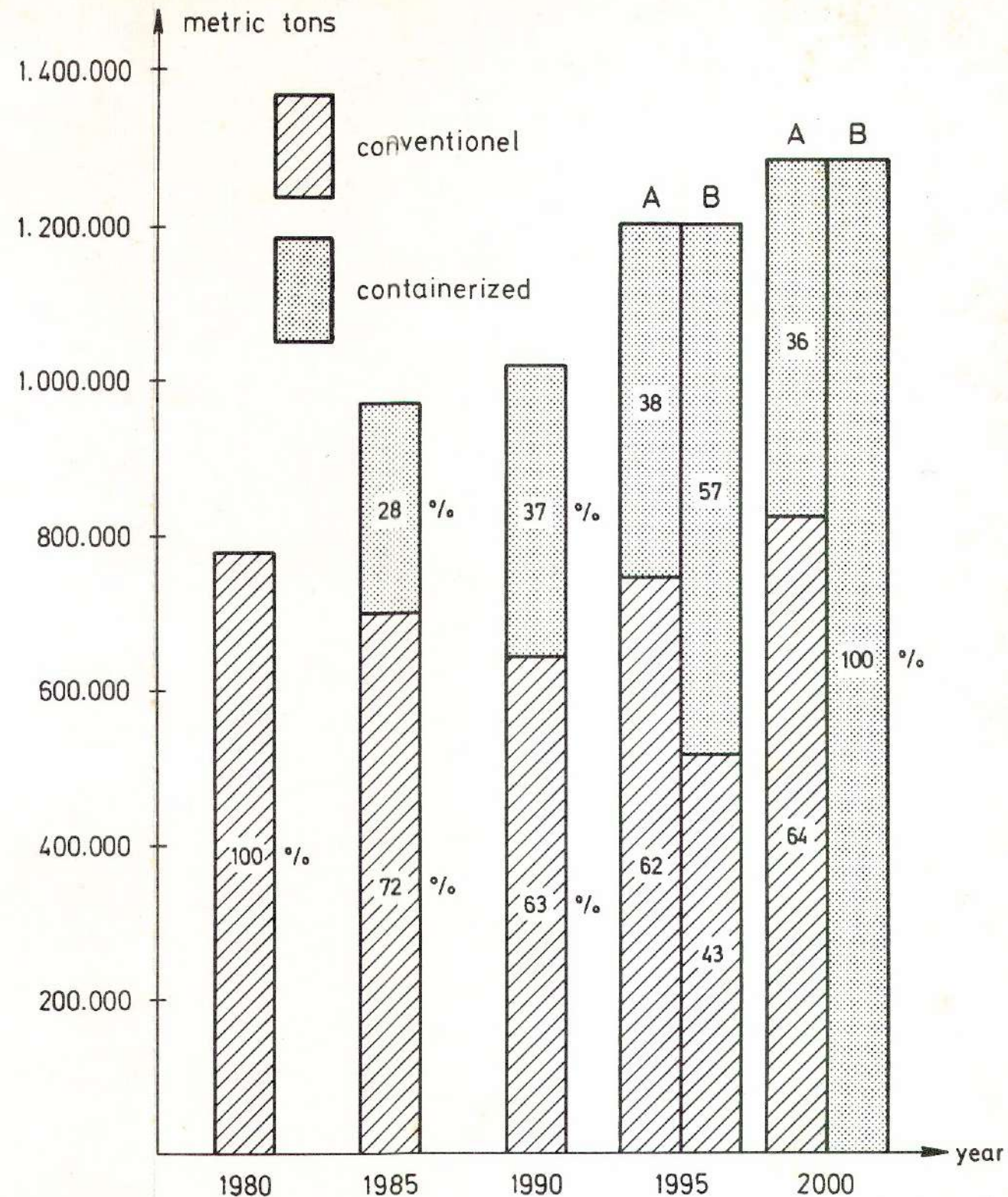
PORTS OF LIMON AND MOIN - EXPORT AND IMPORT - ANALYSIS AND FORECAST



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INTEGRATED ATLANTIC COAST PORT STUDY MASTERPLAN LIMON / MOIN	
TRAFFIC ANALYSIS AND FORECAST	SHEET C-1
RHEIN-RUHR ING.-GMBH	PORT AND TRANSP. CONS. BREMEN GMBH
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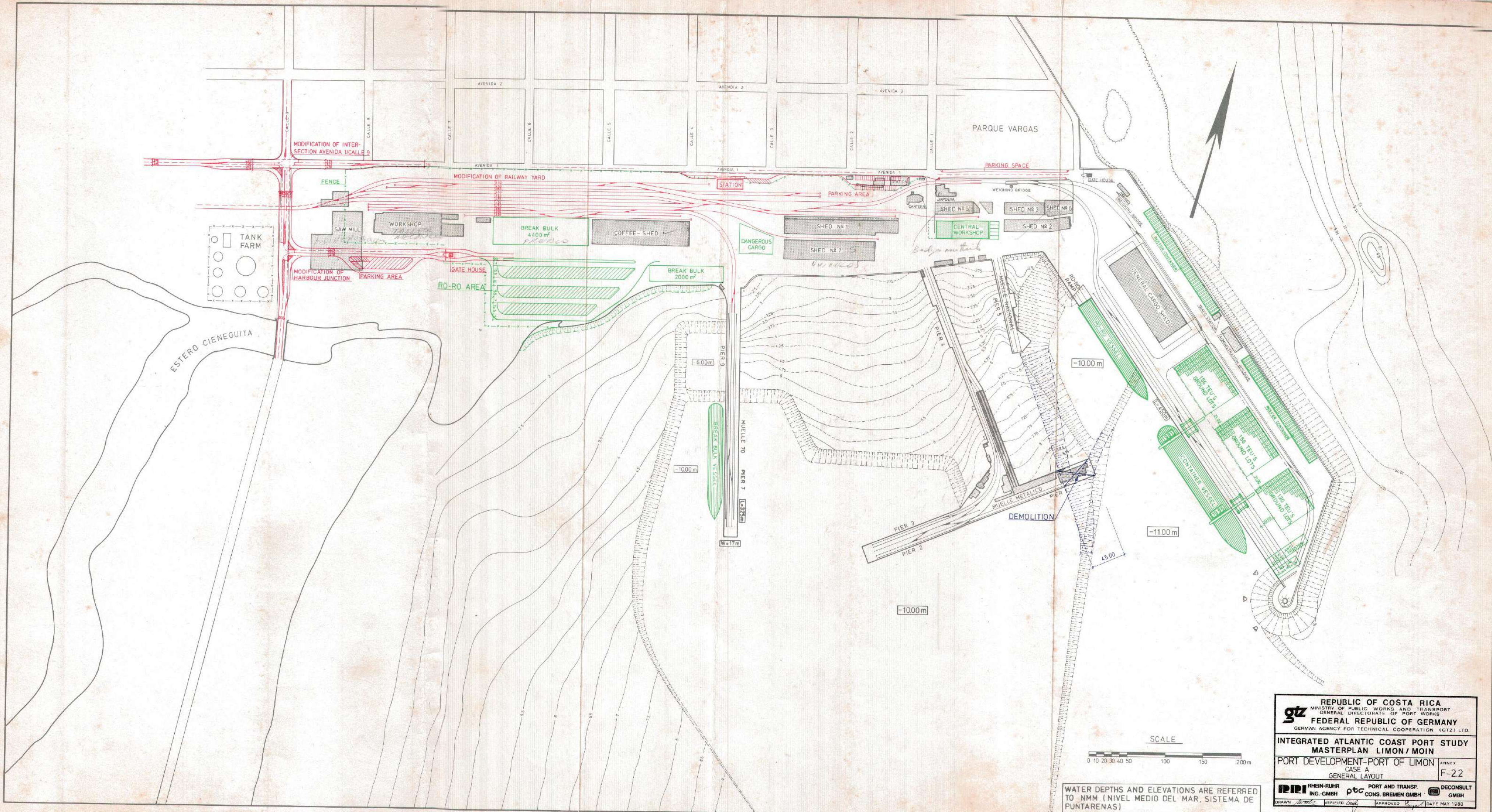
GENERAL CARGO



BANANAS

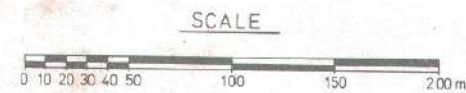
DEGREE OF CONTAINERIZATION
(REFER TO CHAPTER D-1)

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INTEGRATED ATLANTIC COAST PORT STUDY MASTERPLAN LIMON / MOIN	
DEGREE OF CONTAINERIZATION	ANNEX D-1
RHEIN-RUHR ING.-GMBH	PORT AND TRANSP. CONS. BREMEN GMBH
DRAWN: Bru.	VERIFIED: [Signature] APPROVED: [Signature] DATE: MAY 1980



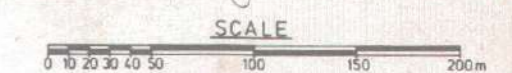
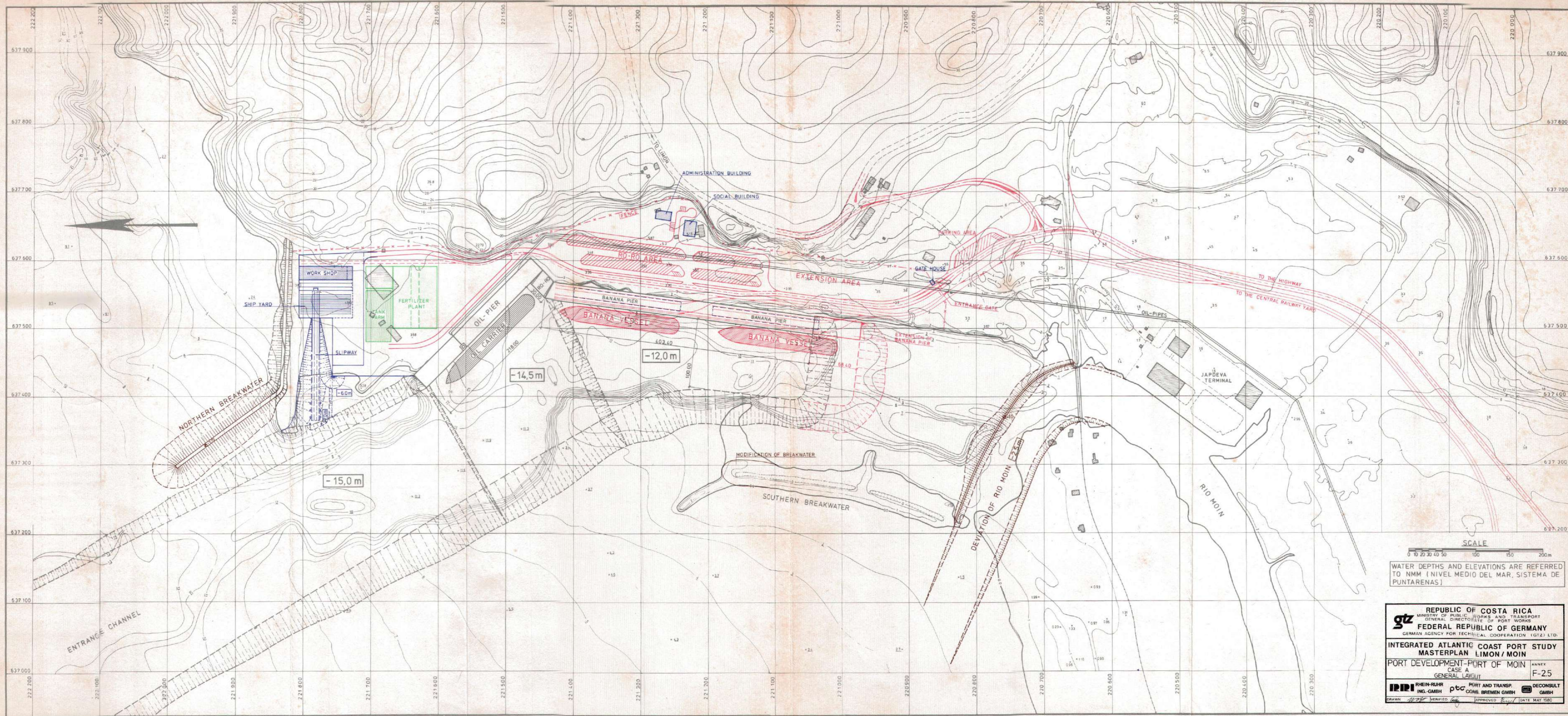
ESTERO CIENEGUITA

PARQUE VARGAS



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PORT DEVELOPMENT - PORT OF LIMON CASE A GENERAL LAYOUT			ANNEX F-2.2
ptc PORT AND TRANSP. ING.-GMBH CONS. BREMEN GMBH	DECONSULT GMBH	DRAWN: [Signature] VERIFIED: [Signature] APPROVED: [Signature] DATE: MAY 1980	



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INTEGRATED ATLANTIC COAST PORT STUDY
MASTERPLAN LIMON/MOIN
 PORT DEVELOPMENT-PORT OF MOIN ANNEX
 CASE A F-25
 GENERAL LAYOUT
RPI RHEIN-RUHR ING.-GMBH **ptc** PORT AND TRANSP. CONS. BREMEN GMBH **DECONSULT** GMBH
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Limón



POSSIBLE
FUTURE
EXTENSION

PUBLIC PORT
CONTAINER & GENERAL CARGO
BREAK BULK

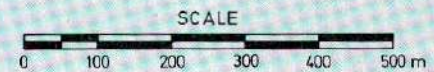
POSSIBLE
FUTURE
EXTENSION 2

NEW RESIDENTIAL AREA
(RELOCATION OF CIENEGUITA RIVER)

INDUSTRIAL
DEVELOPMENT
AREA

SIQUIRRES
CENTRAL VALLEY
MOIN

CARIBBEAN SEA



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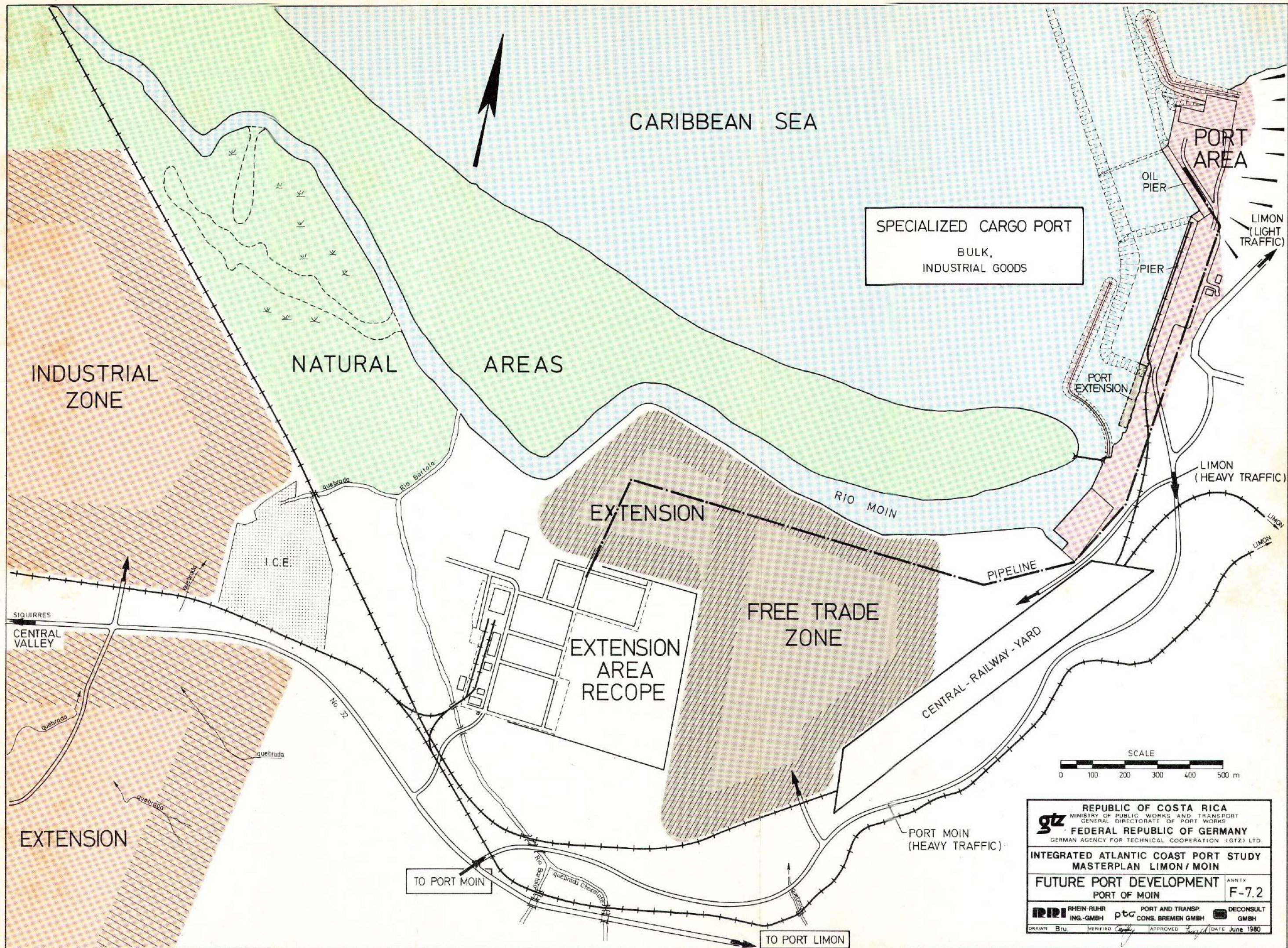
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INTEGRATED ATLANTIC COAST PORT STUDY
MASTERPLAN LIMON / MOIN

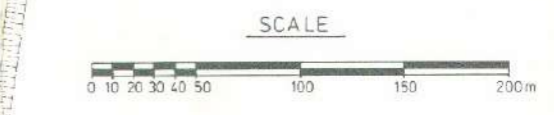
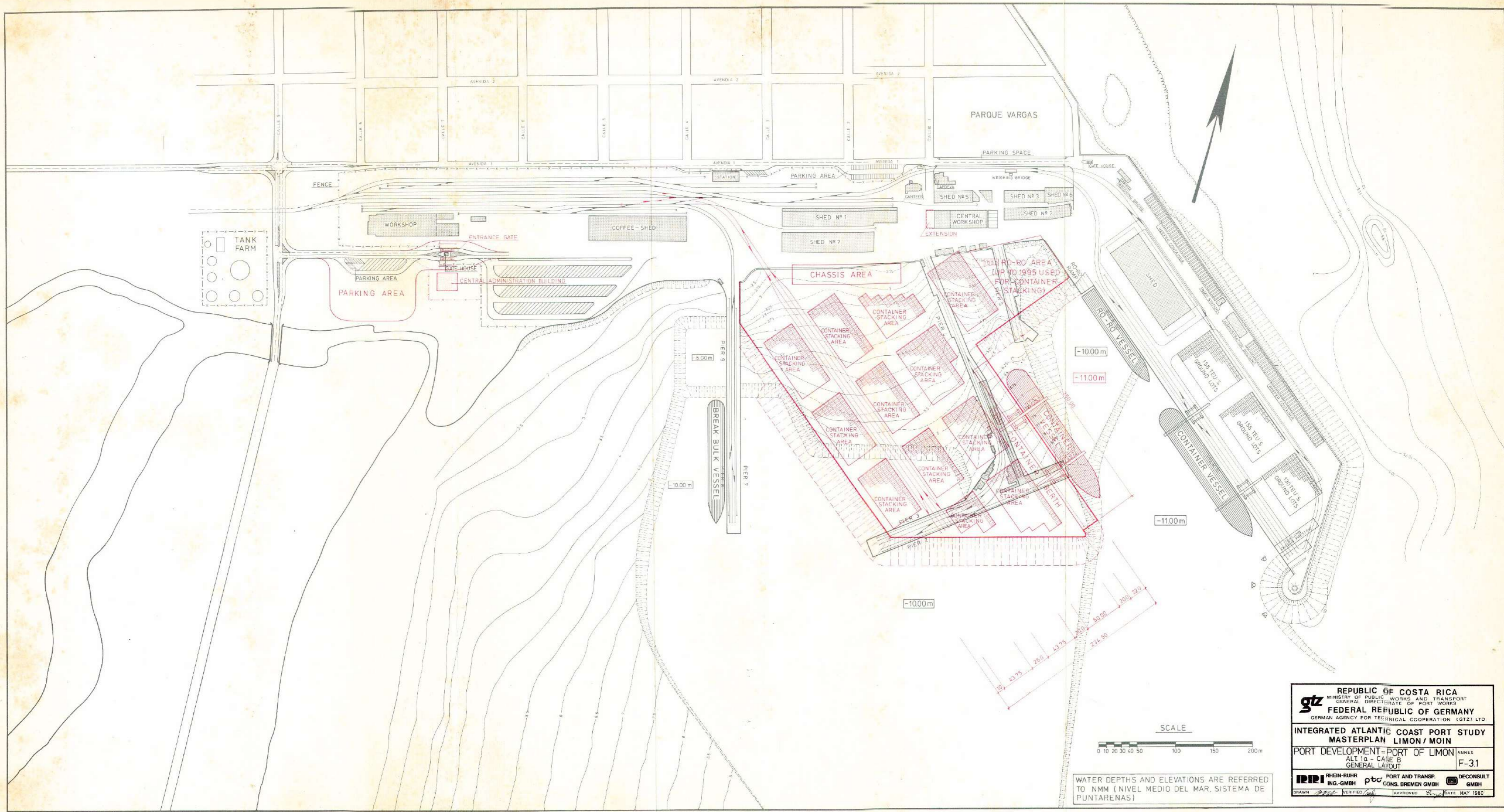
FUTURE PORT DEVELOPMENT ANNEX
PORT OF LIMON F-7.1

IRPI RHEIN-RUHR PORT AND TRANSP. DECONSULT
ING.-GMBH GMBH
CONS. BREMEN GMBH GMBH

DRAWN Brü. VERIFIED [Signature] APPROVED [Signature] DATE June 1980



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INTEGRATED ATLANTIC COAST PORT STUDY MASTERPLAN LIMON / MOIN	
FUTURE PORT DEVELOPMENT PORT OF MOIN	ANNEX F-7.2
RPI RHEIN-RUHR ING.-GMBH	ptc PORT AND TRANSP CONS. BREMEN GMBH
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PORT DEVELOPMENT-PORT OF LIMON ALT. 1a - CASE B GENERAL LAYOUT		ANNEX F-31
RHEIN-RUHR ING-GMBH		PORT AND TRANSP. CONS. BREMEN GMBH
DRAWN: [Signature]		DECONSULT GMBH
VERIFIED: [Signature]		APPROVED: [Signature] DATE MAY 1980



FISHERY PORT

FISHERY PORT

LAGUNA GANDOCA

BANANA EXPORT
PAIS - PROJECT



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INTegrated ATLANTIC COAST PORT STUDY MASTERPLAN LIMON / MOIN	
FUTURE PORT SITUATION ON THE ATLANTIC COAST OF COSTA RICA	ANNEX F-6
IRI RHEIN-RUHR ING.-GMBH	ptc PORT AND TRANSP. CONS. BREMEN GMBH
DRAWN <i>B/v</i>	VERIFIED <i>Leopold</i>
APPROVED <i>Bejt</i>	DATE APRIL 1980