PART II

I EXPORT CORRIDOR OF MINAS GERAIS AND ESPIRI TO SANTO STATES

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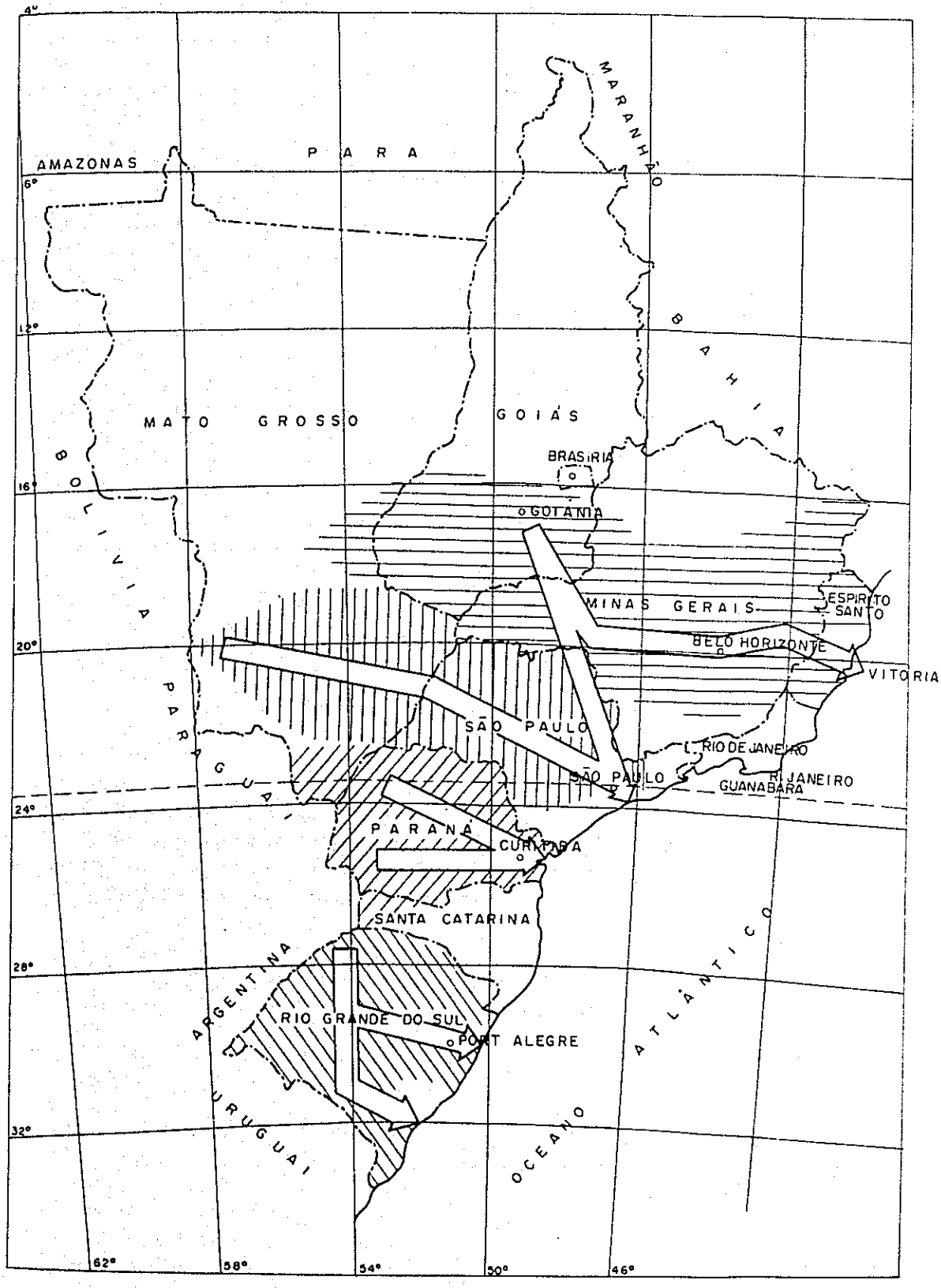
Export Corridor Plan



I. EXPORT CORRIDOR OF MINAS GERAIS AND ESPIRITO SANTO STATES

These two states are blessed with rich mineral resources, particularly iron ores. Most well known among the many mines in the two states is the iron mine located in the central part of Minas Gerais state. In 1971, iron ores produced at this mine for supply to overseas markets amounted to 20 million tons, of which 8 million tons was shipped to Japan.

The mining company which runs the said iron mine has an exclusive railway for ore transportation. The railway, called "Vale do Rio Doce Railway", ranks top in the country in both transport capacity and functions and is therefore considered to bear closely upon the future overland transportation of export grains. Future, Tubarão port at Vitoria, an ore shipping port, is provided with well consolidated facilities.

The present Export Corridor Plan aims at accelerated agricultural production in Triangulo district in the western part of Minas Gerais state and in the adjoining Goias state. It is planned that about 900 thousand tons of agricultural products, chiefly maize, will be exported in 1976 from Vitoria port.

To attain this purpose, the project embraces the construction plan of Capuaba area whose completion will be ensured by another construction plan to be implemented in Aribiri area. Construction of intermediate silo facilities with a capacity of 100 thousand tons is also envisaged by the plan.

Success of the project hinges, above all other things, on the efficient utilization of Vale do Rio Doce Railway which is anticipated to provide ample transport capacity for the projected export promotion. If distance alone is taken into account, it leaves no doubt that Santos port is more advantageous than Vitoria port because it is closer to the producing area. Therefore, if farm products are to be carried over a longer distance for export from Vitoria port, then Vale do Rio Doce Railway must be connected as soon as possible with the inland railway which now links the agricultural area embodying Triangulo and Belo Horizonte, the capital of the state. Accordingly, railway consolidation between Belo Horizonte and Costa Lacera is given top priority under the plan.

1-1 Production and Export of Agricultural Products

Table 1.4 shows the present and planned production and exports of agricultural commodities in Minas Gerais state. Besides such commodities as maize, coffee, oil, oil cakes, sugar cane (molasses), cotton and meat which have been produced in large quantities over the past years, the table also includes such other items like sorghum, soybeans, pellet mandioca, and so forth. Thus, the plan framed in this state for accelerated production and export covers a great diversity of agricultural products.

In terms of maize production, Minas Gerais state is next only to Parana state and São Paulo state. Maize is cultivated throughout the state and its major producing area are Triangulo, Alfo Paranaiba (Potas de Minas) and Unai which is in the northwestern part of the state. Since each of these areas embraces a huge arable land suitable for maize production, the state authorities are planning to increase the present production of 2,300 thousand tons to 3,600 thousand tons in 1977 and thereby raise the existing export level of 100 thousand tons to a maximum to 980 thousand tons.

As for sorghum and soybeans, their production is still very meager at present but is anticipated to grow rapidly in future with the progress of entrepreneurial farm management in Triangulo and Alfo Paranaiba disticts. Hence, the present export volume of one thousand tons is planned to be augmented in 1977 to 35 thousand tons for sorghum and 48 thousand tons for soybeans. Production of soybeans, in particular, is planned to be increased by as many as 25 times the present level in five years in order to cope with the sharp growth of domestic consumption.

Accelerated production and export is also planned for other commodities such as cooking oil (cottonseed oil and soybean oil), meat, and so forth.

Export promotion of agricultural products is also planned in Espirito Santo state which will be covered by the proposed corridor. As seen in Table 1.5, export target to be attained in 1977 is set at 200 thousand tons for maize, 80 thousand tons for soybeans and 180 thousand tons for beef. Agricultural commodities exported from this state have so far been limited to coffee and cocoa. Maize, however, is cultivated throughout the state including the western hilly area and in addition, the state's coastal area embraces an extensive arable land suited for maize cropping. The state authorities are enforcing various agricultural development policies including establishment of demonstration farms where guidance are offered for raising yield per unit area. It can therefore be said that both production and export of maize will show a substantial increase in the coming years.

Thus, the target export volume set by the two states for cereals is more than 1,300 thousand tons (1,180 thousand tons for maize and 128 thousand tons for soybeans), which is far surpasses 850 thousand tons adopted by the federative republic government. It may be said that this large discrepancy reflects faithfully the earnest hopes placed by the state governments on the improvement and consolidation of pertinent transportation facilities.

The mission is of the opinion that this export target, though much higher than that of the federative republic government, can be attained because production will be augmented sharply for reasons itemized below.

1. Extensive arable land is found in many parts of the states such as Triangulo district.

2. There can be observed many factors, including the settlement of entrepreneurial farmers from other states, which will introduce large scale farm management employing advanced farming techniques.

3. Satisfactory technical guidance can be given to small holders by virtue of the well consolidated extension system (ACAR).

It is to be pointed out, however, that agricultural cooperative association in Minas Gerais state are less well organized than in other states and should therefore be strengthened in the coming years. Efforts should also be made for inducing investment of private enterprises in the agricultural sector so that farmers may be better organized, provided with guidance and training in advanced farming techniques, and encouraged in industrializing their production activities.

1-2 Storage Facilities for Agricultural Products

Table 1.6 shows the results of storage capacity calculation worked out for export from Minas Gerais state. The table indicates that storage facilities with a total capacity of 534 thousand tons must be operated in two to three rotations to ensure smooth shipping operation in 1977 when the total export volume is expected to reach 1,503 thousand tons. As an emergency measure to meet this storage requirement, the state authorities are planning to establish storage facilities having a total capacity of about 200 thousand tons, comprising ordinary warehouses (66 thousand tons), silos (110 thousand tons), cold warehouses (17.3 tons), and others.

The storage facilities construction plan mapped out by the federative government is smaller in scale than this state plan. It covers silos (110 thousand tons; but 100 thousand tons in actuality because the existing silos have a capacity of 10 thousand tons) and cold warehouses (17.3 thousand tons), but does not include any ordinary warehouses.

As seen in Table 1.6, the total storage capacity estimated to be required in Minas Gerais state is quite large, and the greater portion of it is planned to be provided by grain silos whose construction plan must be based on a careful study of a number of factors such as the method of collecting products, silo operation system, relations and coordination with ordinary warehouses, etc. In the initial stage, therefore, it will be necessary to give priority to the construction of silos along important railway routes, to be later ensured by the establishment of additional silos at other places in the state with the improvement of the operation method and increase of production.

Construction of warehouses is also planned by the authorities of Espirito Santo state to provide a storage capacity of 400 thousand tons of bulk grains. Though not included in the federative republic government's plan, this plan need to be put to a review because the producing area in Espirito Santo state is close to the shipping port.

1-3 Inland Transportation

1-3-1 Railway Transportation

Under the present project, it is planned that farm products will be transported from the producing area to Vitoria port via Goiania - Ibia (or Goiandira - Araguari - Uberaba - Ibia) - Belo Horizonte, with Costa Lacerda - Vitoria port section covered by the railway transportation service of Companhia Vale do Rio Doce. The route covers quite a long distance. For example, the distance between Goiania and Vitoria is as large as 1,867 km, and that between Uberaba and Vitoria is 1,451 km.

(1) Existing State of Railway Facilities and Service (See Fig. 2)

Goiania - Belo Horizonte and Uberaba - Ibia routes belong to the Fifth Local Control Division of Federal Railways, and Belo Horizonte - Costa Lacerda route to the Sixth Local Control Division of Federal Railways, whereas Costa Lacerda - Vitoria route is covered by Companhia Vale do Rio Doce. Track condition of Federal Railways is rather poor, with a sharp grade ranging from 3 to 2.5 % and a heavy curve of about 100 m observed at many places. By reason of this poor track condition, tractive force of 1,300 HP class diesel locomotives running on Federal Railway routes does not even reach 500 tons at some points. Rail weight is mostly 37 kg/m but is found to be smaller in certain sections.

Transport volume recorded in 1971 is as follows.

Goiania → Garcas : 16 - 71 thousand t/year
Goiania ← Garcas :: 169 - 455 thousand t/year

Garcas → Belo Horizonte : 387 - 644 thousand t/year
Garcas ← Belo Horizonte : 56 - 93 thousand t/year

Belo Horizonte → Costa Lacerda : 898 thousand t/year (2,500 t/day)
Belo Horizonte ← Costa Lacerda :1,030 thousand t/year (2,800 t/day)

Thus, the largest transport volume is recorded between Belo Horizonte and costa Lacerda. The annual transport capacity over the entire routes is approximately 2 million tons.

(2) Export Corridor Plan

(a) Track Improvement

The heaviest grade will be reduced to about 1.0 - 1.5 % and the minimum radius of curvature increased to about 300 m in the following sections.

Itauna section (12 km), Perobas section (15 km), San Antonio section (35 km), Tobati - Babui section (70 km), Patrocinio section (5 km), Macaubas section (18 km) and Itipu section (35 km).

In Sabara- Costa Lacerda section where the track condition is particularly poor, improvement work will be effected on a larger scale for reduction of the maximum grade from 2.5 % to 1.0 % and increase of the minimum radius of curve from 100 m to 300 m.

(b) Improvement of Tracks and Safety System

Improvement and reinforcement of signalling and communications facilities will be effected in addition to track improvement in Belo Horizonte - Goiandira and Ibia - Uberaba sections.

(3) Evaluation of Export Corridor Plan

Completion of the above improvement work will make it possible for a 1,500 HP class locomotive to generate 1,000 tons of tractive capacity, though it may be necessary to employ an auxiliary engine in some sections. Since this means that nine more trains can be put in daily operation to add to the present transport volume, there will be no difficulty in transporting 850 thousand tons of agricultural products in five months.

At present, Companhia Vale do Rio Doce is putting its train in seven turnback operations a day for ore transportation on its single-line track (which is partially double-tracked). Vale do Rio Doce Railway will be available for projected farm produce transportation because the company is planning to complete double-tracking of its entire line by 1975.

These improvement plans are meaningful in that they will promote the consolidation of arterial railway lines as well as regional development along such lines. However, if they are to be implemented for the purpose of the export corridor improvement alone, priority should be given to the improvement of such sections whose poor track condition and facilities will make it impossible to maintain the present railway transport volume and secure an additional transport capacity of 5,700 tons/day of farm

During the mission's stay in Brazil, the federative republic Railway Authorities presented no concrete plan for grain transportation under the export corridor plan. Considering the present transport capacity, scale of required improvement work and routing benefit, the mission believes that the improvement work should be started in Belo Horizonte - Costa Lacerda section, though the opinion was advanced by some Brazilian officials that top priority should be given to Goiandira - Belo Horizonte route.

The plan is intended for grain transportation from the entire Triangulo area to Vitoria port and not to Santos port though the latter is closer to Triangulo. If export grains produced in Goiandira - Araguari - Uberaba districts are to be shipped from Vitoria port, the overland transport route must be covered by three different railway enterprises, i.e., São Paulo State Railways, Federal Railways and Companhia Vale do Rio Doce. In such a case, the freight will be considerably high if charged for each segment of the route. It will therefore be necessary to frame up a new freight policy under which a thorough freight system can be enforced.

1-3-2 Highway Transportation

Of all the states covered by the project, Minas Gerais state is the largest in area, but ranks bottom in the density and condition of arterial highways.

The highway network indispensable for increased production of farm products and their transportation to storage warehouses is poor particularly in the northern part of the state. For smooth transportation of farm products to storage points, the existing road network should be so consolidated as will be connected to railway stations by new construction and improvement of arterial highways as well as branch roads branching off from or linking arterial highways.

Road transportation is required not just for agricultural products. It is increasingly demanded for a great diversity of other commodities as well. If Vitoria port is to perform the function of an international trading port in future, the roads linking the port and the northern part of the state such as BR-451 (Federal Highway No. 451) and BR-259 should be improved without delay. Further, construction of BR-262 should be expedited for early connection of Belo Horizonte and Vitoria port, and a ring road running along the periphery of Belo Horizonte city should be constructed in order that no heavy congestion will be caused in the city by the inflow of car traffic from Triangulo and northwestern part of the state.

Espirito Santo state covers a strip-shaped area extending north to south, and its products are transported mostly by road. The state provides the transportation route for various processed commodities manufactured at factories established in recent years as well as for agricultural products of Minas Gerais state. It is highly probable that the state will play a vital role in future commodity transportation with the development of Vitoria port. At present, however, the length of paved roads is small relative to the total extension of roads in the state. Though classified as state road, many of the roads in the state such as ES-2 (Espirito Santo State road No. 2) and ES-37 are important for future cargo traffic. Efforts should therefore be made for extending the paved distance of these roads.

Since the traffic demand in the two states is rather small, it can be satisfied for a considerably long time once the highways network is consolidated as proposed above. It is considered that four-lane road construction will not be required except in the vicinity of Belo Horizonte city and in a very limited section of BR-262 which runs through Espirito Santo state.

1-4 Vitoria Port

1-4-1 Outline of Vitoria Port

Vitoria port has two port areas, i.e., the old Vitoria port area and Tubarão port area which was newly developed by Companhia Vale do Rio Doce. Though the port is found at about the centre of Espirito Santo state, its hinterland area covers not only Espirito Santos state but the extensive Minas Gerais state. From the explanation given by the governor of Espirito Santo state, the mission felt that the port is important as the gateway of Minas Gerais state rather than that of Espirito Santo state.

(1) Topography

Vitoria port presents a striking topographical resemblance to Santos port. The entire port area faces Espirito Santo bay along which extends, like an arc, a sandy beach called Camburi and Comprida. The old port area faces Estario de Santa Maria, a narrow and straight arm of sea penetrating into the land in the western direction from the southern tip of the sandy beach. The new Tubarão port area, on the other hand, is found on Ponta do Tubarão which is at the extreme eastern end of beach.

Vitoria city is on Ilha do Espirito Santo and connected with the continent by a bridge. At the southern tip of the city is established a cais comercial (commercial quay) which faces, across the sea, a cais industriats (industrial quay). On the east side the industrial quay are found Capuaba area and Aribiri area which are expected to play an important role in the future development of the old Vitoria port area.

(2) Administration

Vitoria port is under the administrative control of Espirito Santo state. However, port facilities actually placed under the direct control of the state authorities are limited to the commercial quay, navigation channel and basin in the old Vitoria port area. Control of other facilities in Vitoria port area is undertaken by USIMINAS and Eumenes Guimarães (ore and coal quay) as well as Esso and Texaco/Shell (petroleum terminal). In Tubarão port area, on the other hand, Companhia Vale do Rio Doce assumes responsibility for operation of the ore terminal and Petrobras is charged with the control of the petroleum terminal.

(3) Cargo Handling Volume at Vitoria Port

In 1971, Vitoria port handled 28,400 thousand tons of export and inter-state outbound cargoes and 1,600 thousand tons of import and inter-state inbound cargoes, totalling 30,000 thousand tons. This cargo handling volume makes the port the largest trading port in Brazil. 90 % of this total cargo volume, or 27,000 thousand tons, was handled in Tubarão port area and the remaining 10 %, or 2,800 thousand tons, was handled in Vitoria port area.

The total cargo volume handled at this port in 1966 was about 11,000 thousand tons. Over the past five years, the volume increased by about three times and this is due to the sharp increase of iron ores shipped from Tubarão port area during that period.

Agricultural commodities exported from Vitoria port up to August 1972 were limited to coffee and cocoa and included virtually no cereals. Trade return up to that time neither includes commodities like meat, fruits and fruits juice. Meat produced in the state is almost all carried to Rio de Janeiro port and shipped to overseas markets from the latter part of March towards the beginning of September at a rate of about 5,000 tons a month.

Wheat is the only agricultural product imported into the state. Its import volume is about 40 thousand tons and silos with a capacity of 8 thousand tons are established to handle this volume.

Number of incoming vessels maintained almost on the same level over the past three years, registering 1,175 in 1969, 1,213 in 1970 and 1,260 in 1971. This suggests the increase of gross tonnage of the vessels that called at Vitoria port during these three years.

Table 1-1 Sundry Goods Handled at Commercial Quay

1966/1972 (ton)

Classification	1966	1967	1968	1969	1970	1971
Export incl. Inter-state Movement	261,211	342,475	326,596	278,080	297,873	183,436
Import incl. Inter-state Movement	64,887	79,996	90,820	171,346	122,749	248,511
Total	326,098	422,471	417,416	449,426	420,622	431,947

Table 1-2 Cargo Handling Volume at Vitoria Port

Kind of Quay and Commodity		Tonnage
Commercial Quay	Sundry Goods	431,949
Paul Quay	Fine Ores	141,124
Coal Quay	Coal	774,929
E. Guimaraes Quay	Lump Ores	1,182,332
Petroleum Products Terminal		316,021
Sub-total		2,846,355
Iron Ore Terminal		26,879,197
Petroleum Products Terminal		224,207
Sub-total		27,103,404
Total		29,949,759

(4) Existing State of Port Facilities

(a) Navigation Channel and Basin

Vitoria port area has a navigation channel having a length of about 6.3 km. Though this channel has a small width of 120 m, its depth is -13 m. Adjacent to this navigation channel is arranged a basin (Bacia de Evolucão) which is -10.6 m deep and 330 m wide. Tubarão port area also embraces a -17 m deep navigation channel and a -16 m deep basin.

In Vitoria port area, a groyne connecting a number of islands i.e., Ilha do Boi, Ilha do Bode, Ilha do Sururu and Espirito Santo island, is constructed to protect the -13 m navigation channel against silting up by littoral drift sand moving southwards from Espirito Santo bay. This is one of the few channel protective facilities found in Brazil where sea port construction is usually undertaken by taking advantage of the surrounding topographic condition.

(b) Mooring Facilities

Outline of mooring facilities in the two port areas is as shown in Table 1.3

With its annual cargo handling capacity limited to about 530 tons per meter, the commercial quay in Vitoria port area is not operated very efficiently. The ore terminal in Tubarão port area, on the other hand, exhibits a high operation efficiency as evidenced by an annual handling capacity of 18,000 t/m. The terminal is a 760 m long pier having a water depth of -16m, and can accommodate a 120,000 DWT class ore carrier along its northern side and an 80,000 DWT class ore carrier on its southern side. On this terminal, two units of cargo handling equipment, one having a capacity of

Table 1-3 Existing State of Port Facilities at Vitoria Port

Area	Name of Quay/ Terminal	Depth(m)	Length(m)	Handling Capacity (t/m)	Controlling Body
Vitoria	Commercial Quay	-6.0~11.0	800	530	State authorities
	E. Guimaraes Quay	-10.7	110	10,750	Eumenes Guimaraes
	Coal Quay	-11.0	260	2,980	USIMINAS
	Ore Quay	-11.0	160	880	Ditto
	Petroleum Terminal	-10.9	-	-	Esso
	Petroleum Terminal	- 9.3	-	-	Joint control by Texaco and Shell
Tubarão	Ore Terminal	-16	760 x 2	17,680	Co. Vale do Rio Doce
	Petroleum Terminal	-10	-	-	Petrobras

8,000 t/h and another 6,000 t/h, are installed. The mission was informed that the maximum tonnage of vessels that can be berthed is 170,000 D/W, and that the bertning time required for a 150,000 D/W class carrier ranges from 10 to 12 hours.

Existing state of other port facilities such as warehouses, tanks and other storage facilities, harbour traffic facilities, and handling equipment and machinery is as described under the following items.

(5) Warehouses and Other Storage Facilities

Warehouses	7 9,600 m^2
Storage tank	400 - 12,500 kl 19
Silo	8,000 t (12,000 t for short time storage)

(6) Harbour Railway

Siding track	7.43 km
Crane track	1.04 km

(7) Harbour Road

Unknown

(8) Handling Equipment and Machinery

Motor-operated crane	1.5 - 1.6 t	x 20 units
	10 - 12.5 t	x 4 units
Mobile crane	10 - 15 t	x 3 units
	20 - 30 t	x 2 units
Forklift	1 - 10 t	x 40 units
Suction Feeder	20 - 25 t/h	x 3 units
	60 t/h	x 1 units
Redler	30 - 60 t/h	x 5 units

(9) Other Handling Facilities

Ore storage yard	Paul	1,000 t/h
	Eumenes G.	1,500 t/h
	Tubarão	14,000 t/h (6,000+ 8,000 t/h)
Coal storage yard	Paul	400 t/h

1-4-2 Port Improvement Plan

(1) Estimate of Cargo Handling Volume

From the production expansion plan of Companhia Vale do Rio Doce, it can be expected that the iron ore shipment from Tubarão port will increase to 37,000 thousand tons in 1973, 45,000 thousand tons and further to 50,000 - 60,000 thousand tons in 1975.

Under the export corridor plan on the other hand, it is planned that 850 thousand of cereals, mainly maize, will be exported from Vitoria port. The plan therefore incorporates a project for providing the port with facilities for handling 1,000 thousand tons of cereals and 100 thousand tons of meat.

(2) Port Improvement Plan

Construction work is already in progress by the hand of Companhia Vale do Rio Doce according to the following port improvement plan which is based on the aforementioned export expansion target.

Under this plan, materialization of the following improvements is envisaged.

1. Construction of a new pier on the northern side of the existing one for accommodation of 250,000 DWT class ore carriers.

2. Dredging of the navigation channel and basin to a depth of -22.5 m and -21.5 m respectively.

3. Installation of a handling equipment with a capacity of 16,000 t/h, to be ensued by the provision another equipment with the same capacity to secure a loading capacity of 32,000 t/h.

4. Reclamation of sea area for creation of a new ore storage yard to double the present storage capacity of 2,000 thousand tons.

The company is also contemplating double-tracking the distance between Itabira mine and Tubarão port which is currently covered by a single-track line, and has the intention to introduce C.T.C. system in time with double-tracking. When this scheme is brought to a reality, the railway between these two points will have an annual transport capacity of 100 million tons. This means that there will be created a sizable surplus transport capacity if the railway thus improved is used for ore transportation alone. Under the export corridor plan it is planned to take advantage of this surplus capacity for transportation of agricultural products from inland areas to Vitoria port.

The wharf in Capuaba area is planned to be consolidated for export of agricultural products, with top priority given to the construction of a frozen products terminal and second priority to the provision of two -12 m quay and grain silos. It is expected that Shell's petroleum terminal will be moved to another place because it will impede the execution of this plan.

On the frozen products terminal, cold warehouses with a capacity of 7,500 t will be the core of facilities. It is intended that 60 % of this storage capacity will be made available by 1974 to handle 5,000 tons of bonned meat. This will be ensued by the construction of the remaining 40 % of warehouses so that a total of 15,000 tons of boneless meat can be stored in future. Installation of four units of cranes each having a loading capacity of 15 t/h at a hoisting load of 3.5 tons is also planned for handling export meat on this terminal.

The 540 m long -12 m berth will be divided into two parts, one having a length of 180 m and used for loading frozen products and the other covering the remaining 360 m length and used for shipment of steel products manufactured by USIMINAS. It is predicted that 600 thousand tons of steel products will be handled in 1976.

The grain silo construction plan is intended for securing a storage capacity of 30,000 tons. The mission was informed that a new quay will be constructed between the planned Capuaba quay (Cais do Capuaba) and the existing Atalaia quay will be integrated into one berth for loading grains from silos. The mission was also informed that iron ores presently loaded from Atalaia quay will be shipped from Tubarão port area for implementation of the silo construction plan.

The -6.0 m commercial quay is planned to be improved to have a larger depth of -9.5 m. Further, reclamation is planned to be conducted in front of the existing 90,000 m^2 wide open storage yard, which is on the western side of the commercial berth, in order to create another yard having the same storage capacity.

(3) Harbour Land Transportation Improvement Plan

A harbour siding to Capuaba area is planned to be taken from a point on the existing metric gauge line which extends to Alataia quay after by-passing Mt. Paul (Montanha do Paul). As for harbour traffic road, it is planned that a new road branching off from the existing road to the industrial quay will be constructed.

The continental side (on which the industrial quay and Capuaba area are found) and Espirito Santo island (on which Vitoria city is located) are connected by a road-railway bridge (Ponte Florentino Avidos). At present, smooth traffic across the bridge is impeded to an extreme extent because of the bridge's small width which inhibits passage of automobiles when a train is running. To bring solution for this traffic problem, a new road bridge is planned to be constructed at a point 700 - 800 m west of the existing bridge.

(4) Evaluation of Port Improvement Plan

The mission was informed by the competent Brazilian authorities that the port improvement plan explained above will be put to reexamination and revised by the end of 1972. Instead of putting the plan to a critical evaluation, therefore, the mission's comment on the plan is given below in the hope that it will prove instrumental in making the rexamination.

The mission wishes to make it clear that after reviewal of the Vitoria port improvement plan, it was felt that the plan lacks accuracy and clear-formed ideas when compared with the similar plans drafted for other sea ports serving as gateway of export corridors in other states. This impression is based on the following facts.

1. While the construction of warehouses would have to be preceded by the completion of a quay in front of them, top priority is given to warehouses which are planned to be constructed by 1974 and second priority to the quay for completion by 1976.

2. Construction of a quay in front of grain silos is not incorporated in the export corridor plan whereas a -12 m berth is planned to be constructed for shipment of steel products which are irrelevant to the plan.

3. The capacity of grain silos, 30,000 tons, is too small when compared to the export target of the port.

Accordingly, the following points will have to be taken into account when mapping out a new improvement plan.

1. Assuming that the grain carriers to be berthed are of 50,000 DWT class, they will have a length of 220 - 230 m and a draught of 12 m. This means that the berth must have a depth of -13 m and a length of 250 - 260 m to cover the length of mooring lines. This berth length will cut into a part of the frozen products berth under the existing plan, and is liable to cause irregular cargo handling work when a grain carrier and a refrigerating carrier are berthed at the same time. The plan must be reexamined to remedy this drawback.

2. Silos are required to have a capacity 1.5 times the loading volume or larger. Hence, their total required storage capacity should be 75 - 80 thousand tons.

3. Two units of ship loaders, each having a capacity of 1,000 t/h, should be installed.

4. Since cold warehouses are to be operated in about 10 rotations year they should have a storage capacity of 10 thousand tons. In the initial stage, however, a capacity of 5,000 tons will be reasonable.

5. Since the navigation channel and basin are narrow, operation of high-powered tug-boats will be required when vessels of 50,000 DWT class enter the port.

Though the port improvement plan as part of the export corridor plan covers only Capuaba area, development of Capuaba area is planned to be followed by that of Aribiri inlet area (Saco do Aribiri). The inlet is the estuary of the Aribiri river (Rio Aribiri), a small river having an estimated discharge of 7 m^3/sec, and is found about 1,000 m to the east of Capuaba area. If new port facilities are constructed by dredging the inlet and excavating part of the surrounding flat land, it will be possible to create a wharf which is comparable in shoreline length to the three seas combined, i.e., industrial, commercial and planned Capuaba. The wharf thus created will also have a substantially extensive hinterland area.

Table 1-7 Export of Iron Ores at Vitoria Port and Tubarão

1966/1972

Unit: t

Distinction of Quay	1966	1967	1968	1969	1970	1971
Quay in Vitoria Port Area	7,177,371	2,886,621	1,220,839	1,868,808	1,982,912	1,323,456
Terminal in Tubarao Port Area	2,921,306	8,768,829	11,536,636	15,870,159	22,069,096	26,879,197
Total	10,098,677	11,655,450	12,757,475	17,738,967	24,052,008	28,202,653

Table 1-8 Import of Coal 1966/1972 at Vitoria Port

1966/1972

Unit: t

Distinction of Quay	1966	1967	1968	1969	1970	1971
Coal Quay	494,038	534,718	530,400	727,329	794,300	774,929

Table 1-9 Inter-state Import of Petroleum Products at Vitoria Port

1966/1972

Unit: t

Distinction of Terminal	1966	1967	1968	1969	1970	1971
Esso - Shell - Texaco Atlantic - Petrobras	380,124	406,561	459,384	482,086	472,757	540,228

Table 1-4 Agricultural Production and Exports in Minas Gerais State

(Unit : 1,000 t)

		Maize	Sorghum	Soybeans	Ground-nuts	Castor Beans	Coffee Beans	Sub-total	Cotton	Oil & Oil Cakes	Pellet Mandioca	Molasses (Sugar Canes)	Coffee (Ground or Powdered)	Meat & Meat Products	Sub-total	Total
1972	Production	2,300.0	4.0	5.0	6.0	16.0	170.0	2,501.0	32.0	65.0	-	135.0	21.0	240.0	493.0	2,994.0
	Export	100.0	1.0	1.0	0.5	2.0	105.0	209.5	5.0	5.0	-	55.0	3.0	30.0	98.0	307.5
1977	Production (Estimate)	3,600.0	44.0	125.0	11.5	28.0	310.0	4,118.5	60.0	230.0	28.0	200.0	45.0	340.0	903.0	5,021.5
1	Export (Estimate)	980.0	35.0	48.0	2.0	4.0	60.0	1,129.0	26.0	140.0 Oil 35.0 Oil Cakes 105.0	25.0	91.0	7.0	85.0	374.0	1,503.0

Table 1-5 Exports of Agricultural Products from Espirito Santo State (1977)

(Unit: 1,000 t)

Maize	Soybeans	Pellet Mandioca	Fruit Juice	Coffee (Powdered or Ground)	Beef	Oxhide	Wood and Pulp	Coffee Beans	Cacao
200	80	100	10	2	180	22.5	300	100	54

Table 1-6 Storage Capacity Required in Minas Gerais State (Theoretical Values)

(Unit: 1,000 t)

	Production and Export in 1977			Turnover Rate of Warehouses	Required Storage Capacity		
	Production (Whole State)(1)	Exports (Whole State)(2)	Exports (Project Area)(3)		(1)	(2)	(3)
Primary Products:	1,617.5	1,276	1,129	-	567	457	387
Maize	1,300	1,000	980	3	433	334	327
Sorghum	40	35	35	3	13	12	12
Soybeans	120	50	48	3	40	17	16
Groundnuts	5.5	2	2	3	2	1	1
Castor Beans	12	4	4	3	4	1	1
Coffee Beans	140	185	60	2	75	92	30
Processed Products:	410	451	374	-	156	180	147
Cotton	28	28	26	2	14	14	13
Oil & Oil Cakes	165	160	140	3	55	53	47
Pellet Mandioca	28	25	25	2	14	12	12
Mollasses (Sugar Canes)	65	130	91	2	32	65	45
Coffee (Processed)	24	13	7	3	8	4	2
Meat & Meat Products	100	95	85	3	33	32	28
Total	2,027.5	1,727	1,503	-	723	637	534

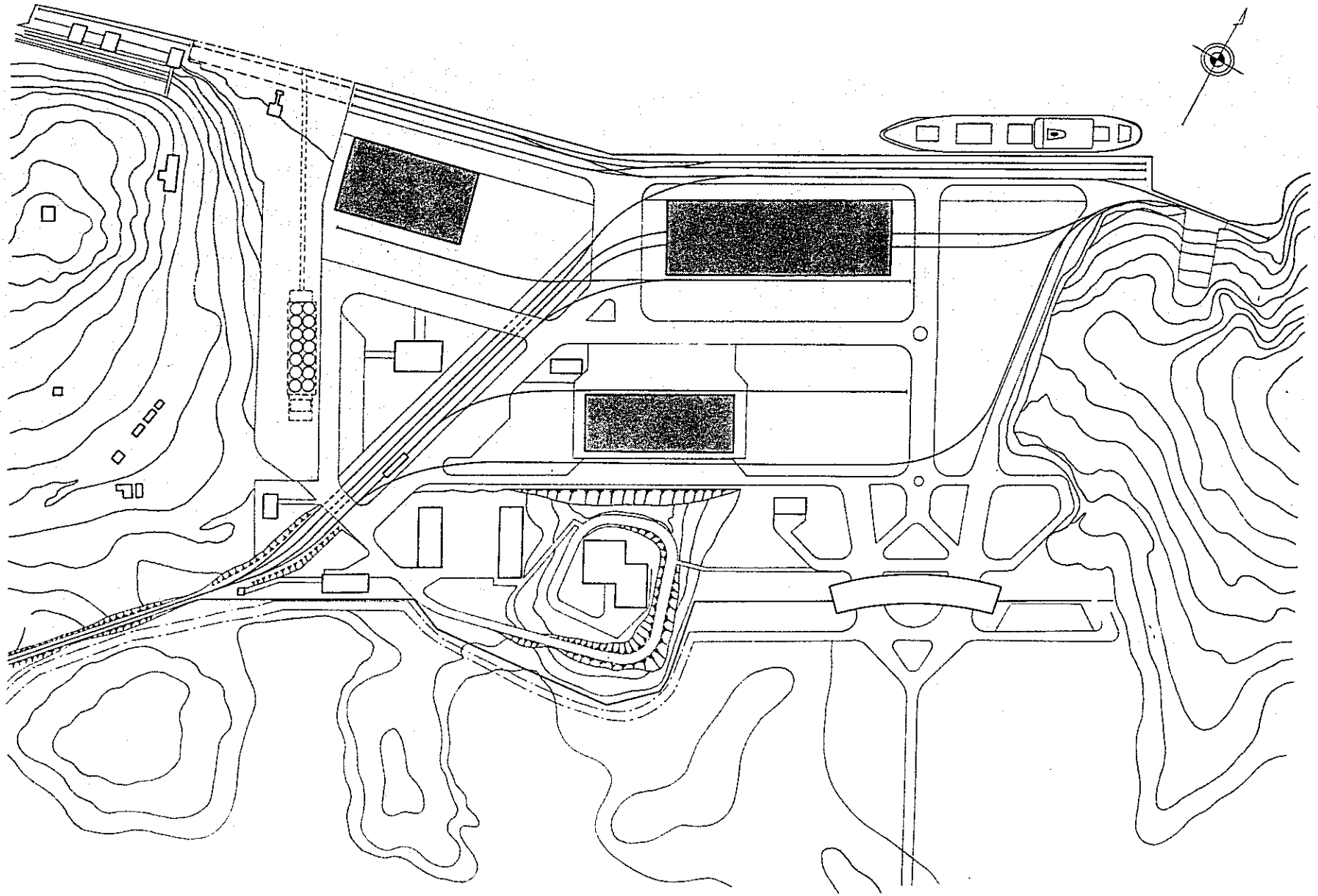


Fig. 1.1 Sketch of Capuaba Port District, Vitoria Port

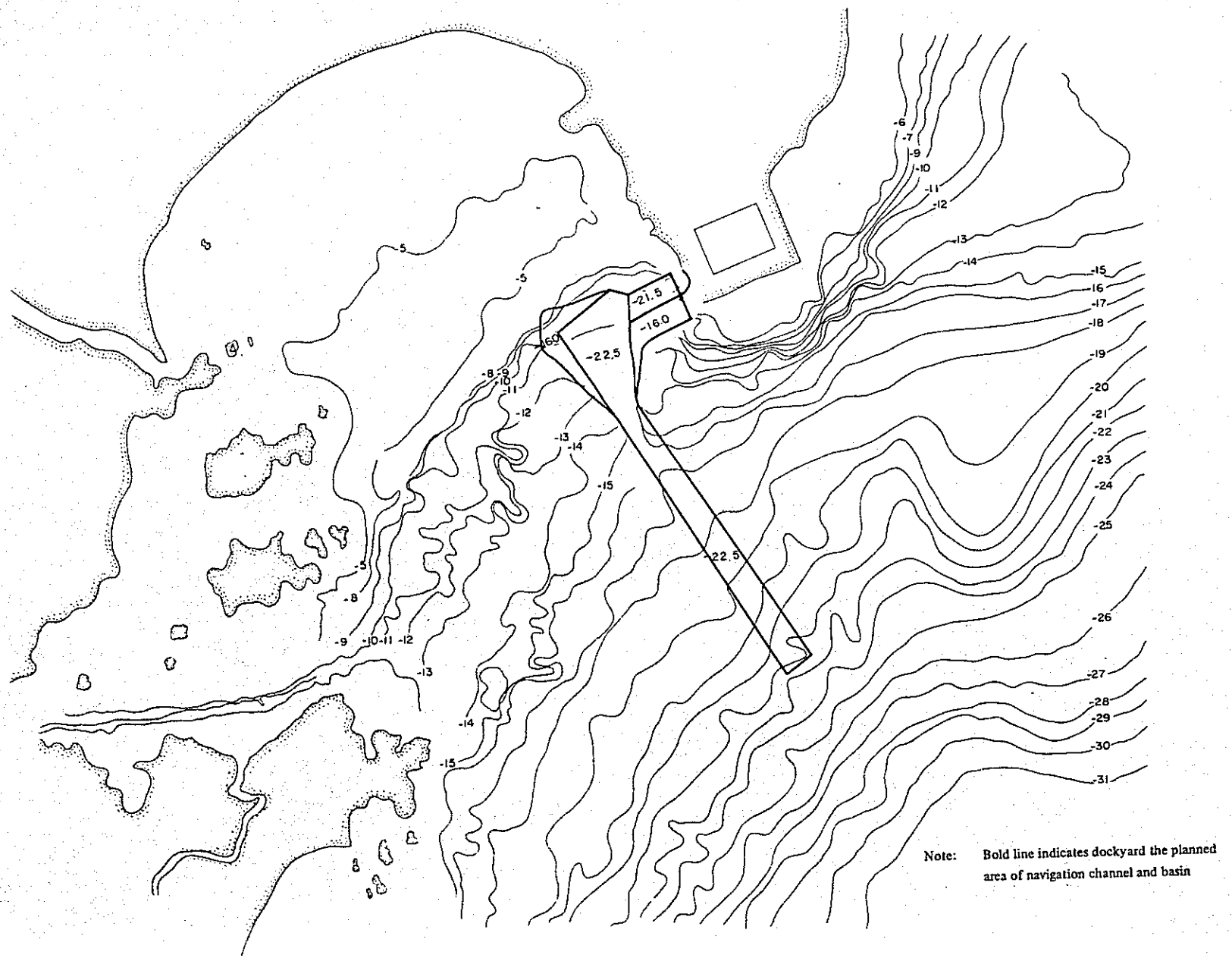
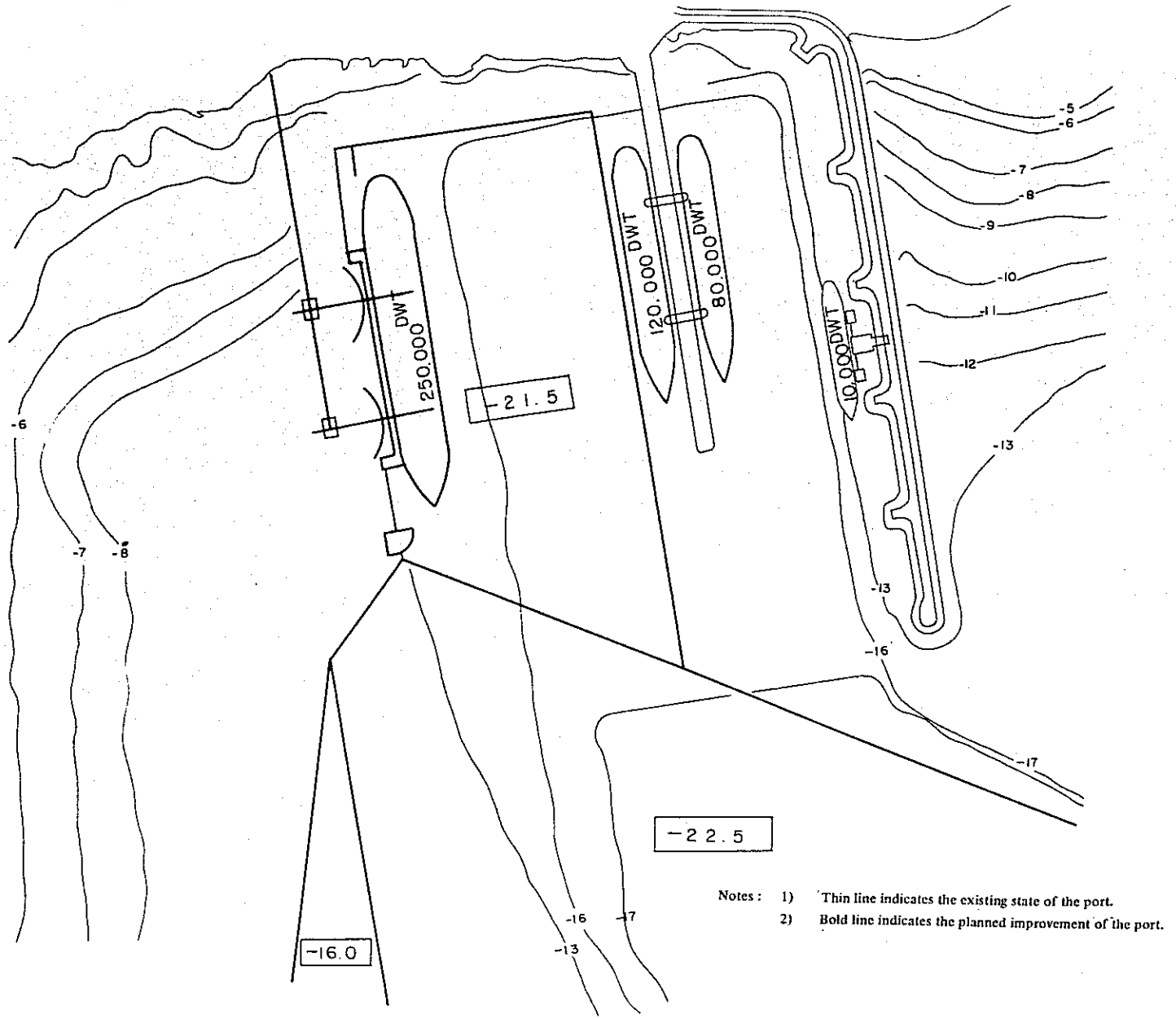


Fig. 1.2 Tubarão Port District, Vitoria Port



Notes : 1) Thin line indicates the existing state of the port.
2) Bold line indicates the planned improvement of the port.

Fig. 1.3 Tubarão Port District, Vitoria Port

II. EXPORT CORRIDOR OF SÃO PAULO

Sao Paulo state is known as the most advanced state in Brazil. Its industrial structure is made quite diversified and complex by a great variety of industries such as agriculture centering on coffee cultivation, agricultural product processing industry, automobile industry and many other modern industries. The state also holds a superior place over all other states in infrastructural improvement in various aspects such as railway and road transportation and export shipment from Santos port, the gateway of the state for international trade.

Under the present export corridor plan it is planned that approximately 2,900 thousand tons of various agricultural products such as maize, sorghum, soybeans, fruit juice, meat, etc. will be shipped from Santos port to overseas markets. Though Santos port is already playing quite an important role in the international trade of the state, a number of plans are incorporated in the plan for its further improvement. These plans include the dredging work and expansion of the port area and berthing capacity to enable larger vessels to enter the port, and are currently in progress on a large scale with necessary fund provided chiefly from the World Bank and the federative republic government. To augment the cargo handling and storage capacity of the port, the plan also embraces a plan to build new warehouses and silos, introduce cargo handling equipment and machinery and construct harbour railways. Further, due account is taken of the need of intermediate silos, with a plan already drafted to secure a storage capacity of 150 thousand tons.

São Paulo city is the origin of all railway lines in the state, and it is linked with Santos port by a single railway line. Since traffic congestion in São Paulo city has recently reached a state of saturation, it is now planned to augment the transport volume between the two points by constructing a new railway line to Santos port which will take a roundabout route near São Paulo.

2-1 Production and Export of Agricultural Products

Items that can be cited as export agricultural commodities of São Paulo state are maize, soybeans, sorghum, orange juice, soybean oil, soybean cakes, beef, and so on. The target export volume in 1975 of cereals and their processed products totals 2,700 thousand tons, which is planned to be composed of 2,000 thousand tons of maize, 300 thousand tons of soybeans, and 400 thousand tons of pellet (soybean cakes and others). This target volume of 2,878 thousand tons envisaged by the federative republic government.

Maize is cultivated mostly by small holders throughout the state, and its major producing areas are Bauru, Ribeirao Preto, São Jose do Rio Preto and Sorocuba. At present, 3,000 thousand tons of maize is harvested in a total planted area of 1,500 thousand hectare distributed mostly in these major producing areas. The present yield rate of about 2 t/ha. is planned to be raised to about 3 t/h through extension of advanced farming techniques including the distribution of seeds of improved varieties, improvement of

fertilization method, control of diseases and insect pests, introduction of mechanized farming, etc., so as to attain a production of 4,500 thousand tons in 1975 and export 2,000 thousand tons to foreign countries. (For details of the yield rate improvement, refer to the experimental data of São Paulo State Agricultural Experiment Station shown in Table 2.1).

Production of soybeans has been on the sharp increase over the past years. In 1960, the total planted area was only 4.2 thousand ha. In 1972, soybeans are cultivated in an area of as large as 126.6 thousand ha. Though nearly 80 % of total production is now covered by the farmers in Ribeirao Preto district, it is expected, for reason described below, that soybeans will be cultivated on a large scale in the coming years by those farmers who are operating with medium and large operational holding in the middle northern part of the state.

1. Mechanized farming can be introduced with relative ease for soybean production.

2. By applying fertilizers, infertile land (Cerrados) which is said to cover an area of about 1,500 thousand ha can be converted to arable land suited for soybean production.

3. Yield per unit area is expected to be raised in future.

In addition, soybeans are planted by increasingly many farmers in the wheat producing area in the southern part of the state for double cropping with wheat.

For all these reasons, it is anticipated that the soybean planted area will be increased to 530 thousand ha in 1975 when production will reach 800 thousand tons, and 300 thousand tons of this output is planned to be supplied to the world market. It is possible that production will exceed the target volume if the export estimate is confirmed.

Sorghum is a crop introduced into the state only in recent years. There is a possibility, however, that its planted area will increase rapidly by reason of such favourable factors as 1) it can withstand drought condition, 2) farming machines and equipment can be employed for its cultivation, and 3) improved varieties are being introduced at present. If this possibility is convereted into a reality, it is likely that sorghum will be grown as self-supplied feed substituting for maize.

In order to attain the target maize production of 4,500 thousand tons in 1975, considerable effort will have to be exerted for the extension of necessary techniques. Considering the expected production growth of soybeans and sorghum, it appears probable that the total production of cereals will reach 6,300 thousand tons in 1975. It can therefore be reasonably said that the total grain export of 2,700 thousand tons (including pellet) can be achieved in that year.

In São Paulo state, export agricultural commodities are exempted from the taxes on circulation and acts or subjects to such taxes at a reduced rate. This taxation policy is considered to serve as a powerful incentive to export promotion both at present and in future.

It is to be added that establishment of a systematic production system including the fostering of agricultural cooperation associations is a must for stabilized agricultural production. This is particularly true in soybean producing areas.

2-2 Storage Facilities for Agricultural Products

The total capacity of public and private storage facilities now existing in São Paulo state is 700 thousand tons, of which 140 thousand tons is covered by grain silos. To realize the 1975 export target of 2,300 thousand tons (2,000 thousand tons of maize and 300 thousand tons of soybeans), construction of additional silos with a total capacity of 360 thousand tons is planned by the state authorities for shipment of maize during the six month period from March to August and soybeans during the four month period from March to June (Table 2.2). The new silos will be established at eight places in major producing areas. Each of these eight places, to be located near a railway line or a road, is planned to be provided with a storage capacity of 20 to 80 thousand tons and cover a circular area extending within a radius of 50 to 60 km. The construction plan is so mapped out as will allow for additional construction of silos to meet the possible future need for larger storage capacity. The new silos will be constructed, operated and managed by CEAGESP, a semi-governmental warehousing company financed mostly by the state, which is known to have been operating various warehouses including cold warehouses over the past years.

Under the silo construction plan of the federative republic government, it is planned that 150 thousand tons of the above-mentioned 360 thousand tons capacity will be provided for the present to add to the existing capacity of 140 thousand tons. The federative republic government's idea is that the total capacity of 290 thousand tons thus obtained is sufficient for handling 1,800 thousand tons of grains, and that any deficiency in capacity should be covered by ordinary warehouses.

Though the state authorities can be justified in their general approach to the silo construction scheme, it is to be pointed out that their construction and management plan entails many institutional problems including the collecting system which demands that due consideration be given to the relationship with the producing farmers and their cooperative associations. The construction plan should therefore be implemented with priority given to those areas promising to provide augmented production in the immediate future, and the silo managment system should be studied carefully in such areas with account taken of the relations between silos and ordinary warehouses. Accordingly, the mission considers it advisable that new silos should be constructed in conformity with the federative republic government's plan.

Distribution of the existing and planned silos in São Paulo state is shown in Fig. 2.1.

2-3 Inland Transportation

2-3-1 Railway Transportation

Description given in this section is based on the premise that about 3 million tons of farm products produced in Sao Paulo state will be exported from Santos port.

(1) Existing State of Railway Facilities and Service

As shown in Fig. 3, two different gauges, 1.6 m and 1.0 m, are adopted in the railway network which composes the export corridor of São Paulo state.

The 1.6 m gauge railway line linking Campinas and Santos via Sao Paulo is double-tracked except in the coastal mountainous section extending from Santos, and is electrified in Rincão (vicinity of Araraquara) - Santos section and Cabralia Paulista (vicinity of Bauru) - Itirapina section.

The 1.0 m gauge line, on the other hand. is double-tracked in São Paulo - Ipelo section and electrified in São Paulo - Santos, Assis (vicinity of Ourinhos) - São Paulo and Ipero - Itapetinga sections.

The coastal range stretching along the Pacific coast of the country at an elevation of 900 m servers the sea from the mild plateau extending towards inland. This 900 m altitude difference must be overcome to reach the coast from plateau.

For this reason, a rope railway system is adopted in Alto da Serra - Cubatão section (Under this system, a loop steel rope makes a circulating movement along the railway between the top and bottom of a grade section. Up and down trains are hooded to this rope and ascend or descend the grade section like a cable car by the tractive force of the rope. In Alto da Serra - Cubatão section, the average grade is 8 % and both up and down trains are composed of two coaches). There used to be two lines of this type of railway, one opened in 1863 and the other in 1905. The one opened in 1863 is now being improved into an Apt-system railway (Under the Apt-system, the drive gear of locomotive is engaged with the cogwheel installed at the centre of track so that the train can make an ascending or descending movement by the rotation of the frive gear. This system used to be adopted in Yokokawa - Karuizawa section of Shinetsu line in Japan).

Beside the above-mentioned rope railways, São Paulo State Railways (gauge: 1.0 m) also connects the inland area and Santos port. Improvement is being effected to this railway because it descends the coastal range in a zig-zag course and therefore has a sharp grade (2.0 %) and a small curvature of radius (200 m) in many section.

Heavy grade and small radius of curvature are observed in many parts of the fan-shaped railway network developed in the inland area. Improvement efforts are therefore being made to reduce the maximum grade to 1.0 - 1.5 % and increase the radius of curvature as much as possible.

The transport volume recorded in 1970 by Federal Railways (gauge: 1.6 m) in São Paulo - Santos section is as shown below.

São Paulo ⟶ Santos		Santos ⟶ São Paulo	
Coffee	93 thousand tons	Fertilizers	530 thousand tons
Maize	288 " "	Others	1,590 " "
Others	1,169 " "		
Total	1,550 thousand tons	Total	2,120 thousand tons
Transport Capacity:	2,500 thousand tons	Transport Capacity:	2,500 thousand tons

Route-wise transport volume of São Paulo State Railways could not be obtained. It is known, however, that the transport capacity of the route of Santos which is subjected to the heaviest cargo traffic demand is as follows.

Campinas ⟶ Mayrink	1,900 thousand t/year
Mayrink ⟶ Santos	2,500 thousand t/year

(2) Export Corridor Plan

(a) Construction of Apt-system Railway in Alto da Serra - Cubatão Section.

Upon completion of the Apt-system railway now under construction, the existing rope railway will also be improved into an Apt-system railway. By this improvement, the Apt-system railway will be double-tracked and its transport capacity will be augmented by about four times of the present level.

(b) Construction of a New Railway Line in Maua - Jurubatuba Section

This is planned to link the 1.0 m gauge railway from Sorocaba and the 1.6 m gauge railway running between Jundiai and Santos, and will compose part of the south circuit line of São Paulo city.

Double gauge line system applicable for both 1.0 m and 1.6 m gauges will be adopted for this line.

(c) Construction of a New Railway Line in Paratinga - Pereque - Pissanguera Section

This is a 1.0 m gauge line extending to the lefthand side bank of Santos port (where grain silos are planned to be constructed). In Pereque - Pissanguera section, it will be constructed by the double gauge line system applicable to 1.0 m and 1.6 m gauges for grain transportation to the left side bank of Santos port. This line is already completed in part of Paratinga - Pereque section.

(d) Others

Track improvement, installation of additional substations, and other works are planned to be carried out to reinforce the transport capacity of each line.

(3) Evaluation of Export Corridor Plan

Ratios of railway utilization for farm produce transportation from various parts of the state of Santos port can be estimated as follows from the report of an investigation conducted by São Paulo State Railways.

From Ourinhos and vicinities	32 %	52 %
" Itapenva and vicinities	11 %	Gauge: 1.0 m
" Itapetinga and vicinities	9 %	Ipero→Mayrink→Santos
From Orlandia and vicinities	13 %	Gauge: 1.0 m Campinas→Mayrink→Santos
From Barretos and vicinities	18 %	35 %
" Votuporange and vicinities	17 %	Gauge: 1.6 m Campinas→Jundiai→Santos

If 3 million tons of agricultural products are to be transported to Santos by railway from various parts of the state, the transport volume to be borne by the two routes can be calculated as follows.

Mayrink⟶Pres Altino⟶Santos (1.0 m gauge)
3 million t x 65 % = 1,950 thousand t

Campinas⟶Jundiai⟶Santos (1.6 m gauge)
3 million t x 35 % = 1,050 thousand t

The daily transport volume of the two routes will be as follows if the said 3 million tons of farm produce are to be transported in five months.

Mayrink⟶Pres Altino⟶Santos	13,200 t/day
Campinas⟶Jundiai⟶Santos	6,600 t/day

Assuming that the locomotive has a tractive capacity (total weight of cargo) of 1,000 tons, 20 and 10 train operations respectively are required on the two routes.

Comments on Export Corridor Improvement Plan:

Item (a) - In Alto da Serra - Cubatão section, completion of the Apt-system railway now under construction will make it possible to secure 56 one-way operations daily if 4 trains each having a tractive capacity of 500 tons are put in continuous operation to make 14 return trips a day. However, actual number of daily train operations will be substantially smaller than mentioned above for reasons ascribable to operation condition and maintenance requirement. Therefore, the planned construction of another Apt-system railway is advisable because it promises to privide ample transport capacity in this section.

Item (b) - The new railway line proposed to be constructed under this item is important in that it will supplement the single-track 1.0 m gauge railway to Santos with the completion of the Apt-system railway lines planned in Item (a).

Item (c) - Construction of a new line planned in this item is significant because it will provide a new transport route to the port's left side bank where grain silos are planned to be established. It is also important for the materialization of the project because it constitutes part of the Santos port improvement plan.

Under the present plan heavy transport load is imposed on the 1.0 m gauge railways. Considering the present service condition, it does not seem an easy task to operate 20 freight trains a day for grain transportation from Mayrink to Santos via Presaltino. The plan incorporates a number of plans intended for additional installation of substations, track improvement, grade improvement and other works, and some of them are known to be already in progress. In implementing these improvement plans, therefore, high priority should be given to the said section to reinforce its transport capacity.

The mission wishes to add that improvement works are also required in Salto - Mayrink section because of its poor track condition, though the section is not covered by the plan.

2-3-2 Highway Transportation

São Paulo state has the most well developed highway networks in Brazil, but its traffic demand is very heavy because it embraces a population of 18 million or 19 % of the country's total and commercial and industrial activities in the state are brisk and animated.

In the vicinity of São Paulo city, the very high population density and flourishing industries are creating a heavy traffic of trucks carrying consumer goods, raw materials, industrial products and processed goods. The rate of road transportation of agricultural products to Santos port is therefore considered lower than in other parts of the state.

A number of federal highways concentrate on São Paulo city. Some of them such as Via Dutra (São Paulo - Rio de Janeiro section of BR-116), Via Anchieta (São Paulo - Santos section of BR-050), Via Anhanguera (São Paulo - Limeira section of BR-050), Via President Castelo Blanco (São Paulo - Avaic section of BR-374) are dual carriageway roads with four or more traffic lanes. Widening work is under way on Via Dutra to cope with the heavy traffic volume (50 thousand vehicles/day) which is causing slow-down of traffic flow.

Traffic volume on Via Anhanguera is about 30 thousand vehicles/day, but since traffic jam occurs in weekend, São Paulo - Campinas section is planned to be a six-lane highway, with a new four-lane highway Via Norte to link the two points. A new highway Via Das Imigrantes is also under construction from São Paulo to Santos.

Because of plateau, São Paulo is about 800 m higher than Santos, so an interesting attempt is made in design. In the plateau section where the traffic is heavy the new highway is planned to have eight lanes. In the gradient section, however, it will have three uptrade lanes, two downgrade lanes and two more lanes that is reversible for traffic in either direction.

Besides these, there are many plans drawn up or already being implemented to improve the highway network and to meet the growing traffic demand in the state. Improvement of São Paulo belt highway and BR-116 (São Paulo - Curitiba section) is one of such plans.

In the neighbourhood of São Paulo city, cities are located not very far from each other and the direction of traffic flow is largely affected by time because traffic demand is created predominantly by passenger cars and trucks carrying industrial products. Operation of tool roads will therefore prove highly profitable. It is considered that some of new routes such as Via Norte and pass through Via Dos Imigrantes will demonstrate good payability when operated as toll road.

In the inland area, efforts should be made for facilitating transportation of agricultural products to railway stations through extension of Via President Castelo Blanco and improvement of roads connecting radial arterial highways originating from São Paulo city.

2-4 Santos Port

2-4-1 Outline of Santos Port (Porto de Santos)

Santos port is one of the representative sea ports of Brazil and ranks with Rio de Janeiro port and Tubarão port area of Vitoria port. Its hinterland is an extensive area covering São Paulo state, northern parts of Mato Grosso, Goias and Parana states, southern part of Minas Gerais state, and eastern part of Paraguay and Bolivia. São Paulo city is the economic centre of Brazil situated in this area and its population, now standing at 5.4 million, is the largest in the whole Latin America.

(1) Topography

Santos city faces Santos bay (Baia de Santos) along which extends, like an arc, an 8 km sandy coastline which consists of a number of shores named Praia Jose, Mehino, Gonzaga, Boquirão and Embare. These shores are good sea-bathing resorts for the citizens of Santos city and São Paulo city also.

Facilities of Santos port are constructed on both banks of a long estuary (Estuario) stretching northwards in a gentle curve from the eastern end of the sandy coast, and face the extensive sea areas (Largo do Caneu and Largo Santa Rita) which are found adjacent to the estuary. Since the port is so planned as will make the best use of its natural topographic condition, the navigation channel linking the port and Santos bay is S-shaped and narrow in width.

(2) Port Administration

All the facilities of Santos port are placed under the control of Santos Dock Company (Companhia Docas de Santos), the controlling organ (Concessionara) of the port, with the exception of some privately operated terminal (Terminals particulares).

(3) Cargo Handling Volume

In 1971, Santos port handled a total of about 13,000 thousands, comprising about 10,000 thousand tons of foreign trade cargoes (Longo curso) and about 3,000 thousand tons of domestic trade cargoes (Cabotagem). The port's annual cargo handling volume has shown no growth over the past ten years, recording approximately 13,000 thousand each year. Though it rose to 16,600 thousand tons in 1968, it declined to 13,000 thousand tons in the following year when the petroleum terminal constructed at São Sebastião was put in operation to handle a substantially large portion of petroleum so far handled at Santos port.

The annual volume of international and inter-state import cargoes handled at Santos port recorded no appreciable changes over the past ten years, the former being about 7 - 8,000 thousand tons and the latter 2 - 3,000 thousand tons. Nor have there been observed any noticeable changes in the volume of international and inter-state export cargoes which has maintained the same level of approximately 3,000 thousand tons a year. However, while export has been on the upward trend, inter-state export has been on the decline.

The greater part of cargoes are handled by the facilities controlled by Santos Dock Company. The portion handled at private terminals has been rapidly growing, marking 290 thousand tons in 1969, 1,000 thousand tons in 1970 and 1,700 thousand tons in 1971.

Item-wise breakdown of cargo volumes shown in the 1969 statistics indicates that foreign trade cargoes are composed predominantly of crude oil and petroleum products (2,400 thousand tons), chemical and metal products (1,200 thousand tons) and fertilizers (1,000 thousand tons). Maize registers only about 300 thousand tons though it is one of the commodities to which great importance is attached under the export corridor plan.

In the total volume of domestic trade cargoes, crude oil and petroleum products hold the first place with 2,900 thousand tons.

(4) Existing State of Port Facilities

At present, the total wharf extension at Santos port is 8,400 m which is divided, as shown in Table 2.3, into a number of berths for handling different commodities. Fig. 2.4 shows the locations of these berths.

A total of 13,524 thousand tons of cargoes were handled on this 7,844 m long wharfs in 1970, so that the cargo handling volume per meter of wharf was 1,724 tons in that year. In 1970, a smaller volume of 1,614 tons was recorded. Table 2.4 shows the volume of cargoes handled per meter on respective berths.

The existing mooring facilities are found upstream of the transmission cable which spans the esturary. Construction of new mooring facilities is in progress downstream of this transmission cable in parallel with dredging and consolidation of a navigation channel. The navigation channel has a depth of -10 m upstream of the cable and -13 m downstream of it.

At present, import and export sundry goods and bulk cargoes are handled mostly on the -6 ~ -9 m berths extending from Valongo area to Paqueta area and on the -10 m berths stretching from Paqueta area to Oueteirinhos area. The former, constructed in the beginning of 20th century, do not permit free movement of cargoes becauses of the small wharf area. The latter, on the other hand, have a wide wharf area, and with warehouses built in six rows, they are the most important wharfs at present.

The wharf in front of Warehouse Nos. 12 - 23 have a water depth of -11m and that in front of Warehouse Nos. 23 - 27, -8 m. On the -11 m wharf used for handling export and import cargoes mainly of agricultural products and sundry goods, a large number of loaders and cranes are installed, with a waggon siding laid as far as the edge of the apron. Export grains are loaded by means of loaders (nominal capacity: 150 t/h) in front of Warehouse Nos. 14, 19, 20 and 22. Warehouse No. 23 is used for storing imported salt, and other warehouses are for storing general import cargoes. The water depth in front of Warehouses Nos. 1 - 12 is -7 m.

Besides these, the port has a dolphin berth for petroleum distribution in Alamoa area and a chemical products terminal in Barnabe island (Ilha Barnabe) area. These two berths have a water depth of -10 m.

All the mooring facilities mentioned above are located upstream of the transmission cable. In the downstream area, construction of new mooring facilities is in rapid progress on either bank.

In Macuco area on the right side bank, three -10 m berths and four -11 m berths have already been completed, with the first row of transit sheds now under construction. It is planned that warehouses will be constructed on this wharf as the second row of structures behind the transit sheds. Construction of four -11 ~ -13 m berths on the downstream side of this wharf is also planned and partly put into execution.

On the left side bank, the fertilizer terminal (Terminal para fertilizantes) was completed early this year. It has two -13 m dolphin berths having a total length of 567 m capable of berthing a 54,000 DWT class vessel. With two fertilizer warehouses(capacity: 54,000 t) and four cranes (capacity: 5 t/unit) put in operation for 20 hours daily using 500 t/h grab buckets, the two berths combined exhibit a maximum unloading capacity of 19,000 t/day and a normal unloading capacity of more than 10,000 t/day.

The mooring facilities introduced above can be classified as follows according to water depth.

Existing state of other port facilities such as warehouses, tanks and other storage facilities, harbour traffic facilities, and handling equipment and machinery is as described under the following items.

(5) Storage Facilities

1.	Warehouses	For import - 33 warehouses, 108,069 m^2, 243,250 tons; Nos. 32 - 35, 9,500 m^2 x 4 (including Baranabe). For export - 28 warehouses, 227,060 m^2, 453,945 tons. Others - 33 warehouses, 73,167 m^2, 176,250 tons.
2.	Tanks	For storage of oils - 361 thousand tons
3.	Cold Warehouses	1 warehouse, 2,820 m^2, 4,000 tons capacity, 13 cold storage compartments.
4.	Silo	1 silo, 30,000 ton wheat storage capacity, used occasionally for export and import of grains other than wheat.

(6) Harbour Railway

Siding Track	Total length - 134 km, gauge - 0.8 m, 1.0 m and 1.6 m
Crane Track	Approx. 10 km

(7) Harbour Road

Unknown

(8) Handling Equipment

1.	Bulk Grain Loaders	400 t/h x 2 units 150 t/h x 6 units 50 t/h x 4 units
	Wheat Unloaders	60 t/h x 4 units 120 t/h x 2 units 150 t/h x 5 units
	Movable Loaders	150 t/h x 12 units
2.	Cranes	4.5 - 9.1 t x 16 units, diesel 4.5 - 5 t x 21 units, mobile 10 - 10.8 t x 6 units, diesel electric 22.6 - 22.7 x 9 units, hydro-diesel Others x 174 units
3.	Forklift	1.5 - 4.5 t x 329 units
4.	Locomotives	300 - 570 HP x 25 10 - 55 HP x 4

Wagons 338 units

5. Other Equipment

The port is provided with such other facilities as the heliport, launches and dredgers.

(9) Export Grain Loading Facilities

(a) Warehouses

Loading of export grains is conducted at the aforementioned four wharfs where warehouses, conveyors and loaders are installed. Table 1 shows the loading capacity of respective warehouses.

The loading capacity shown in the above table is larger than the actual value which is about 14 thousand tons per warehouse. It is believed that the storage capacity of the existing warehouses, excepting those now under construction, is about 84 thousand tons or lower. The grain handling volume registered by Warehouse Nos. III, VI and VII and others totalled 635 thousand tons in 1971, with about 420 thousand tons of maize, about 140 thousand tons of pellet, and about 75 thousand tons of soybeans.

(b) Receiving and Reclaiming of Grains

Grains carried in bulk by waggons or trucks from producing areas are emptied out into the receiving hoppers at the warehouses by manual labour. This unloading work usually takes about 45 minutes for both waggons and trucks. Beneath each hopper is provided a 40 t/h belt conveyor by which grains are carried into the warehouse. Each warehouse is equipped with four hoppers so that four waggons or trucks can be unloaded at a time. Jet slingers are used for storing grains inside the warehouse. This is the method so far adopted for carrying grains into warehouses. At present, however, hoppers are provided beneath the railway tracks at some places, and some warehouses employ an overhead conveyor for storage of grains.

Each warehouse has four loading hoppers from which grains are carried by a 75 t/h capacity bucket conveyor. Grains carried from hopper by each two bucket conveyors are weighed by a 500 kg batch type hopper scale and transported to the berth by belt conveyors having a capacity of 150 t/h per line.

On the berth are installed ship loaders of fixed type and movable types, both having a capacity of 150 t/h. As seen in the photograph, fixed type loaders have their legs fixed to the ground, but their chute can make both vertical and slewing motions. Movable type loaders, used also at other ports, are intended for direct loading from wagons and trucks. In most cases, they are put in operation together with fixed type loaders.

(c) Ship Loading Capacity

Table 2.6 shows the top five registered in the past record of loading capacity. The high loading capacity shown in the table is considered assignable

to the large storage volume in the warehouse and favourable receiving condition to the warehouse. It is generally accepted that if two loaders each having a capacity of 150 t/h are put in operation over a long period, the capacity they exhibit averages 1/3 to 1/4 of their combined loading capacity, i.e., 300 t/h. This poor average capacity is attributed to the following reasons.

1. Lack of smooth grain flow through hoppers and by conveyors.

2. Occasional need for moving loaders to the position of the ship hatch.

3. Trimming of ship required for frequent loading of grain not loaded at Paranagua port.

The fact that the conveyor connecting the warehouse and the fixed type loader has a considerably heavy gradient may be cited as another reason for the said poor loading capacity.

For these reasons, the ship loading capacity is approximately 1,500 t/day at present.

(d) Cold Warehouse

The cold warehouse is constructed between Warehouse Nos. 23 and 25 on the -8 m berth. It has a floor space of 2,820 m^2 (94 m x 30 m) and a storage capacity of 4,000 tons. It usually stores 4,800 cases of fruits, 230 tons of fishes and 2,000 tons of beef. It has 13 compartments and the temperature is kept at 1 - 3°C for cold storage and at -8 ~ -9°C for freezing.

(e) Loading of Frozen Products

Frozen products are carried out from the cold warehouse from the side opposite to the apron by four to five workers who use a hand truck to load them into a container car (not powered) which is then trailed to the apron by a trailer for loading at the carrier's gang plank. The loading capacity is approximately 10 t/h.

Export of meat, fruits and fruit juice has been on the increase in recent years. Beef export registered about 80 thousand tons in 1970, 70 thousand tons in 1971, and 85 thousand tons up to August 1972. Fruits and fruit juice, on the other hand, recorded an export volume of 75 thousand tons and 80 thousand respectively in 1971. In 1972, both reached nearly 45 thousand tons up to August. Since the storage capacity of the existing cold warehouse is far too limited, frozen products are carried from distant places by freezing trucks for loading at Santos port. In the port area, many freezing trucks can be seen waiting for the loading time. Cutralle, the largest fruit juice maker in Latain America, ranks top in the volume of fruit juice shipped from Santos port. The company constructed a fruit juice cold warehouse with a floor space of 20,000 m^2 in August 1972, and is planning to establish additional cold warehouses in 1973.

2-4-2 Port Improvement Plan

(1) Estimate of Cargo Handling Volume

At present an estimate is being formed of the cargo handling volume at Santos port for each year from 1970 to 1980 as well as for 1985 and 1990. According to this estimate, it is expected that Santos port will handle a total of 23,258 thousand tons of cargoes consisting of 5,075 thousand tons of export cargoes, 15,682 thousand tons of import cargoes, 265 thousand tons of inter-state export cargoes, and 2,236 thousand tons of inter-state import cargoes. However, since the volumes estimated for 1970, 1971 and 1972 disagreed with the actually recorded values and the conditions assumed for the estimate became considerably divergent from those actually seen, a new estimate is reportedly being made at present. The estimate, it may be added, includes maize (683 thousand tons) as the only export agricultural commodity in 1976 which is one of the target years established under the export corridor plan

Under the export corridor plan, it is planned that 2,878 thousand tons of cereals will be shipped from Santos port in 1976, and this calls for provision of various facilities which will afford a grain transportation capacity of 3,200 thousand tons. The plan also incorporates a plan for establishing meat storage facilities having a capacity of 280 thousand tons.

It is expected that the target export volumes set under the plan will be included in the new estimate now being formed of the port's cargo handling volume.

(2) Port Improvement Plan

(a) Navigation Channel Improvement

On the downstream side of the transmission line spanning the estuary, the navigation channel is maintained at a minimum width of 200 m and a depth of -13 m, and dredging work is being carried out at present in Santos bay to create a channel having a width of 200 m and a depth of -14 m by May 1973. Dredging work is also in progress in the navigation channel upstream of the transmission line to increase its depth from the present -10 m to -12 m.

It is to be pointed out here that while L. L. W. L. (Lowest Low Water Level) is employed as datum level in harbour construction works, M. L. W. L. (Mean Low Water Level) is taken as datum level in charts. The difference between the two levels in Santos bay is approximately 70 cm, so that a navigation channel with a depth of -13 m or -14 m is indicated to be -13.7 m or -14.7 m deep respectively in the chart. For this reason, it is considered that the channel on the upstream side of the transmission line, which is to be dredged to a depth of -12 m, will allow for the entry of 40,000 DWT class vessels, and that on the downstream side for the entry of 60,000 DWT class vessels.

(b) Improvement of Mooring and Storage Facilities

Four -11 ~ -13 m berths are planned to be constructed on the lowermost part of the right side bank of the estuary, and construction of some of

these berths is already under way. Under the export corridor plan two of them, each having a depth of -13 m, are planned to be used for grain export, with two silos constructed on the wharf to provide a storage capacity of 65,000 tons and 100,000 tons respectively. Japan pledged to the financial aid required for construction of the silo and provision of grain handling equipment. The 100,000 ton silo, on the other hand, is given second priority under the project and is planned to be constructed even if it is devoid of the prescribed capacity provided that technical solution can be brought for the construction of a siding and operation of handling equipment.

On the left side bank, a container terminal and a grain terminal equipped with a 100,000 ton silo are planned to be established on the upstream and downstream sides respectively of the fertilizer terminal which has already been completed. The World Bank has made its decision to finance this construction plan which includes the laying of a 21 km long railway from Piacaguera. The area further downstream of the grain terminal on the left side bank is planned to be developed into a fishery port.

Further, construction of general cargo warehouses on the sundry goods wharf stretching from Paqueta area to Outeirinhos area on the left side bank is given third priority under the plan.

In addition, it is planned to construct a -13 m dolphin berth for handling the products of the chemical plant operating on Barnabe island and a -12 m dolphin berth adjacent to the existing dolphin berth for petroleum distribution.

(c) Harbour Land Transportation Improvement

It is planned that a harbour road running on the right side bank will be constructed to link Alamoa and the downstream-most wharf via Sabu, Valongo, Paqueta, Outeirinhos and Macuco. The right of way has already been secured in the Alamoa - Sabu section and Macuco area.

As for the harbour railway, the right bank route reaching Macuco area from the upstream area is already complete, and this route is planned to be extended to the downstream-most wharf. Further, a shunting yard is expected to be constructed in Outeirinhos area. For the left side bank, it is planned that the aforementioned railway from Piacaguera will be extended to the container terminal and further to the fertilizer terminal and grain terminal via the shunting yard.

In order to supply the chemical plant on Barnabe island with petroleum the raw material of its products, a submarine pipeline is planned to be laid beneath the navigation channel to connect Valongo with Barnabe island. It is planned that the pipeline will have a depth of about -18 m.

(3) Evaluation of Port Improvement Plan

The port improvement plan introduced above is appraised below against the yardstick of the target export volumes of agricultural products set under the export corridor plan.

Plans for improving the port facilities for grain export are as listed in Table 2.7.

Dredging of a -14 m navigation channel, to be undertaken in Santos bay subsequent to the completion of a -13 m channel in the estuary, can be included in the above-mentioned port improvement plan.

The target export volume of grains set for 1976 under the plan is 2,878 thousand tons. Commodity-wise distribution of this total target volume is 2,000 thousand tons for maize, 300 thousand tons for soybeans and 400 thousand tons for pellet, and facilities for handling 280 thousand tons of meat are planned to be constructed. The following comment on the port improvement plan is made with these data taken as the basis of appraisal.

The storage and loading capacities of the existing cold warehouse fall short of the demand. Since the export of frozen products has been on the increase, the plan to construct additional cold warehouses adjacent to the existing one can be justified. Prior to its implementation, however, the plan will have to be partly revised because what justifies it is the originally framed storage capacity which included the capacity of the cold fruit warehouse constructed after the plan was mapped out.

Construction of new grain silos, to be undertaken in addition to the improvement of the existing warehouses, will provide a large storage capacity. Due to the poor grain handling capacity, however, they will not serve to augment the grain export to a large extent. Assuming that the 65 thousand tons horizontal under construction can handle 1 thousand tons per year of grain and that an approximately same volume of grain can be handled by both the 100 thousand ton silo to be financed by the World Bank and the 100 thousand ton silo to be constructed under the plan, the total volume of grain that can be handled by silos turns out to be 3,300 - 3,500 thousand tons per year. Though this figure appears to be a little larger than the actual capacity, the silo construction plan can be justified because the 65 thousand ton silo will be converted to an ordinary warehouse according to the demand situation.

As for the -14 m navigation channel to be created in Santos bay, there will be some difficulty in maintaining it in perfect condition. The mission considers it necessary to make careful studies and establish a system under which sounding work will be conducted actively for early discovery of the possible silting up of the channel and dredging will be carried out immediately when silting up of any degree is detected.

Meat export will be enhanced if shipment is made at the container terminal in Conceicão Zinha area on the strength of an integrated transportation route established by the use of freezing containers. The possibility of establishing such a route deserves due consideration.

Table 2-1 Data of Yield Rate Experiment of Maize
(São Paulo State Agricultural Experiment Station)

(kg/ha)

Individual Spacing x Row Spacing / Number of Fertilizer Applications / Variety	40cm x 100cm			30cm x 100cm			20cm x 100cm		
	0	1	2	0	1	2	0	1	2
Cateto (local variety)	2158	3049	3359	2354	3050	3575	2451	3526	3613
Asteca	2622	3297	3590	2942	3719	3953	3298	4091	4633
H6999 (Hybrid new variety	2880	4090	4331	3194	4407	4729	3577	4690	5393

Table 2-2 Collection, Export Plan and Required Storage Capacity of Maize and Soybeans, São Paulo State

	Maize				Soybeans			
	Collection %	Collection Q'ty (1,000t)	Export (1,000t)	Required Storage Capacity (1,000t)	Collection %	Collection Q'ty (1,000t)	Export (1,000t)	Required Storage Capacity (1,000t)
Mar.	10	200	200	-	40	120	75	45
Apr.	20	400	360	40	60	180	75	150
May	30	600	360	280	-	-	75	75
June	20	400	360	320	-	-	75	-
Jul.	20	400	360	360	-	-	-	-
Aug.	-	-	360	-	-	-	-	-
Total	100	2,000	2,000		100	300	300	

Table 2-3 Existing Berths at Santos Port

Classification		Length (m)
Sundry goods berth (foreign trade)	(A)	3,132
Sundry goods berth (domestic trade)	(B)	371
Liquid products berth (for distribution of petroleum, etc)	(C)	871
Bulk cargo berth (fertilizers, coal, maize, wheat, etc.)	(D)	2,864*
Maize and pellet berth (equipped with a loader)	(E)	605
Passenger vessel berth	(F)	373
Others	(G)	462
Total	(H)	8,677
Berth portions in common use		
(C) and (D)	(I)	200
(B) and (D)	(J)	125
(A) and (F)	(K)	373
(A) and (E)	(L)	136
Total	(M)	834
Grand Total (H) and (M)		7,844

* The 567 m length of the fertilizer terminal in Conçeicão Zinha district is not included.

Table 2-4 Cargo Handling Volume at Each Berth, Santos Port

Kind of Berth	Volume (t/m/year)
Sundry Goods Berth	1,252
Bulk Cargo Berth	1,429
Liquid Products Berth	4,944
All Berths	1,724

Table 2-5 Warehouses and Loading Capacity at Santos Port

Warehouse No.	Floor Space	Nominal Capacity	Loading Capacity	Remarks
III	9,200 m^2	18,400 ton	150 t/H x 2	Nominal capacity
V	9,200"	18,400	150 "	"
VI	9,200"	18,400	150 "	"
VII	9,200"	18,173	150 "	"
X	9,200"	18,400	Joint operation with warehouse No.V	
XV	9,200"	18,400	"	
VIII	9,200"	18,400	300 t/H x 1	Under construction
XXIII	9,200"	18,400	600 t/H x 1	"
Total	73,600 m^2	146,973 ton		

Table 2-6 Top 5 in the Record of Maize Loading Capacity at Santos Port

No.	Date	Warehouse No.	Working Hours	Number of Loaders		Loaded Quantity	Capacity (t/h/loader)
			H	(Day)	(Night)	t/day	
1	21/12/71	20	20	3	3	5,394	90.0
2	22/ 7/72	20	20	3	3	4,708	78.5
3	18/ 8/70	22	20	5	6	4,526	41.2
4	7/12/71	20	20	3	2	4,462	89.3
5	8/12/71	20	20	3	2	4,155	83.4

Table 2-7 Plans for Improving Port Facilities for Shipment of Agricultural Products at Santos Port

Location	Berth Depth	Maximum Vessel Class	Loader Capacity	Storage Capacity	Remarks
Right bank, between Macuco and Ponta da Prata	-13m	64,000 DWT	3,000 t/h	65,000t	Construction to be financed by Japan.
Left bank, in Conceicozinha district	-13m	60,000 DWT	Unknown	100,000t	Construction to be financed by the World Bank.
Right bank, between Macuco and Ponta da Prata	-13m	60,000 DWT	Unknown	100,000t	Priority order 2 under Export Corridor Plan.
Total	-	-	-	265,000t	-

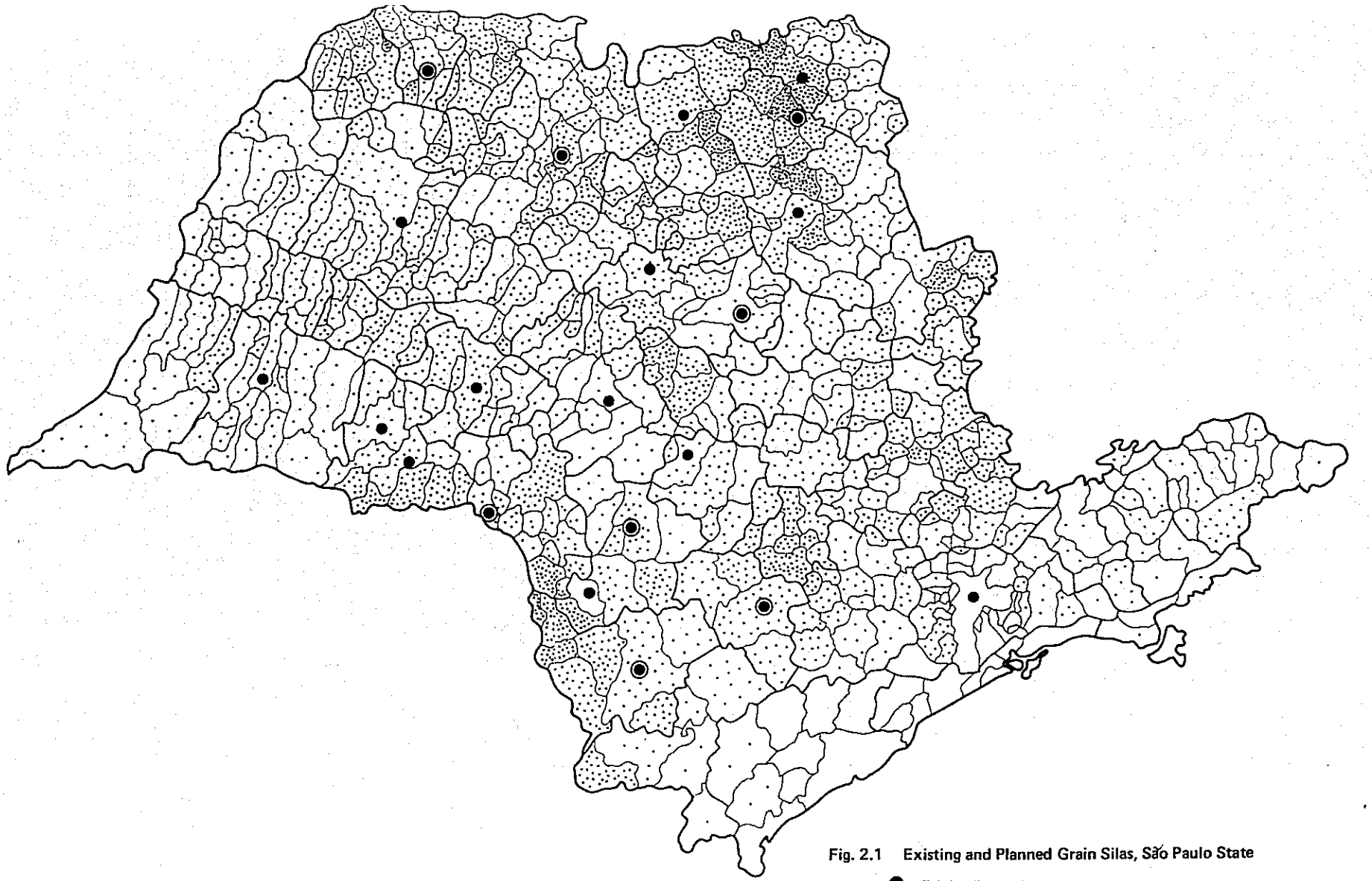
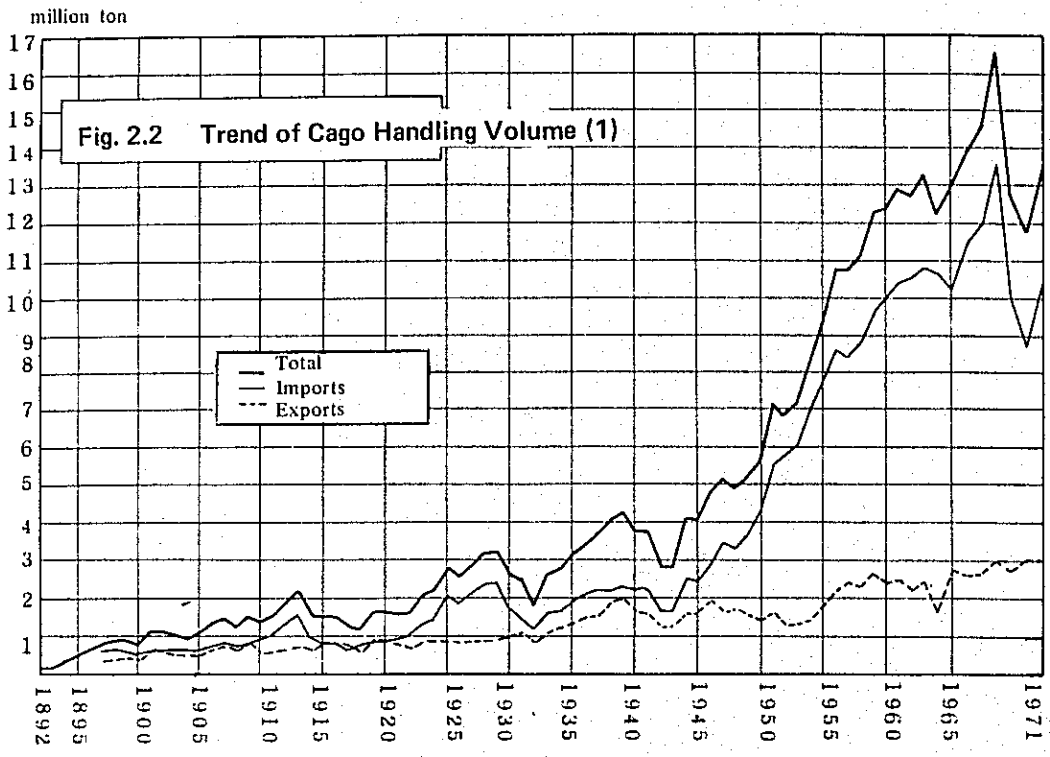
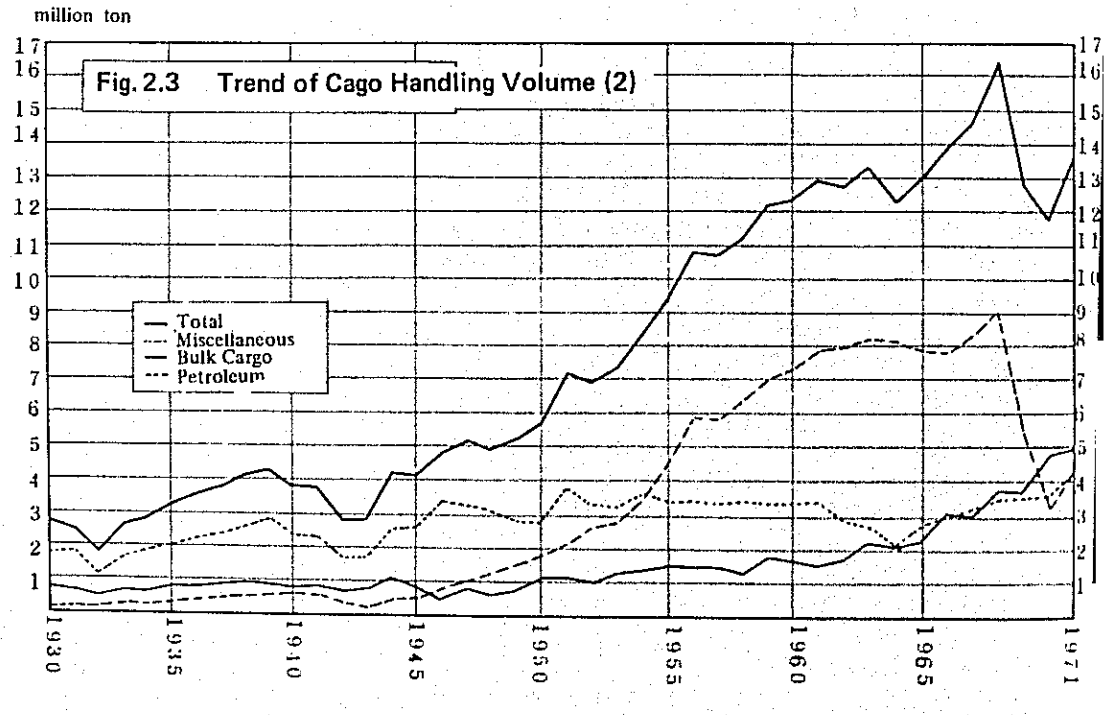
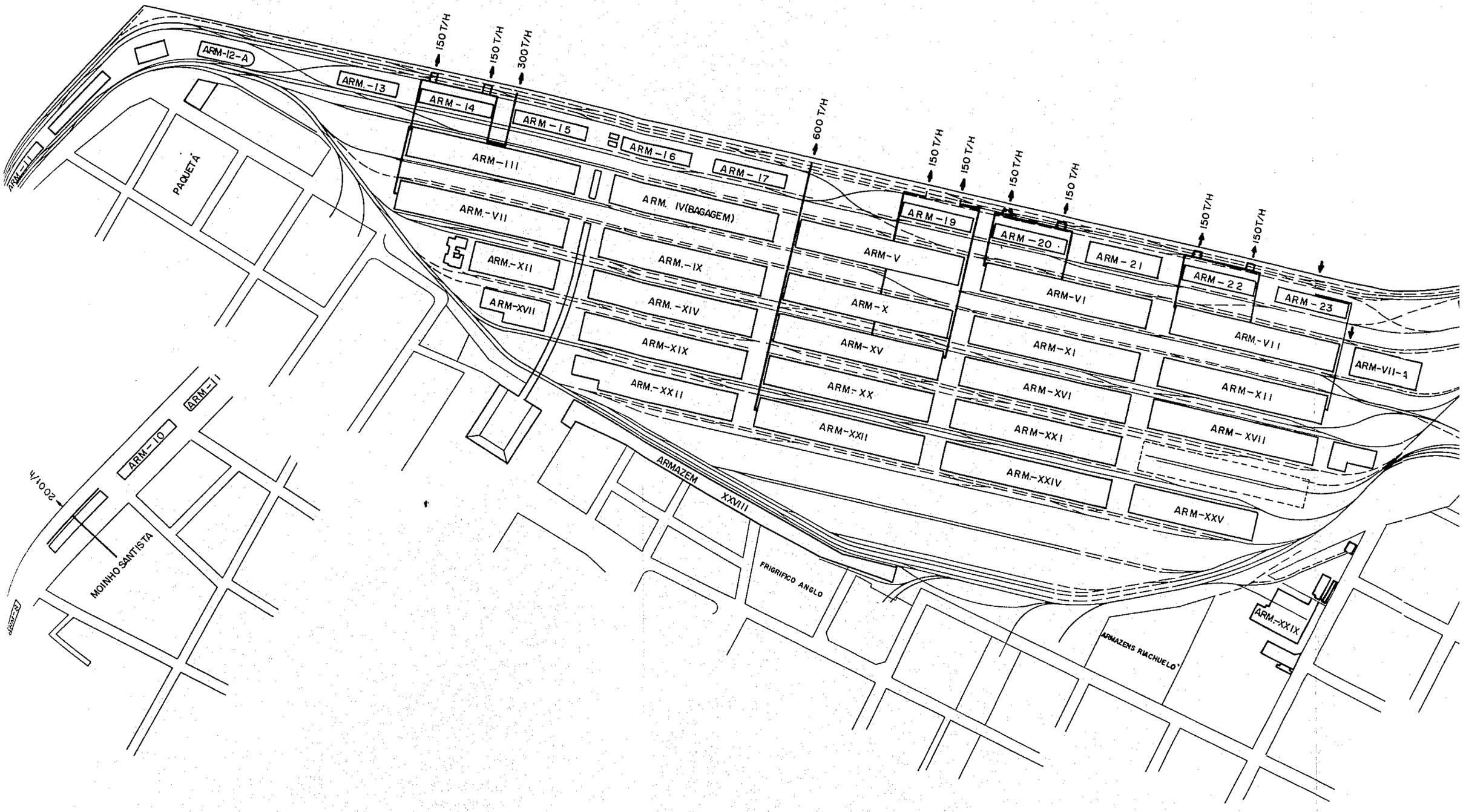


Fig. 2.1 Existing and Planned Grain Silas, São Paulo State

- ● Existing silos (vertical type with drying facilities)
- ◎ Planned silos (vertical or horizontal type with drying facilities)
- ( ) Storage capacity of existing silos
- [ ] Storage capacity of planned silos (Total : 360 thousand t)


million ton
Fig. 2.2 Trend of Cago Handling Volume (1)
Total
Imports
Exports


million ton
Fig. 2.3 Trend of Cago Handling Volume (2)
Total
Miscellaneous
Bulk Cargo
Petroleum


150 T/H
150 T/H
300 T/H
600 T/H
150 T/H
150 T/H
150 T/H
150 T/H
150 T/H
150 T/H
ARM-12-A
ARM.-13
ARM-14
ARM-15
ARM-16
ARM-17
ARM-19
ARM-20
ARM-21
ARM-22
ARM-23
ARM-III
ARM. IV(BAGAGEM)
ARM.-VII
ARM.-XII
ARM.-IX
ARM-XVII
ARM.-XIV
ARM-XIX
ARM.-XXII
ARM-V
ARM-X
ARM-XV
ARM-XX
ARM-XXII
ARM-VI
ARM-XI
ARM-XVI
ARM-XXI
ARM.-XXIV
ARM.-VII
ARM-XII
ARM-XVII
ARM-XXV
ARM-VII-A
ARM.-XXIX
PAQUETÁ
ARM-11
ARM-10
ARM-9
ARM-8
MOINHO SANTISTA
ARMAZEM XXVIII
FRIGORIFICO ANGLO
ARMAZENS RIACHUELO

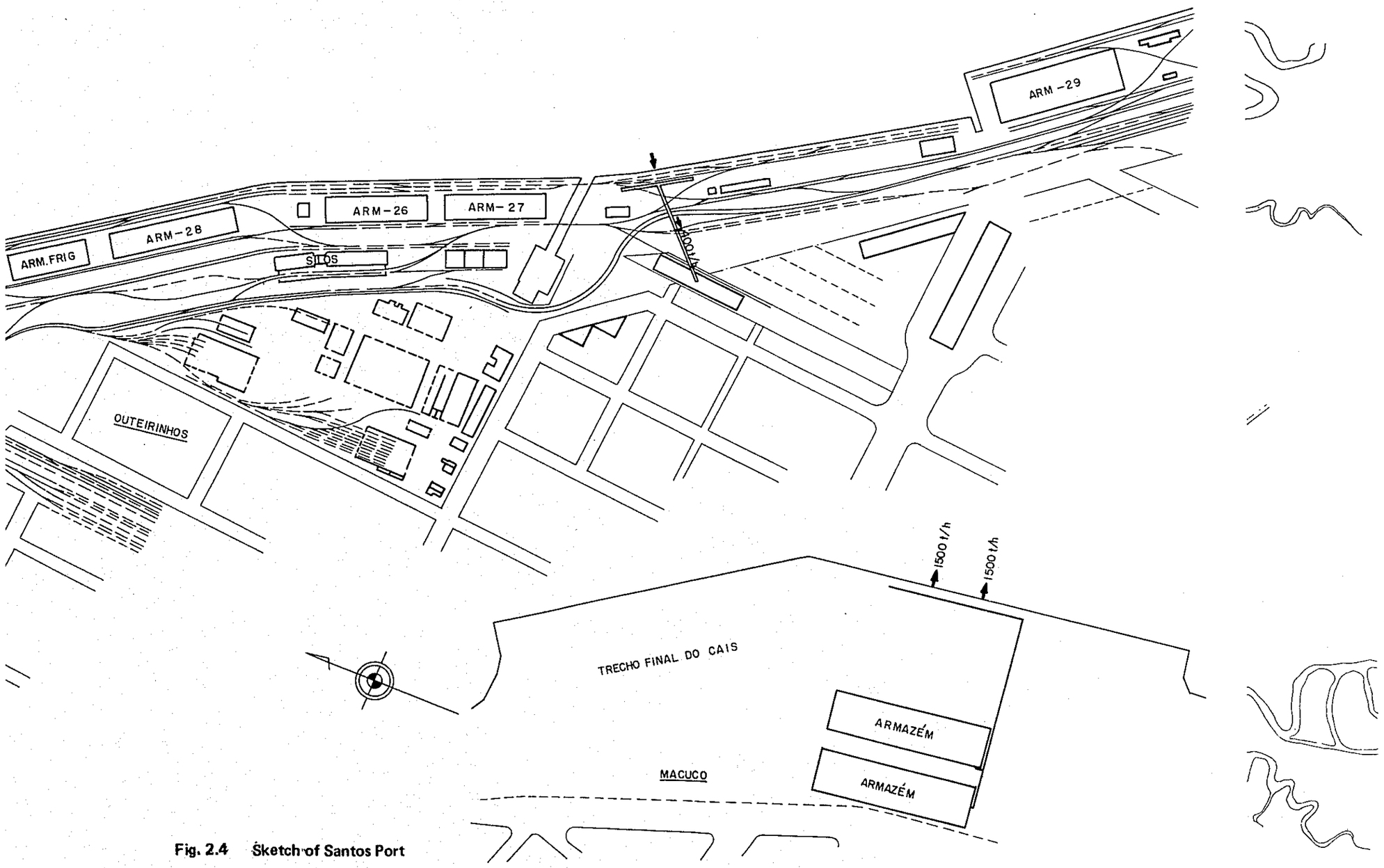


Fig. 2.4 Sketch of Santos Port

ILHA BARNABÉ

VICENTE DE CARVALHO

PAQUETA

VILA NOVA

CENTRO

VALONGO

SABOÓ

VILA MATIAS

OUTEIRINHOS

MACUCO

ENCRUZILHADA

EMBARÉ

BOQUEIRÃO

VILA BELMIRO

JABAQUARA

CAMPO GRANDE

CHICO DE PAULA

3 year plan

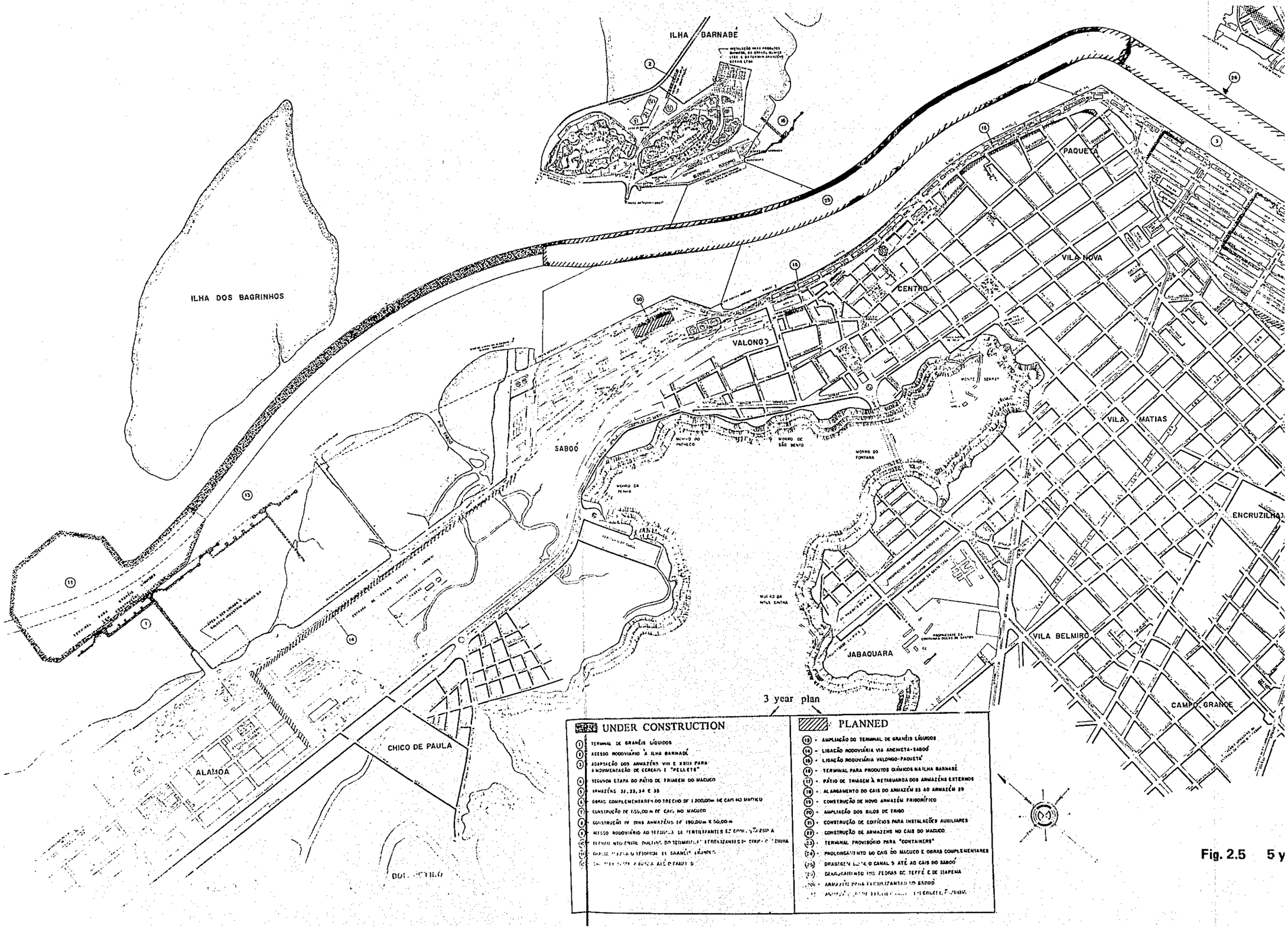
UNDER CONSTRUCTION

- TERMINAL DE GRANÉIS LÍQUIDOS
- ACESSO RODOVIÁRIO À ILHA BARNABÉ
- ADAPTAÇÃO DOS ARMAZÉNS VIII E XXIII PARA A MOVIMENTAÇÃO DE CEREAIS A "PELLETS"
- SEGUNDA ETAPA DO PÁTIO DE TRIAGEM DO MACUCO
- ARMAZÉNS 32, 33, 34 E 35
- OBRAS COMPLEMENTARES DO TRECHO DE 1.200,00m DE CAIS NO MARTIM
- CONSTRUÇÃO DE 1.350,00 m DE CAIS NO MACUCO
- CONSTRUÇÃO DE DOIS ARMAZÉNS DE 180,00m X 50,00 m
- ACESSO RODOVIÁRIO AO TERMINAL DE FERTILIZANTES E CORREDEIRA
- TERMINAL MULTIPLO FUTURO DO TERMINAL DE FERTILIZANTES E CORREDEIRA
- [illegible]

PLANNED

- (13) - AMPLIAÇÃO DO TERMINAL DE GRANÉIS LÍQUIDOS
- (14) - LIGAÇÃO RODOVIÁRIA VIA ANCHIETA-SABOÓ
- (15) - LIGAÇÃO RODOVIÁRIA VALONGO-PAQUETÁ
- (16) - TERMINAL PARA PRODUTOS QUÍMICOS NA ILHA BARNABÉ
- (17) - PÁTIO DE TRIAGEM À RETAGUARDA DOS ARMAZÉNS EXTERNOS
- (18) - ALARGAMENTO DO CAIS DO ARMAZÉM 23 AO ARMAZÉM 29
- (19) - CONSTRUÇÃO DE NOVO ARMAZÉM FRIGORÍFICO
- (20) - AMPLIAÇÃO DOS SILOS DE TRIGO
- (21) - CONSTRUÇÃO DE EDIFÍCIOS PARA INSTALAÇÕES AUXILIARES
- (22) - CONSTRUÇÃO DE ARMAZÉNS NO CAIS DO MACUCO
- (23) - TERMINAL PROVISÓRIO PARA "CONTAINERS"
- (24) - PROLONGAMENTO DO CAIS DO MACUCO E OBRAS COMPLEMENTARES
- (25) - DRAGAGEM [illegible] DO CANAL 5 ATÉ AO CAIS DO SABOÓ
- (26) - REALINHAMENTO DAS PEDRAS DE TETTÉ E DE ITAPEMA
- (27) - ARMAZÉNS PARA FERTILIZANTES NO SABOÓ
- [illegible]

Fig. 2.5 5 year Improvement Plan of Santos Port with Partial Financial Aid of Warld Bank


ILHA BARNABÉ
ILHA DOS BAGRINHOS
PAQUETÁ
VILA NOVA
CENTRO
VALONGO
SABOÓ
VILA MATIAS
ENCRUZILHADA
VILA BELMIRO
JABAQUARA
CAMPO GRANDE
CHICO DE PAULA
ALAMOA
3 year plan
UNDER CONSTRUCTION
PLANNED
(13) - AMPLIAÇÃO DO TERMINAL DE GRANÉIS LÍQUIDOS
(14) - LIGAÇÃO RODOVIÁRIA VIA ANCHIETA-SABOÓ
(15) - LIGAÇÃO RODOVIÁRIA VALONGO-PAQUETÁ
(16) - TERMINAL PARA PRODUTOS QUÍMICOS NA ILHA BARNABÉ
(17) - PÁTIO DE TRIAGEM À RETAGUARDA DOS ARMAZÉNS EXTERNOS
(18) - ALARGAMENTO DO CAIS DO ARMAZÉM 33 AO ARMAZÉM 29
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(21) - CONSTRUÇÃO DE EDIFÍCIOS PARA INSTALAÇÕES AUXILIARES
(22) - CONSTRUÇÃO DE ARMAZÉNS NO CAIS DO MACUCO
(23) - TERMINAL PROVISÓRIO PARA "CONTAINERS"
(24) - PROLONGAMENTO DO CAIS DO MACUCO E OBRAS COMPLEMENTARES
(25) - DRAGAGEM DO CANAL 5 ATÉ AO CAIS DO SABOÓ
(26) - DESASSOREAMENTO DAS FOZES DO TEFFÉ E DE ITAPENA
(30) - ARMAZÉNS PARA FERTILIZANTES NO SABOÓ

Fig. 2.5 5 y

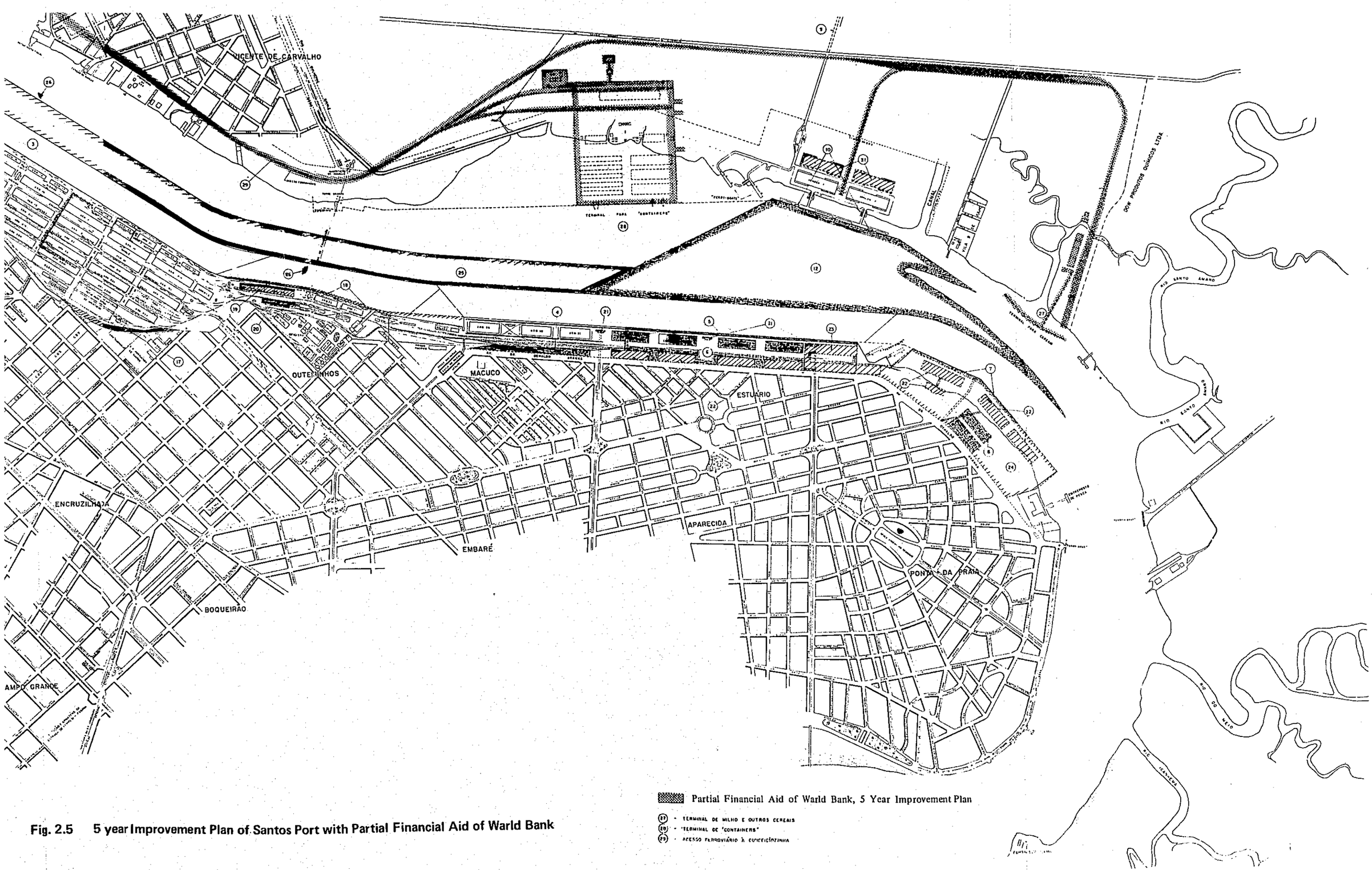


Fig. 2.5 5 year Improvement Plan of Santos Port with Partial Financial Aid of Warld Bank

III. EXPORT CORRIDOR OF PARANA STATE

Just as in Rio Grande do Sul state, much hope is placed on the development of its export corridor in Parana state, and it is already planned that approximately 3.5 million tons of agricultural products, consisting chiefly of soybeans and maize, will be shipped Paranagua port in 1976.

The state has large potentials for increased agricultural production but is far behind the other states of the country in infrastructural improvement. Accelerated infrastructural improvement is the pressing need in the state.

To augment the ship loading capacity and cargo handling capacity of Paranagua port, construction of warehouses and silos with a capacity of 70 thousand tons and 100 thousand tons respectively is planned under the plan The plan also incorporates a construction plan of intermediate silo having a capacity of 150 thousand tons.

In this state, success of the plan hinges on the improvement of the railway network which is so poor at present that the greater part of inland transportation demand is met by trucks. Curitiba, the capital of the state, is severed from Paranagua port by the coastal range. This unfavourable topographic condition sets limits rigidly to the railway transportation capacity over the approximately 100 km distance between the two points. Augmentation of railway transportation capacity in this section should therefore be given high priority in the coming years.

3-1 Production and Export of Agricultural Products

Coffee, maize, soybeans, cotton and oil cakes can be cited as export commodities of Parana state. The state authorities are planning to accelerate the production and export of coffee, maize, soybeans and meat, with special efforts directed towards increased coffee export.

The present and estimated production and export of cereals and processed agricultural products are as shown in Table 3.3. As seen in the table, estimated shipment in 1976 is 2,336 thousand tons for maize, 1,200 thousand tons for soybeans and 1,300 thousand tons for soybean cakes. Since all this volume is expected to be supplied to the world market, export volume of these three commodities alone will reach 4,836 thousand tons in 1976.

Thus, the export volume estimated by the state authorities far surpasses the federative government's estimate of 3,500 thousand tons.

Parana state is by far the greatest maize producing area in the whole country. Maize is cultivated throughout the state and its annual production is larger than 4,000 thousand tons. However, since this crop is produced chiefly by small holders and its cultivation is closely related with hog raising, it is not expected that there will be any phenomenal increase of production. Hence, the target production set for 1976 by the state authorities is limited to about 5,000 thousand tons.

The expected increase of sorghum production may open up the possibility for accelerated maize export because this crop can not only be cultivated by mechanized farming but can also take the place of maize as self-supplied feed. Conversion of this latent possibility into a reality will entail some problems because sorghum is a crop newly introduced into the state and expansion of its planting area is likely to involve some questions.

Parana state ranks with Rio Grande do Sul in the production of soybeans. The state authorities' estimate is that even if the sharp increase of domestic consumption of soybean oil is taken into account, there will still be surplus soybeans for export when the production is increased from the present level of 1,200 thousand to 2,800 tons in 1976. The mission considers that this estimate of the state authorities will be substantiated by reason of the following factors.

1. While soybeans are cultivated only in the western part of the state at present, increased planting of this crop is possible because the state embraces arable land suited for soybean cultivation.

2. Planting of soybeans in coffee plantations after removing old and non-productive coffee trees is expected to increase.

3. Double cropping of soybeans and wheat is expected to increase.

4. Production increase can be attained with relative ease by the application of farming machinery and equipment and improvement of farming techniques.

It is to be added that Parana state resorts to agriculture for half of its budget. Therefore, probability is high that the state authorities will focuss its efforts on the endeavour to develop its agriculture. Hence, it is possible that the actual export volume in 1976 will exceed the value envisaged by the federative government.

Agricultural cooperative associations are fairly well developed in Parana state, but further efforts should be made for their organizational reinforcement in order to stabilize agricultural production.

Note: Plans for transporting agricultural products shown in Table 3.3 are illustrated in Fig. 3.1 (Maize), Fig. 3.2 (Soybeans), Fig. 3.3 (Total) and Table 3.3 (Total of agricultural products).

3-2 Storage Facility for Agricultural Products

The total storage capacity in Parana state is 521 thousand tons at present. This capacity is planned to be increased by 500 thousand tons through construction of silos in order to cope with the expansion of export volume. Of this additional 500 thousand ton capacity, 300 thousand tons will be covered by the present project, with 155 thousand ton capacity planned to be provided by the first phase construction plan and the remaining 145 thousand ton capacity by the second phase plan.

Distribution of those existing warehouses which are run by COPASA (Parana State Warehouse Company) and CIBRAZEM (Federal Warehouse Company) and the silo construction plan (first and second phases) embraced in the project are shown in Fig. 3.4. Though no final decision has yet been made, operation of the new silos is planned to be left to the hand of COPASA. As for the silo type, comparative studies are being made at present between vertical type silos and horizontal type silos.

In estimating the grain export in 1976 for Parana state, the federative republic government took account of the present export level. The target export volume set by the federative republic government is 3,500 thousand tons, and this is about 2,500 thousand larger than that at present. Realization of this export plan calls for an additional storage capacity of 500 thousand tons even if all the warehouses are ideally operated by 5 rotations a year. The mission's opinion as regards the silo construction plan, which is intended to secure this additional capacity, is that careful prior studies should be made to bring solution for a variety of problems involved therein, e.g., who is to undertake the construction and operation of the silos, need of ensuring smooth collection of products with due regard to the relationship with the producers, selection of silo type, etc.

3-3 Inland Transportation

3-3-1 Railway Transportation

As described already, about 3,500 thousand tons of agricultural products are planned to be shipped from Paranagua port in 1976.

(1) Existing State of Railway Facilities and Service (See Fig. 5)

Due to the poor consolidation of the whole railway network, as much as 90 % of agricultural products shipped from Paranagua port are transported by trucks.

Morretes - Bangado section (33 km) of the Curitiba - Paranagua route has many parts with a heavy curve (minimum radius of curvature - 90 m) and a sharp grade (maximum grade - 3.6 %; average grade - 3.3 %) because the train must descend the coastal range in this section. The mission learned that the route was opened 100 years ago but noted that virtually no repair work has been made since that time.

Eng. Bley - Curitiba section also involves many parts where the maximum grade reaches 2.6 % and the minimum radius of curvature is as small as 90 m. In this section, however, improvement work is now in progress to reduce the maximum grade to 1.0 % and increase the minimum radius curvature to 1,100 m.

At present, two new railway lines, one linking Ipiranga and Araruva and the other connecting Ponta Grossa and Itapeva, are under construction to improve the state's railway network.

The only railway now available for transportation of agricultural products from the northwestern part of the state of Ponta Grossa takes a roundabout route via Ourinhos. This route is not only very long (630 km) but its track condition is poor in many sections as shown below.

Section	Maximum Grade	Minimum Radius of Curvature
Apucarava - Ourinhos	1.8 %	150 m
Ourinhos - Jaguariniva	2.0 %	150 m
J. Murtinho - Ponta Grossa	2.7 %	100 m

For this reason, agricultural products cultivated in the northwestern part of the state are either shipped from Santos or transported by trucks. The aforementioned new route between Ipiranga and Araruva not only cuts down the distance by half to 330 km but also has better track condition (maximum grade - 1.2 %; minimum radius of curvature - 300 m). When this new route is opened in 1973 as planned, it will provide a daily transport capacity of 18,000 tons, and this is three times the 6,000 ton capacity of the existing roundabout route.

Construction of the other new route, which links Ponta Grossa and Itapeva, is also in progress, with bridge and tunnel construction and roadbed work already brought to completion over the entire route. Commissioning of this route is expected to be followed by the construction of another new line between J. Murtinho and Morros, and this will make it possible to abolish the two poorly conditioned routes, one linking Itarare and Jaguariaiva and the other running between J. Murinho and Ponta Grossa.

(2) Export Corridor Plan

1. Improvement of Curitiba - Paranagua Route.

   The mountaineous line linking Morretes and Banhado is planned to be improved to reduce it maximum grade to 1.5 %.

2. A new line will be constructed between Eng. Bley and Eng. Gutierrez.

3. Improvement work will be carried out in Eng. Gutierrez - Guarapuava section to reduce the maximum grade from 1.8 % to 1.3 %.

4. A new line will be constructed between Guarapuava and Cascavel.

(3) Evaluation of Export Corridor Plan

The alignment of the mountaineous Morretes - Banhado section of Curitiba - Paranagua route is such that the average grade is as heavy as 3.3 % and curve is sharp (minimum radius - 90 m) over the entire 33 km distance. The average daily transport volume in this section recorded in 1971 was 2,335 tons in the direction of Morretes (i.e., downgrade towards Paranagua) and 1,513 tons in the direction of Banhado (i.e., upgrade towards

Curitiba). The transport capacity per trains was 600 tons in the direction of Morretes and 320 tons in the direction of Banhado. Increase of transport capacity in this section calls for an analytical study of various factors such as the kind of locomotives, train speed, effective rail length, strength of wagon coupler, and so forth. As a result of a study made on the basis of data obtained in the state as well as the opinions and information provided by the Federal Railways, the mission reached the conclusion that the maximum transport capacity obtainable by the operation of two 1,500 HP class locomotives would be as follows.

1,000 t x 14 trains/day in the direction of Paranagua (down grade)
500 t x 14 trains/day in the direction of Curitiba (up grade)

If input of the total transport capacity for grain transportation is feasible, about 1,400 thousand tons can be carried because grains are transported within 150 days. However, since about 100 thousand tons of other commodities are known to be transported by train, the transport volume throughout the grain shipment period which can be reasonably expected from the existing railway facilities will be no larger than 1,300 thousand tons. This means that the remainder of agricultural products must be carried by trucks as can be seen today.

The mission was informed that Federal Railways are making surveys for improving the mountaineous line. Improvement work of this line will require a considerably long time because construction of a substantially large number of tunnels and bridges will be necessitated due to the unfavourable topography along the line. However, early completion of the improvement work is strongly hoped for because it is a must for efficient utilization of Paranagua port which is a good natural harbour with an extensive port area.

For transportation of agricultural products from the western part of the state to Paranagua, a roundabout route must be taken. This route passes through Guarapuava, Eng. Gutierrez, Ponta Grossa, and Eng. Bley before reaching Paraguana, and its Eng. Gutierrez Ponta Grossa section embraces parts where the heaviest grade is 2.6 % and the minimum radius of curvature is only 100 m. The plan to construct a new line between Eng. Bley and Eng. Gutierrez and extend the railway line from Guarapuava to Cascavel, which was drawn up in view of the poor track condition in the said section, is quite meaningful in that it will serve for both grain transportation and regional development. The line to Cascavel is planned to be further extended to Foz do Iguacu in future. Materialization of this plan is very important since the new line will become an international arterial route connecting Paranagua and Paraguay.

It is to be added that completion of Ipiranga - Araruva and Ponta Grossa - Itapeva routes now under construction is also important though these routes are not covered by the export corridor plan.

3-3-2 Highway Transportation

Curitiba, the capital of Parana state, is located in the highland area (El. 900 m) approximately 90 km from Porto Alegre, and BR-116 links the city with São Paulo state and Santa Catarina state.

In the northern part of the state is located Londorina which is the collecting and distributing centre of coffee. The highway network in the vicinity of Londorina is fairly well developed, with BR-369 leading to São Paulo city. Though Londorina and Curitiba are connected by BR-376, neither arterial nor branch roads are sufficiently available in the middle western part of the state.

At present, Curitiba is connected with the western part of the state by BR-277 which runs through Cascavel and Foz do Iguacu. For improvement of highways transportation in the state, it is necessary to construct radial arterial roads linking Campo Mourão or Cruzeiro do Oeste with Curitiba and Paranagua and to connect these radial roads with each other by branch roads so that trucks carrying agricultural products may be able to take the shortest route between the producing area and the arterial highway.

Highway traffic in Brazil is featured by many large type vehicles. On BR-277 (Curitiba - Paranagua) alone, six wheel trucks or larger trucks and semi-trailers account for 30 % of the daily traffic volume of about 3,000 vehicles. This percentage rises to 60 % if buses and 10 ton trucks are included. Despite of the relatively small traffic volume, therefore, BR-277 is planned to be improved to a four-lane road. All the bridges constructed on this route have four lanes. Though agricultural products collected a Londorina still tend to be shipped from Santos port in São Paulo state, there is little doubt that BR-376 and BR-277 will become very important road transportation routes with the improvement of Paranagua port. Transportation of agricultural products to Paranagua will have to resort to trucks for a considerably long time because the 900 m altitude difference between Curitiba and Paranagua will make the planned improvement and new construction of railway lines a heavy and time-consuming work.

Industiralization is in progress in and around Curitiba city. To provide for the future road traffic demand, therefore, it is necessary to formulate a plan for constructing an outer ring road encircling the city.

3-4 Paranagua Port (Porto de Paranagua)

3-4-1 Outline of Paranagua

The hinterland of Paranagua port is Parana state which covers an area of 77 thousand square miles (197 thousand km^2) and is inhabited by 6,998 thousand people. The state has no large cities comparable to Rio de Janeiro or São Paulo. Main cities in the state are Curitiba, the capital of the state (population: 600 thousand), Londorina (population: 160 thousand), Maringa (population: 100 thousand), Ponta Grossa (population: 90 thousand), and Paranagua which embraces Paranagua port (population: 50 thousand). However, population of the state and its cities has been on the rapid increase

over the past years. Population of the state, for example, increased by 55 times during the past 100 years, and that of Curitiba grew by 3.5 times in the past 20 years.

The notable population growth which is clear from the above tables is ascribable, to a large extent, to the expansion of agricultural production. A glance at Table (Outline of Agricultural Production) will make it evident that the state's agricultural production is very large relative to its population which is only 7.6 % of the country's total and the state budget is heavily dependent on agriculture.

(1) Topography

Paranagua port faces the V-shaped Paranagua bay (Baia de Paranagua). The bay is very calm because it is severed from the outer sea by two islands found at its entrance, Mel island (Ilha do Mel) and Pecas island (Ilha des Pecas). Since the present port is located around the middle of the bay's coastline, vessels entering or sailing from the port must pass the narrow channel on the northeastern or southeastern side of Mel island.

(2) Administration

Paranagua port is operated under the control of the state authorities.

(3) Cargo Handling Volume

In 1971, Paranagua port handled a total of 2,750 thousand tons of cargoes comprising 1,720 thousand tons of export cargoes, 80 thousand tons of import cargoes, 70 thousand tons of inter-state export cargoes, and 880 thousand tons of inter-state import cargoes. Export cargoes were all agricultural products of which major items were maize (830 thousand tons), coffee (410 thousand tons), and pellet (310 thousand tons). Inter-state import cargoes are mostly petroleum products. Thus, the port is characterized by the shipment of agricultural products to overseas market and import of petroleum products from other parts of the country.

During the five year period from 1965 to 1971, the port's cargo handling volume increased by 2.5 times. This can be attributed, among others, to the export of agricultural products which has grown by 3.8 times during the said five year period. The growth has been conspicuous in the export of maize and pellet which are the major crops taken up under the export corridor project.

(4) Existing State of Port Facilities

(a) Navigation Channel and Basin

The existing navigation channel is the -10 m deep southeastern channel (Canal sueste) which takes a roundabout route on the northeastern side of Mel island. The channel depth cannot be made deeper than at present because rock-beds prevail in some parts where the depth exceeds -10 m.
The basin has a depth of -8 ~ -12 m.

(b) Mooring Facilities

The total extension of wharfs for handling general cargoes and grains is 2,106 m. Besides these, there are dolphin berths for handling petroleum, LNG and petrolic gas which have a total extension of 330 m.

Table 3-1 Outline of Wharfs at Paranagua Port

Outline of Wharfs		
Depth	Length	Apron Width
- 8m	1,170m	16.7m
-10m	420m	16.7m
-12m	516m	25.0m

Table 3-2 Outline of Dolphine Berths at Paranagua Port

Outline of Dolphine Berths			
Depth	Length	Dolphin Width	Use
-8m	146m	8.0 ~ 9.0m	Gas
-8~-10m	184m	7.5 ~ 15.0m	Oil

The wharfs for general cargoes and grains are so arranged as will form a straight line. The innermost berth, which has a depth of -10 m, is used exclusively for the 10 thousand ton silo (APPA) and 10 thousand ton steel silo (SOCEPPAR) which were constructed in June 1967 and 1968 respectively. Next to this berth is found the -8 m berth, and then the -12 m berth which is the closest to the bay mouth. The -12 m berth was constructed under the Third Port Improvement Plan being implemented in parallel with the export corridor plan. This -12 m wharf is planned to be provided with four horizontal silos with a total capacity of 72 thousand tons, 100 thousand ton silos, parking lot, and so on. Two horizontal silos have so far been constructed and reclamation work is in progress at present to create the land for 100 thousand ton silos.

Of the dolphin berths for handling petroleum and gas, the older berth (length: 146 m) was constructed by the state in 1946, and the new one (length: 184 m) by the federative government in 1970. Since the completion of the new berth, petroleum has been handled on the new berth and gas on the old berth. Storage tanks on these berths are operated by Shell and other oil companies, but the state authorities hold the ownership of the tanks. The construction cost of the tanks is being refunded by the state in instalments with taxes on port improvement.

Existing state of other port facilities such as warehouses, tanks and other storage facilities, harbour traffic facilities, and handling equipment and machinery is as described under the following items.

(5) Storage Facilities

1.	Transit Sheds and Warehouses	29	79,050 m^2
2.	Tanks	Fuel oil	92,000 kl
		Others	4,861 t
3.	Cold Warehouses	Floor space	1,487 m^2
		Volumetric capacity	2,143 m^3
		Number of compartments	10

4. Silos	SOCEPPAR	10 thousand t	12 bins
	A.P.P.A.	10 "	16 bins with 9 auxiliary bins
	CARGILL	20 "	horizontal silo divided into 3 compartments

5. Others

Repair shop and shed	Approx. 2,700 m^2
Cargo assorting and transhipping yard	82,000 m^2

(6) Harbour Railway

Siding Track	Total length - 40 km
Locomotive	150 HP x 2; 300 HP x 2

(7) Harbour Road
Unknown

(8) Cargo Handling Equipment

1.	Cranes	3 - 3.2 t x 16 units 5 - 6 t x 13 " 10 - 12 t x 4 " 30 t x 1 "
2.	Mobile Cranes	9 t x 2 units 10 t x 2 "
3.	Cranes with grab	0.8 ~ 3.2 m^3 x 22 units
4.	Forklifts	2 - 6 t x 62 units
5.	Others	Trucks and waggons 90 units, Pneumatic conveyer car 30 t/h x 4 units, etc.

Because of the large quantities of agricultural products handled at this port, warehouses occasionally become empty in the off-crop season. During the harvesting season, on the other hand, the port area is extremely congested with trucks because they carry the greater part of grains shipped from the port. The majority of the 29 warehouses are grain warehouses. Warehouses are equipped with better facilities than at Santos port, but the ship loading capacity from the warehouses is just about the same. There are six ship loading points and conveyors extend to these point from the warehouses. Ship loading is conducted with a total of eight movable loaders comprising stationary loaders and 100 t/h movable loaders which can be used for direct loading from trucks. Besides these loaders, there are a large

number of 3 - 10t cranes in the apron. The mission felt that there are too many handling equipment relative to the volume of cargoes handled.

(9) Existing State of Grain Loading Facilities

(a) Warehouses

Table 3.8 shows the warehouses used for export of grains.

When the export corridor plan is completed, the port will have a total storage capacity of about 300 thousand tons since the construction of silos will provide a storage capacity of 100 thousand tons in addition to the capacity shown in Table3.8. At present, however, the storage capacity of all the warehouses in use is about 60 thousand tons. APPA's concrete silo is equipped with pneumatic unloader for unloading imported wheat and cannot therefore fully counted on for export shipment. This silo also has driers and good receiving facilities. Construction of GRANSOL's two warehouses and AZ-3B is being executed for completion in five years. Grain loading facilities are planned to be constructed in front of AZ-4 to realize a movable type ship loading capacity of 500 t/h. AZ-9's ship loading capacity (80 t/h) is not large enough to serve for the planned export increase. GARGILL's 20 thousand horizontal silo, which is not under construction, is expected to be divided into three compartments to handle maize (capacity: 10 thousand tons), soybeans (capacity: 5 thousand tons) and pellet (capacity: 5 thousand tons). For this silo grain loading facilities with a capacity of 500 t/h are planned to be installed in front of AZ-12. Efficient operation of these 500 t/h facilities will be made possible by the use of the two units of 1,500 t/h ship loaders now being constructed by Japanese maker.

This grain loading facilities are planned for operation of two units of 1,500 t/h ship loaders. Since the reclaiming conveyor has a capacity of 1,500 t/h and the horizontal silo will have one line of reclaiming conveyor installed along its floor center line, improvement must be made in future in order to assure that the two 1,500 t/h ship loaders will exhibit their full capacity. Dredging to a depth of -12 m is not possible along the six meter section of the wharf in front of the silo due to the wharf's structure. 50,000 DWT class vessels cannot therefore be berthed along this wharf.

(b) Ship Loading Capacity

Ship loading capacity varies by whether the vessel is a grain carrier or a general cargo carrier. Generally speaking, however, the capacity is about 1,500 - 2,000 t/day if the goods are to be loaded from warehouses and 3,000 t/day if the goods are loaded from silos.

Because of the berth depth and other reasons, grain carriers are usually chartered under a contract for loading 2/3 and 1/3 of their loadage at Paranagua port and Santos port respectively. In case of 10,000 - 15,000 class carriers, the running rate is 1,000 t/day at Paranagua port and 500/ t/day at Santos port. This low running rate is assignable to the poor storage capacity and the direct grain transportation from the producing areas which is necessitated by the poor quality maintenance consequent on the lack of

necessary facilities at the port. These detrimental factors, coupled with the deficient railway transportation service, make the truck transportation inevitable, and this in turn causes congestion in the truck weighing yard, complexity of receiving work, and direct loading from trucks, etc.

The mission was informed that in the busiest season, 9 to 10 vessels are kept waiting for berth and as many as 500 trucks are found on the wharf.

3-4-2 Port Improvement Plan

(1) Estimate of Cargo Handling Volume

Under the export corridor plan the volume of export grains to be shipped from Paranagua port in 1976 is estimated at 3,500 thousand tons. In this total volume, maize is expected to occupy 1,500 thousand tons, soybeans 1,600 thousand tons and pellet 1,000 thousand tons.

(2) Port Improvement Plan

(a) Navigation Channel Improvement Plan

Dredging work is now in progress to create a new navigation channel with a width of 150 m and a depth of -13 m by the end of May 1973 for passage of 40,000 DWT class grain carriers. Because of the difficulty in dredging the existing southeastern channel to a depth of -13 m, the new navigation channel is planned to be established along the course of the narrow channel between Mel island and the peninsula stretching from southwest to northeast. Since this narrow channel is severed from the outer sea by Galheta shoal (Banco da Galheta) which is less than -3.0 m in depth, the dredging work must include complete removal of the shoal, but this will entail no difficulty because the bottom is sandy down to a depth of -35 m.

(b) Export Corridor Plan

The export corridor plan for Parana state aims at construction of 70 thousand ton horizontal silos and 100 thousand ton vertical silo by 1974 to convert the target grain export volume of 3,500 thousand tons into a reality. The plan for the 100 thousand ton silo includes construction of a -12 m wharf having a length of 500 m. This wharf will be constructed under the plan in substitution for the wharf which, though initially planned to provide the space for building 70 thousand ton and 100 thousand ton silos, is now intended to be used for handling general cargoes.

With the completion of these silos, Paranagua port will have a total silo capacity of 210 thousand tons. (see Table 3.9)

(3) Evaluation of Port Improvement Plan and Project

Since the new navigation channel is planned to be established by dredging the -3 m Galheta shoal, substantial difficulties will be encountered in maintaining it at a depth of -13 m at all times. The mission considers it necessary to take the following measures in order to cope with such difficulties.

1. Establish a system under which the channel depth will be measured at short intervals and dredging will be carried out without delay when silting up of any part of the channel is detected.

2. Provide pocket holes on either side of the 150 m wide channel so as to check sand intrusion into the channel's course. By dredging the sand from such pocket holes, it will be possible to maintain both the width and depth of the channel.

3. Clear up how Galheta shoal came into existence, and employ an effective sand preventive method developed on the basis of the cause of its formation.

Note must be taken of the fact that the datum level for harbour construction work differs from that depicted in the chart just as at Santos port. The difference being about 80 m in Paranagua port, the -13 m navigation channel will be entered in the chart as having a depth of 13.8 m. Hence, it is considered that the channel will allow the entry of 40,000 DWT class vessels.

Most of the existing warehouses are on the -8 m wharf, but large vessels cannot be berthed along this wharf because of its small depth and limited cargo handling capacity. Two horizontal silos now under construction and the planned 35 thousand ton two horizontal silos will belong to the same loading capacity of about 800 thousand tons per year can be obtained. Since the two units of 1,500 t/h loaders for the 100 thousand ton silo will provide a capacity of 1,300 thousand tons per year, the port's ship loading capacity will total 2,100 thousand tons per year, but falls short of the target capacity.

Though construction of additional 100 thousand ton silo will be required in future, the existing silos of APPA and SOCEPPAR will serve to meet the increased loading demand for some time to come since they are on the -10 m wharf and also well equipped though small in storage capacity.

The planned construction site of the 100 thousand ton silo is behind the horizontal silos now under construction. Since unnatural irregularity is observed in the berth depth in front of the selected site, the mission considers it necessary to make studies on the wharf and construction site.

Table 3-3 Existing State and Estimate of Production and Shipment (Export) of Cereals and Processed Agricultural Products Parana State

Unit: t

year	Cereals & Processed Products	Total Production	Shipment (Export)	Shipment by Destination		Consumption within State
				Paranagua	São Paulo	
1970	Soybeans	567,107	220,478	40,927	179,551	346,629
	Wheat*	228,100	46,084	46,084	-	182,016
	Maize	3,100,000	1,192,191	838,110	354,081	1,907,809
	Soybean Cakes	165,616	165,616	165,616	-	-
	Cotton Seed Cakes	602,800	183,700	88,990	94,710	419,100
1976 (estimate)	Soybeans	2,800,000	1,200,000	900,000	300,000	1,600,000
	Wheat*	426,550	174,690	50,000	124,690	251,860
	Maize	4,982,000	2,336,000	1,655,700	679,300	2,647,000
	Soybean Cakes	1,300,000	1,300,000	1,300,000	-	-
	Cotton Seed Cakes	381,200	200,900	106,500	94,400	180,300

* Wheat is planned to be shipped to other states for consumption in Brazil

Table 3-4 Agricultural Production of Parana State (1971)

Ranking in the Country	Item of Production	Production (Thousand t)	Ratio to Country's Total (%)
1	Coffee	2,200	58
	Peas	380	21
	Ramie	-	about 100
	Peppermint	-	about 100
	Mate	-	-
2	Cotton	370	24
	Peanuts	120	-
	Soybeans	570	20
	Wheat	230	16
3	Potatoes	270	25
	Maize	3,100	21
Others	Livestock	4,700 (thousand heads)	-
	Paddy	490	-

Table 3-5 Population Growth of Parana State

Year	Population (Thousand person)	Ranking
1872	123	16
1890	249	17
1900	327	15
1920	686	13
1940	1,236	10
1950	2,116	9
1960	4,278	5
1970	6,998	4

Table 3-6 Population Growth of Cities in Parana State

City	Population (Thousand person)		
	1950	1960	1970
Curitiba	171	335	600
Londorina	55	94	160
Maringa	7	36	102
Ponta Grossa	47	80	94
Paranagua	23	35	52

Table 3-7 Past Transition Cargo Handling Volume at Paranagua Port

	1965	1966	1967	1968	1969	1970	1971
Export	454,417	610,175	696,320	1,110,424	1,069,554	1,781,278	1,722,932
Inter-state export	40,253	16,446	45,327	53,731	79,796	50,639	68,758
Import	34,983	23,723	30,771	34,155	67,417	68,415	84,897
Inter-state import	569,620	717,730	762,416	903,549	932,544	840,261	882,693
Total	1,099,273	1,368,074	1,534,834	2,101,859	2,149,311	2,740,593	2,759,280

Table 3-8 Warehouses at Paranagua Port

Name of Warehouse	Type	Capacity 1,000t	Hourly Warehousing Capacity t/H	Loader Capacity t/H	Remarks
APPA(AZ-1)	Vertical Concrete Silo	10	300	300	Also used for import of wheat
SOCEPPAR	Vertical Steel Silo	10	300	300	
AZ-2B	One-storied Warehouse	10			Not completed.
AZ-3B	"	55		500	Under construction
GRANSOL	"				"
"	"				"
AZ-4	"		300	200	
AZ-5	"				
AZ-6	"	14	200	300	
AZ-6A/B					
AZ-8	"	4.5	150	200	
AZ-9	"	4.5		80	
AZ-10/11	"	9	450	300	
CARGILL	Horizontal Silo	20	400	500	Under construction
AZ-12/13	"	72	800	1,500	"
Total		209			

Table 3-9 Improvement Plan for Grain Shipment Facilities

Berth Depth	Maximum Vessel Class	Loader Capacity	Silo Capacity	Remarks
-10m	15,000 DWT		20,000t	APPA and SOCEPPAR
-12m	40,000 DWT		20,000t	CARGILL; completion scheduled for December 1972
			70,000t	Partly completed (capacity: 35,000t)
			100,000t	Construction plan under way
Total			210,000t	

Fig. 3.1 Maize, 1976

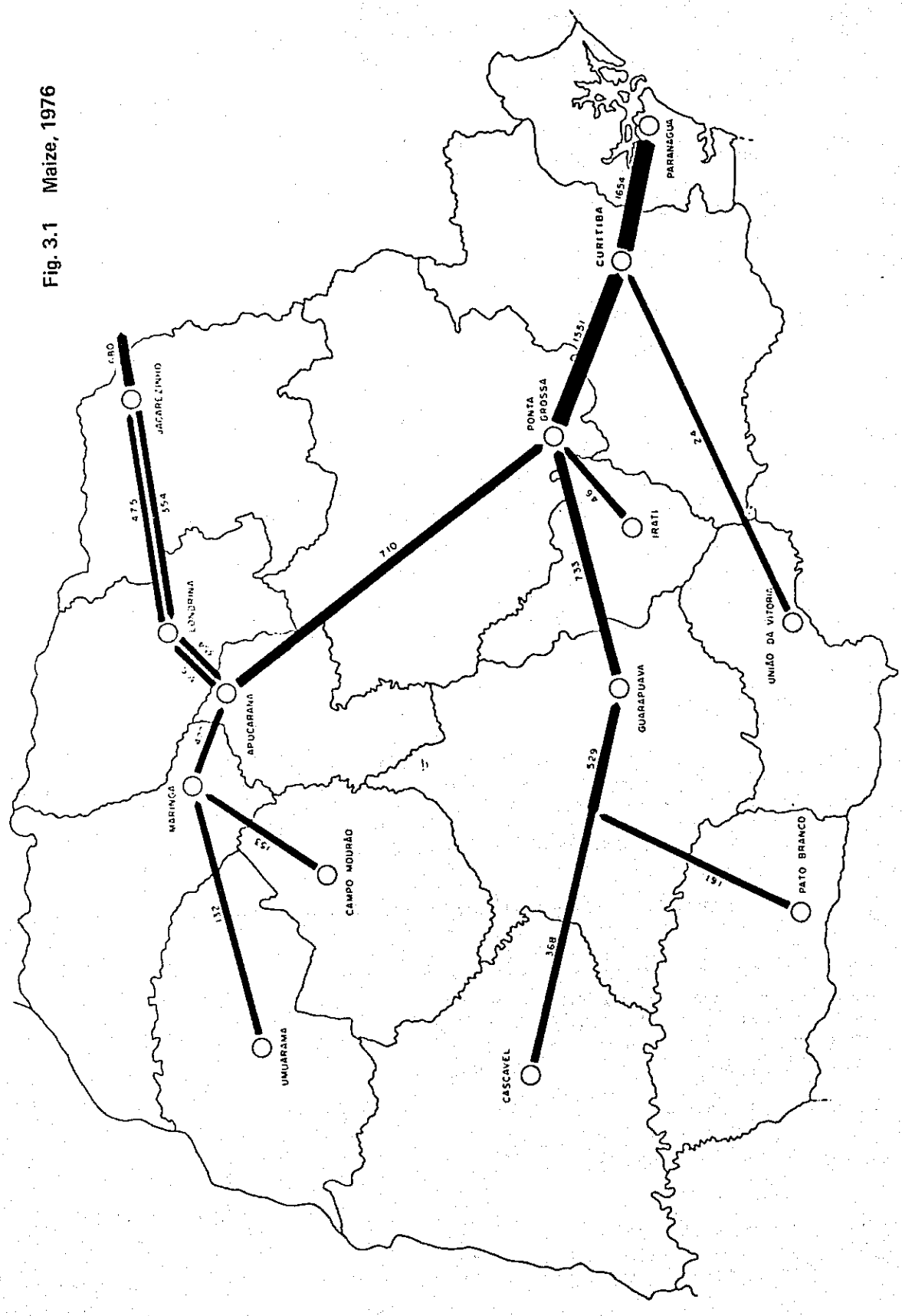


Fig. 3.2 Soybeans (in grain), 1976

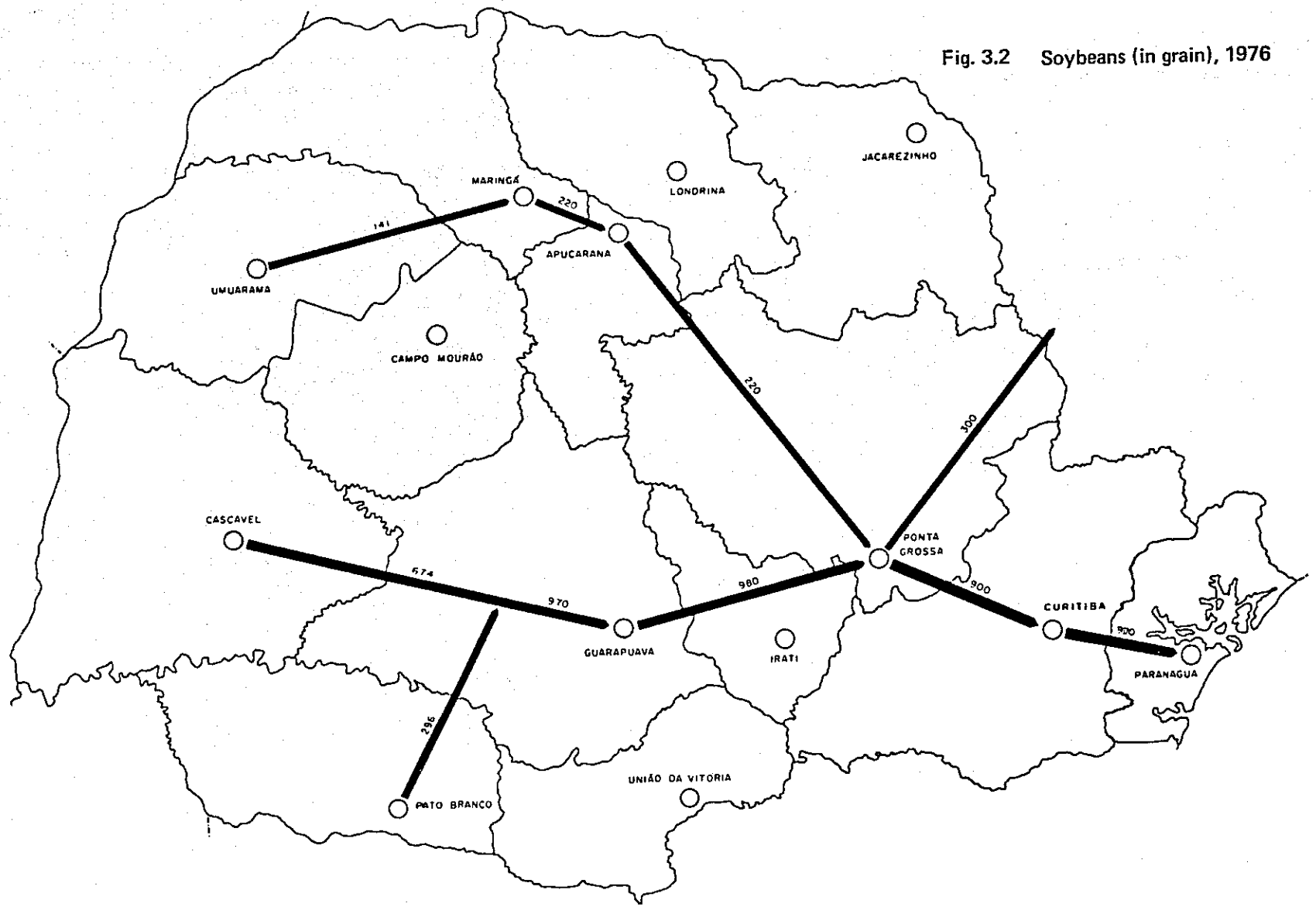


Fig. 3.3 Total, 1976

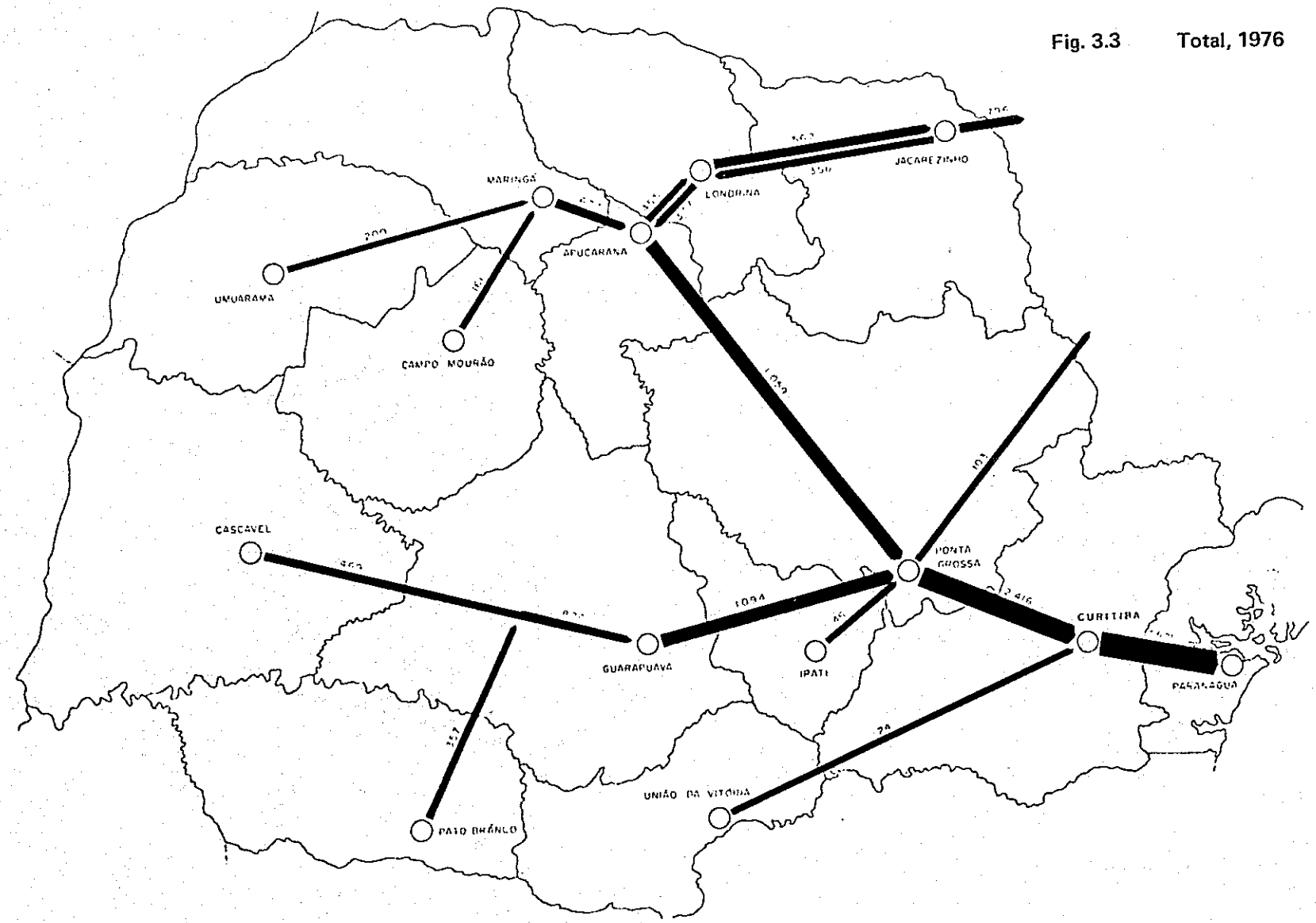
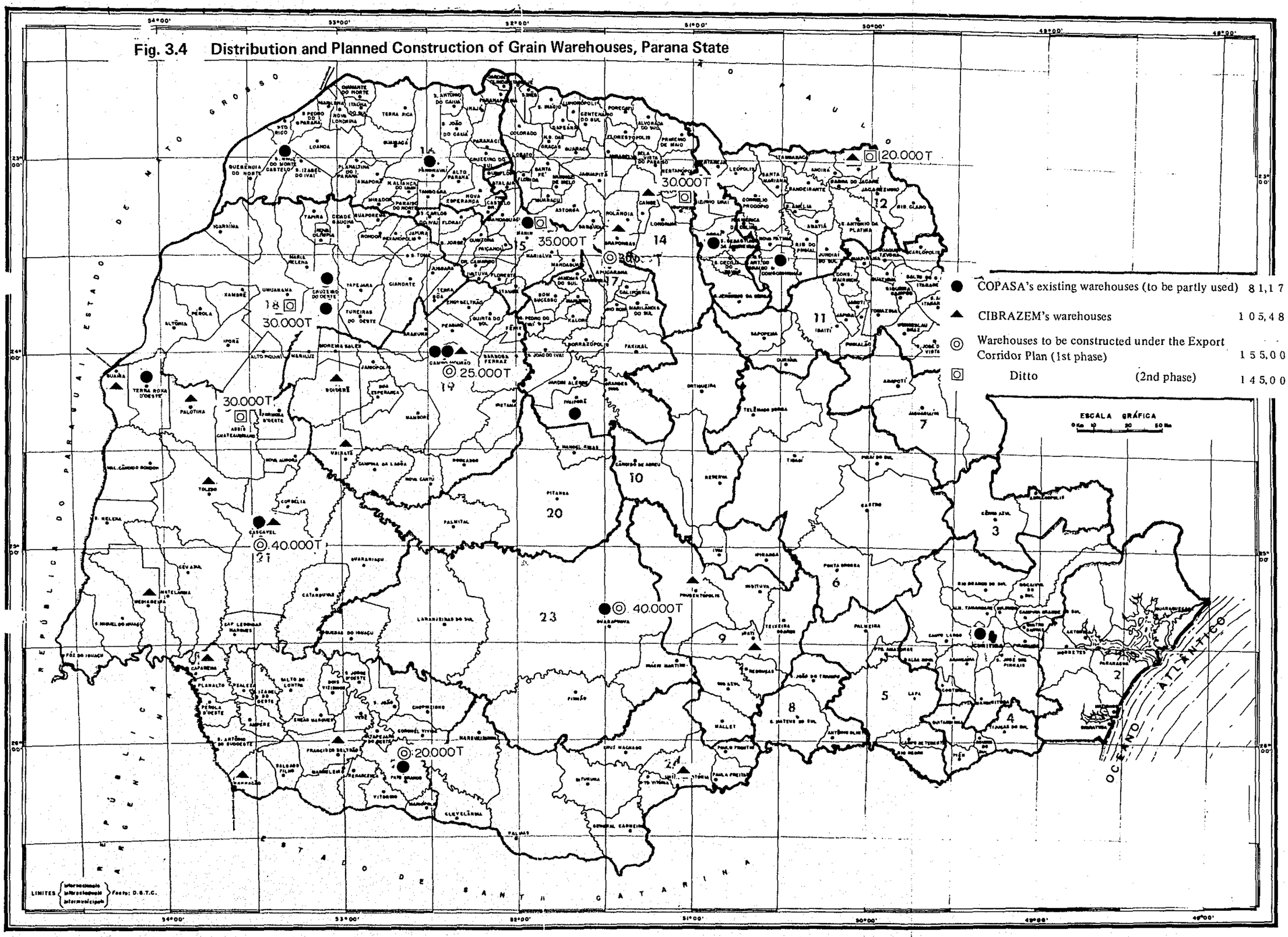
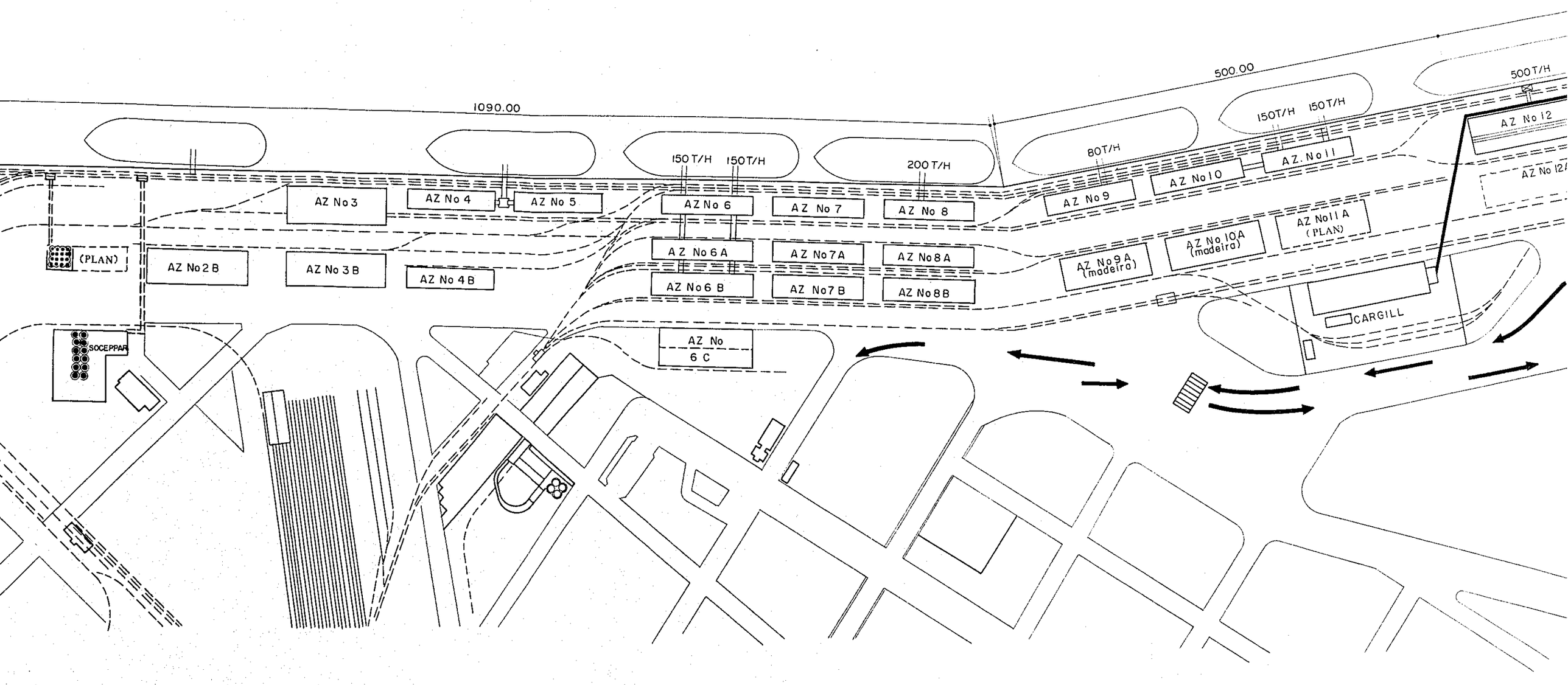


Fig. 3.4 Distribution and Planned Construction of Grain Warehouses, Parana State




1090.00
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AZ No 10
AZ. No 11
AZ No 11A
(PLAN)
AZ No 2B
AZ No 3B
AZ No 4B
AZ No 6A
AZ No 7A
AZ No 8A
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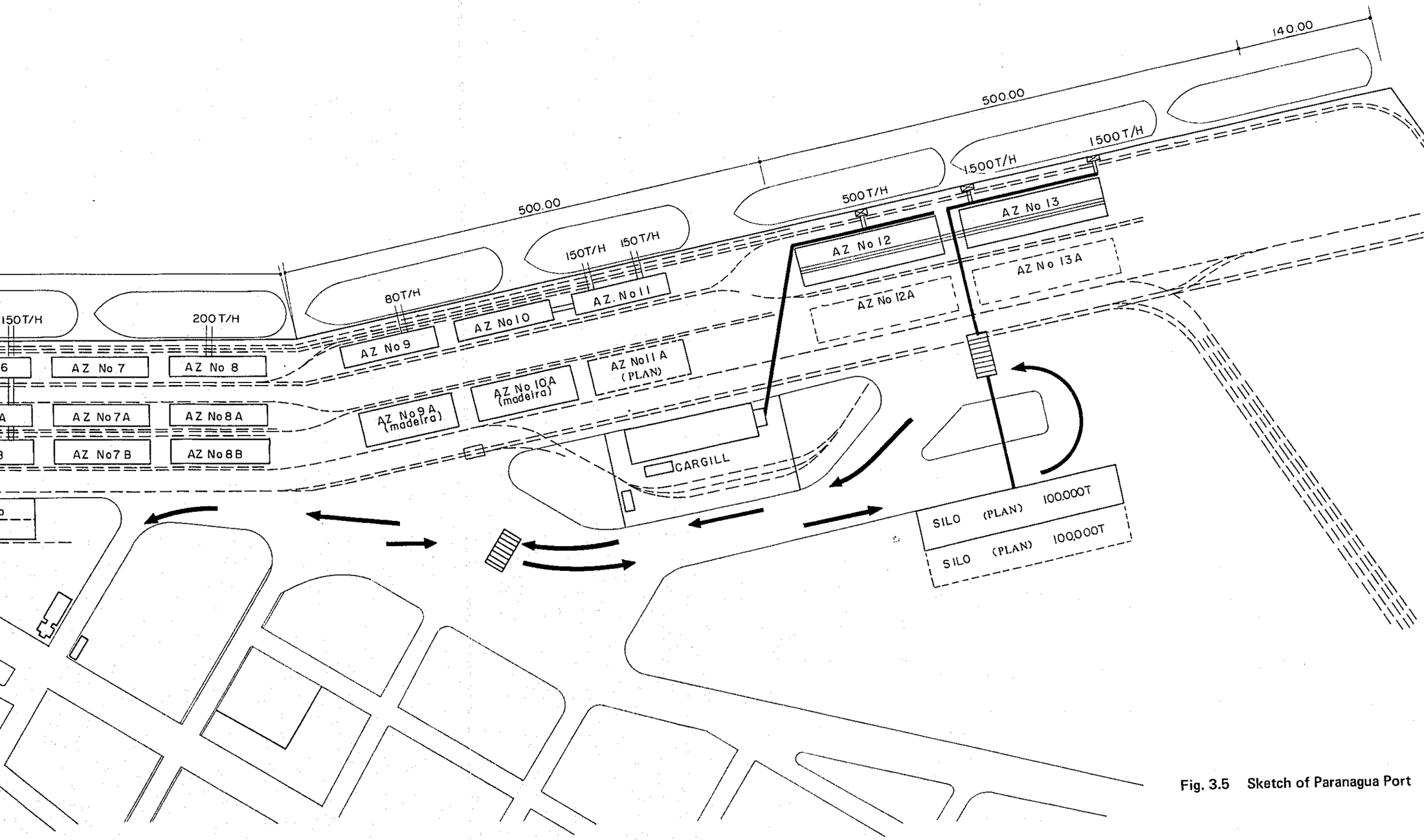


Fig. 3.5 Sketch of Paranagua Port

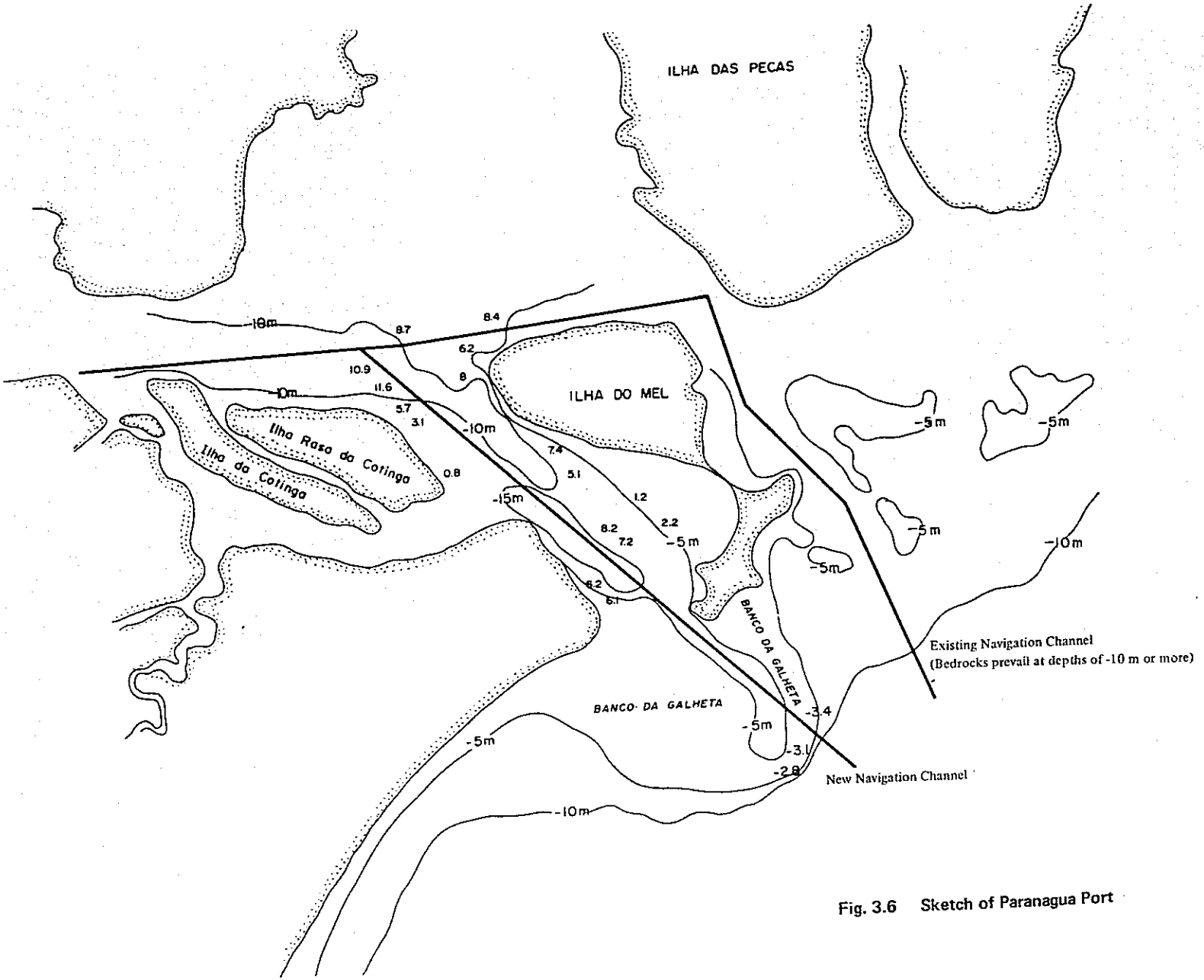


Fig. 3.6 Sketch of Paranagua Port

IV. EXPORT CORRIDOR OF RIO GRANDE DO SUL

Rio Grande do Sul, adjoining the fertile land of Argentina, holds the top in the country in the production of cereals such as wheat and rice and is expected to exhibit an explosive increase in the production of soybeans cultivated as the second crop of wheat and rice. In addition, expanded export of meat is anticipated because the state is favourably conditioned for raising beef cattle.

Since many of the inhabitants are of German descent, agricultural cooperative associations are well developed in the state. Agricultural associations known as "COTRIJUI" play an important role in this state.

It is with such background that the state authorities have established the plan to ship approximately 2,700 thousand tons of agricultural products (chiefly soybeans and meat) from Rio Grande port in 1976.

The infrastructural improvement plan mapped out by the state authorities covers the construction of a 10 thousand ton frozen products terminal in the old Rio Grande port, 60 thousand ton silos in the new port area and 100 thousand ton silos in the super port area as well as the installation of intermediate silos with a capacity of 150 thousand tons and construction of a new railway which will directly link Rio Grande port with Santa Maria, the collecting and distributing place of agricultural products.

In the past years, Porto Alegre port has played an important role as the state's gateway to the outside world. However, since the lagoon separating the port from the outer sea, which is called "Laguna dos Patos", is extremely shallow and does not allow entry of large vessels, improvement is now being effected to the facilities of Rio Grande port which faces the outer sea.

The state has no coastal range as in other states, and has two large rivers, the Jacui and the Taquari, which flow through inland producing areas into Patos lagoon. In this area, therefore, the inland transportation cost of agricultural products can be most effectively curtailed by the establishment of a canal transportation system resorting to these two rivers. Construction of lock gates and terminals is already progress and it is likely that inland navigation on canals from producing areas to Porto Alegre and further to Rio Grande port via Patos lagoon will magnify its importance in future.

4-1 Production and Export of Agricultural Products

Items that can be cited as export commodities of Rio Grande do Sul state are soybeans, soybean cakes, maize, rice, meat and wool. Production of soybeans accounts for about 70 % of the nation's total, but that of maize is small relative to other states. The target export volume of soybeans set for 1976 is 1,800 thousand tons, but no target volume is established for maize and this is perhaps because the livestock farming is active in the state and all the increment of maize production is estimated to be consumed as self-supplied feed.

The target export volume set by the federative republic government for grains and processed agricultural products is 2,719 thousand tons. Item-wise breakdown of this total volume is 1,569 thousand tons for soybeans, 850 thousand tons for soybean cakes, and 300 thousand tons for maize.

This state is known for its large wheat production. Planted area of soybeans is on the increase in this state by mechanized framing being enhanced for double cropping of wheat and soybeans. Further, since paddy cultivation and livestock farming are conducted on a large scale in the state, it is likely that the state's soybean production will be augmented by the introduction of rotation system involving paddy, grazing and soybeans. It is to be added that the state embraces huge arable land suited for soybean cultivation. With this favourable prospect for future, the state authorities expect that the soybean production will increase from the present level of 2,000 thousand tons to 4,200 thousand tons in 1976, and is planning to appropriate 1,800 thousand tons for export in that year assuming that the balance will go to soybean oil production and consumed within Brazil. As for maize, some increase is expected in production, and cultivation of sorghum as substitute for maize is planned. But it does not seem possible to place much hope on the increased maize export from Rio Grande do Sul state.

As already described, agricultural cooperative associations in Rio Grande do Sul state are well developed and they are in full activity. In the coming years, however, further organizational reinforcement will be demanded of them for stabilized production and shipment of farm produce.

4-2 Storage Facilities for Agricultural Products

Existing warehouses and silos in the producing areas of Rio Grande do Sul state have a total storage capacity of 2,480 thousand tons. These storage facilities are run by agricultural cooperative associations (1,537 thousand tons), CESA (state warehouse company; 238 thousand tons), and private warehouse companies. The state will have an additional storage capacity of 1,136 thousand tons by the completion of warehouses and silos which are now under construction or planning by agricultural cooperative associations and CESA to provide a capacity of 747 thousand tons and 389 thousand tons respectively.

It is not clear how this construction plan is related with the silo construction plan incorporated in the corridor plan. It is likely, however, that the silo construction plan of the federative government (150 thousand tons) will be included in CESA's plan (389 thousand tons).

The state's target export volume of grains in 1976 is about 1,800 thousand tons, which is about 1,000 thousand larger than the present export volume. To cope with this increment of export volume, it is necessary to establish new silos with a storage capacity of 300 - 500 thousand tons. Construction plan of these new silos, however, will have to be put to reexamination because a capacity of 747 thousand tons is expected to be secured by the silos planned to be constructed by agricultural cooperative associations.

Distribution and expansion plan of CESA's warehouses and silos are shown in Fig. 4.1.

4-3 Inland Transportation

4-3-1 Railway Transportation

(1) Existing State of Railway Facilities and Service

The coastal range stretching along the Pacific coasts disappears in Rio Grande do Sul state, and the inland area and the coastline are connected with a mild undulated land in between. Hence, there are no such grade problems as observed in São Paulo state and Parana state.

Rio Grande port and Porto Alegre port, the two major ports of the state, can be linked by boat because Patos lagoon created by a long sand pit lies between them. From Porto Alegre port, river navigation is possible considerably deep into the inland area. This geological condition is considered to make it possible to transport a substantially large portion of export grains by water from the northern part of the state.

As shown in Fig. 6, the railway network of the state consists of two systems, one linking Cacequi and Porto Alegre port and the other connecting Cacequi and Rio Grande port. For future improvement of railway transportation, a new line is planned to be constructed between Porto Alegre port and Rio Grande port. Construction of a new line linking Passo Fundo and Roca Sales, which was initiated for closer communication with Parana state, is now suspended.

Generally speaking, railway tracks are rather old and needful of improvement of grade and radius of curvature. Santa Maria - Porto Alegre port section of Cacequi - Porto Alegre port route requires such improvement. However, improvement work has already completed in about 25 % of the section and is in progress in other parts. Completion of this improvement will reduce the grade of the entire Cacequi - Alegre route to less than 1.0 %.

Partial track improvement work is under way on Cacequi - Rio Grande port route. Track improvement for reducing grade to less than 1.0 % is also in progress in Santa Maria - Cruzalta section of the south-north route which links Santa Maria and Marcelino Ramos.

Average daily railway transportation volume in 1971 was as follows.

Cacequi	⟶	Santa Maria	3,228 t (tractive capacity: 1,260 t)
Santa Maria	⟶	Porto Alegre Port	2,402 t (-)
Cacequi	⟶	São Sebastão	2,995 t (tractive capacity: 625 t)
São Sebastão	⟶	Rio Grande	3,538 t (" " : 900 t)

The rail weight ranges from 32 kg/m to 37 kg/m.

(2) Export Corridor Plan

1. Improvement of Cacequi - Rio Grande route to reduce the maximum grade to less than 1.0 % and increase the minimum radius of curvature to more than 300 m.

2. Improvement of safety facilities on Cacequi - Rio Grande route including introduction of automatic block signals and CTC system.

(3) Evaluation of Export Corridor Plan

Since Patos lagoon and canals will offer appreciable facilities for water transport, it is estimated that the railways will cover about 50 % of grain transportation demand. This means that 140 thousand tons of grains will be carried by railway within five months.

When the planned improvement work is brought to completion, 1,500 HP class locomotive engines will exhibit a tractive capacity of 1,200 tons on Cacequi - Rio Grande route.

Calculations disclosed that 12 grain trains will be operated daily. Federal Railways, however, expressed the hope to secure a tractive capacity of 3,600 tons by operating triple headed locomotives. If this hope is realized, operation of four trains a day will be sufficient to meet the demand for grain transportation. (Extension of the effective length of railway stations involves no difficulties at all in Brazil).

4-3-2 Highway Transportation

In terms of the number of registered vehicles, Rio Grande do Sul state ranks next only to São Paulo state among a number of states covered by the export corridor plan. However, the state is backward in the consolidation of roads. Density of roads in this state is small and the ratio of paved roads is lower than the national average.

The existing arterial highway network consists of three routes, i.e., BR-116 which runs along the coastline between Porto Alegre port and Pelotas, BR-386 which connects the port and Carazinho in the north, and BR-290 which crosses the state from east to west direction.

For the planned grain shipment from Rio Grande port, it is necessary to construct arterial highways linking the extensive producing areas in the western part of the state with Pelotas and Rio Grande port. Construction of BR-392 and BR-158 which will connect Pelotas with Cruz Alta or S. Angels port via Santa Maria is therefore a pressing need.

As for the construction of BR-285 which is now in progress to cover a distance of 400 km across the northern part of the state, priority should be given to Santiago - Santa Maria section which will connect Santiago with BR-392 rather than to the completion of the entire route. Efforts should also be made for improving the efficient road network in the western part of the state

and for linking it with Pelotas and Rio Grande.

In the southern part of the state, construction of BR-293 (Pelotas - Santana do Livramento) and BR-116 (Pelotas - Jaguarão) is planned. The mission is of the opinion that these roads should be so designed as will take a roundabout route in the direction of Rio Grande instead of starting from the centre of Pelotas, and that traffic should be guided to reach the centre of Pelotas by streets.

Being the centre of the state, Porto Alegre has a heavy traffic demand arising from commercial and industrial activities in the state and port operation. To meet this heavy traffic demand, it is necessary to construct a large bridge because the Jacui river flows into Patos lagoon. With no such bridge yet constructed, traffic to Porto Alegre is concentrated on certain limited routes where the present heavy congestion are seen.

A new road taking a roundabout route in the east of Porto Alegre should therefore be constructed to alleviate the heavy traffic from the northern part to the city's centre and to cope with the future increase of traffic demand. Provision of parking lots in the central part of Porto Alegre will also be necessary because parking on roads is considered one of the major causes of the heavy traffic congestion in the city.

4-3-3 Canal Transportation

Rio Grande do Sul state is distinguished from the other states covered by the export corridor plan by the fact that its coastal range disappears in the northern part and there are two rivers rising from the central part of the state. One of them, the Ibicui, flows to the inland area and the other, the Jacui, takes an easterly course and empties into Patos lagoon near Porto Alegre. The lake extends to Rio Grande where it faces the Atlantic Ocean. The Jacui is stabilized in both discharge and depth though its bed slope is as small as 1/10,000 - 1/18,000.

Because of the delayed improvement of railways and roads which must cover a very long distance between the inland area and Rio Grande port, the Jacui and Patos lagoon serve as natural water transport facilities quite suited for long distance mass transportation.

In an attempt to secure the means of grain transportation, the federative government is now engaged in the construction work intended for assuring the navigability of the Jacui and its distributary, the Taquari.

The federative government's plan was mapped out to secure a navigable portion of 360 km for the Jacui and 205 km for the Taquari by establishing lock gates and sluices at a number of points on the two rivers. The five construction sites selected on the Jacui are located 74 km, 177 km, 239 km, 299 km and 336 km respectively from Porto Alegre, and the three on the Taquari are 122 km, 155 km and 187 km far respectively from Porto Alegre.

As the first stage work, construction of lock gates at the 239 km point (Fandango) on the Jacui was completed in 1958. At Don Marco which is located on the downstream side of Fandango at a point 177 km from Porto Alegre, construction of a 1 km canal for shortcircuiting a curved section was already completed and a sluice is now under construction. The lock gates at the 74 km point (Amaropolis) is expected to be completed within 1974. On the Taquari, lock gate construction at the 122 km point (Bon Retiro do Sul) is expected to be brought to completion in 1973. For gate construction at upstream points, surveys are now being conducted for combined installation of gates and power plants.

The lock gate is planned to have a length of 120 m and a width of 17 m so as to maintain a water depth of 2.5 m. Completion of this series of construction work in 1974 will permit passage of 1,250 DWT class vessels on the two rivers, making it possible to transport 2,000 thousand tons of cargo annually. This water transport capacity can be increased if vessels are improved for efficient operation of lock gates and the fleet and tonnage are expanded.

For freight comparison by waterway and road, it may as well be mentioned that transportation of one ton of grains over the 150 km distance from Rio Pardo in the Jacui basin to Porto Alegre costs Cr.$10.5 - 12 by boat and Cr.$22 - 24 by truck.

Thus, half the rate of road transportation is charged for water transportation despite the fact it is conducted on a small scale at present without constant assurance of navigable depth. It leaves no doubt, therefore, that when regular transport service on the improved navigation channels becomes a reality, long-distance mass transportation will prove very-advantageous. Hence, navigation improvement on the Jacui and the Taquari should be accompanied by the construction of the water transport terminal.

Storage facilities like silos and warehouses as well as cargo handling equipment are available at Cachocira do Sul in the Jacui basin. If a terminal for water transportation to Rio Grande port is constructed at this place through expansion of the existing storage and cargo handling facilities and improvement of railways and roads leading to the port, it will serve to cut down the grain transportation cost to a large extent. A terminal for grain transportation from the northern part of the state can also be established by providing the necessary facilities such as warehouses, handling equipment, etc. in the neighbourhood of Estrela or Lajeado in Taquari basin.

An efficient transport system can be established for the two river by planning systematic transportation of fertilizers, sundry goods, development equipment, etc. by vessels plying up the river.

The canal connecting the two rivers is expected to be very large in scale. Its construction deserves to be planned as a national scheme because it will enhance the development of various unexploited resources including timber, promote the expansion of arable land, and further open up a new way linking Paraguay and the Atlantic Ocean.

4-4 Rio Grande Port

4-4-1 Outline of Rio Grande Port

Rio Grande port constitutes, like Porto Alegre port (Porto de Porto Alegre) and Pelotas port (Porto de Pelotas), one of the gateways of Rio Grande do Sul state.

Rio Grande do Sul state, which occupies the southernmost part of Brazil, covers an area of 282 thousand km · and adjoins the Republic of Uruguay (Republica do Uruguai) on the southwest, the Republic of Argentina (Republica da Argentina) on the northwest, and Santa Catalina state (Estado de Santa Catalina) on the northeast. In the southeastern part of the state are found lakes such as Patos lagoon (Laguna dos Patos), Lake Mirim (Lagoa Mirim) and Lake Mangueira (Lagoa Mangueira). The total surface area of all these lakes is as large 15 thousand km^2.

Porto Alegre, the capital of the state, is inhabited by about 1,000 thousand people.

(1) Topography

The port is located at the southern end of Patos lagoon. Around this lagoon are found two other ports, i.e., Porto Alegre port which faces Guaiba which is connected to the lagoon and Pelotas port which faces the waterway formed by the lagoon and Lake Mirim.

At present, Porto Alegre port surpasses Rio Grande port in terms of cargo handling volume and total berth length. However, due to the small depth of Patos lagoon (approx. -6 m) and the increasing tonnage of vessels, port facilities improvement is being made with greater weight attached to Rio Grande port.

As for Pelotas port, it seems that there is not much room for further improvement.

North Canal (Canal do Norte) found in the south of Rio Grande provides the only route which links the outer sea with Patos lagoon and Lake Mirim. The canal did not permit passage of vessels with a draught of more than 4 m until 1914 when a French company (Compagnie Francaise due Port de Rio Grande) constructed a 4 km long raining dike along the canal.

It is planned that lock gates will be constructed on the Jacui river (Rio Jacui) and the Taquari river (Rio Taquari) flowing into Patos lagoon near Porto Alegre in order to allow passage of 1,000 ton vessels on the two rivers. Completion of these lock gates will enable vessels to navigate on Jacui and the Taquari as far upstream as 360 km and 205 km respectively from Patos lagoon.

(2) Administration

Administration of the entire Rio Grande port is l ft to the state authorities, with the exception of the grain loading dolphin berth which is operated by COTRIJUI (IJUI Agricultural Cooperative Association).

(3) Cargo Handling Volume

In 1971, Rio Grande port handled 657 thousand tons of export cargoes, 938 thousand tons of import cargoes, 1,116 thousand tons of inter-state export cargoes and 496 thousand tons of inter-state import cargoes. In 1,612 thousand tons of domestic trade cargoes, coastal navigation covered 1,088 thousand tons, lake navigation 502 thousand tons and river navigation 21 thousand tons. During the three year period from 1968 to 1971, the port's cargo handling volume increased by about 1.2 times.

In 1971, Porto Alegre port handled a greater volume of cargoes than Rio Grande port and registered a total of 4,418 thousand. However, cargoes for river navigation occupied a very large portion of this volume. The cargo handling volume of Pelotas port is limited to only 403 thousand tons.(see Table 4.2, 4.3 and 4.4)

(4) Existing State of Port Facilities

(a) Navigation Channel

A 4 km long dike constructed along either side of the navigation channel projects into the Atlantic Ocean from the harbour entrance. Since the dikes are constructed by random work with rubbles each weighing 6 to 8 tons, 20,000 tons of rubbles are replenished each year to maintain their original shape. The two dikes are arranged to come closer to each other towards the offing so that the distance between them will be diminished to 725 m at the extreme end. Therefore, the navigation channel is maintained at a depth of -11 ~ -12 m by the flushing effect of the current flowing out of Patos lagoon.

(b) Mooring Facilities

Rio Grande port has its mooring facilities in three different port areas, i.e., old port area (Porto Velho), new port area (Porto Novo) and super port area. Rio Grande city is a port city developed on a peninsula which projects into Patos lagoon. The old port area is on the northern side end of the peninsula and the new port area is on the southern side end of the peninsula. The super port area, on the other hand, is on the peninsula extending between Mangueira inlet (Saco da Mangueira) and Rio Grande channel (Canal do Rio Grande) which stretches between the new port area and the harbour entrance.

Of these three port areas, the new port area tops in both cargo handling volume and scale of facilities. The old port does not permit entrance of large vessels because its water depth is less than 6.5 m and shoals are found extending in front of its wharf. The super port area is now under construction as a sea-front industrial area and its future development is much hoped for.

However, no appreciable development has yet been made in this area, the only notable facilities being COTRIJUI's grain silos and loading facilities. COTRIJUI's loading facilities have a capacity of 1,000 t/h, and are established on a -14 m berth which has an extension of 160 m at a point 150 m away from the coastline. COTRIJUI's four silos have a storage capacity of 110 thousand tons. COTRIJUI is an organization established and operated by Ijui Agricultural Cooperative Association and handles wheat and soybeans produced by its members.

The new port has a water depth of -8.7 m and a length of about 2,000 m. The port, however, is not in the complete shape because construction of its wharf is not yet finished in some sections. From the exit side of the channel are established the fish processing plant, ice making plant, cellulose plant, coal storage yard, 6,500 ton cold warehouse, transit sheds, warehouses, and CESA's 20 thousand ton silo. Grains are loaded by a 100 t/h movable loader by linking it with the chute extending from each warehouse or directly from trucks in front of Warehouse Nos. A-2, A-4, A-5 and A-8. Besides this ship loader, a good number of cranes with a hoist load ranging from 2 to 10 tons are found on the wharf as in other ports.

Particulars of the mooring facilities in each port area are shown in Table 4.5.

The berthing efficiency of the mooring facilities in the new port area is as shown in Table 4.6. The overall average of the berthing efficiency is 1,493 t/m in this area.

The existing state of warehouses, harbour land transportation facilities, cargo handling equipment, etc. is as described in the following items.

(5) Storage Facilities

1.	Warehouses	18		57,332 m^2		
2.	Tanks	Unknown				
3.	Cold Warehouses	2		7,270 ton capacity		
4.	Silos	165 thousand tons				
	COTRIJUI	110	"	"	4	Horizontal silo
	CESA	20	"	"	1	Concrete silo
	SAMRIG	35	"	"	1	Horizontal silo

(6) Harbour Railway

Siding track - 13 km

(7) Harbour Road

Unknown

(8) Cargo Handling Equipment

1. Cranes (45 units)

New port	3.2t x 17 units
	5 - 6.3 t x 6 units
	10 - 12.5 t x 5 units
	2.5 t x 10 units
Old port	2.5 t x 5 units
	5 t x 2 units

2. Grain Loaders — 100 t/h x 6 units; 25 t/h x 4 units

3. Mobile Crane — 30 t x 1 unit

4. Forklifts — 1.8 - 20 t x 114 units

5. Floating Crane — 90 t x 1 unit

6. Trucks — 16

7. Locomotives — 16.5 - 45 t x 4 units

Waggons — 30 units

8. Conveyors — 30 units

(9) Existing State of Grain Loading Facilities

(a) Warehouses

Table 3 shows the warehouses and silos presently used for grain storage and export.

Table 4-1 Existing State of Warehouses and Silos at Rio Grande Port

Name of Warehouse	Type	Storage Capacity (1,000t)	Warehousing Capacity	Loader Capacity
B-2	One-storied Silo		130 t/H	-
B-4	"		130	200 t/H
B-5	"	80	130	200
C-5	"			-
B-6	"		130	-
SAMRIG	Horizontal Silo	35	150	300
CESA	Vertical Silo	20	300	400
COTRIJUI	One-storied Silo	110	500	1,000
Total		245		

Warehouses B-2 - B-6, which are available besides the fullscale grain warehouses, have a limited receiving and reclaiming capacity, and it is difficult to increase their annual turnover rate. Warehouses A-5 and A-4 are used in the peak shipment season. Grains are stored in bulk in these warehouses with their walls protected by piling up grain bags.

SAMRIG's horizontal silo is on the outer side of the harbour road and handles soybean cakes only.

CESA's silo now has a storage capacity of 20 thousand tons. It is expected that CESA will complete the construction of additional silos and improvement of the existing silo in order to raise the storage capacity to 60 thousand tons and increase the reclaiming capacity to 600 t/h and 500 t/h respectively.

COTRIJUI's grain loading capacity, shown in Table 4.1 is planned to be augmented by the additional construction of four horizontal silos (110 thousand tons), receiving facilities for trucks (500 t/h), ship loading facilities (1,000 t/h) and floating loaders from barges (500 t/h). COTRIJUI is planning to complete this improvement by October 1973.

Though not included in Table 3, construction of a 60 thousand horizontal silo with a ship loading capacity of 1,500 t/h is in progress adjacent to the SAMRIG's horizontal silo. Completion of the plans not incorporated in the project will therefore provide an additional capacity of 210 thousand tons, so that the total storage capacity will reach 455 thousand tons. However, since the capacity of the warehouses now in use in the new port area should be deducted from this total because of their poor ship loading capacity, it is estimated that the total storage capacity will be 375 thousand tons.

(b) Ship Loading Capacity

Grains can be unloaded from six waggons at a time and carried into COTRIJUI's horizontal silos by 500 t/h receiving conveyors. COTRIJUI's daily receiving capacity ranges from 3,000 to 4,000 tons at present.

For reclaiming of grains from its silos, COTRUIJI has one line of underground conveyor which runs under hoppers (provided at intervals of about 5 m) and leads to the loading conveyor through the hopper scale. The loading conveyor extending from under the silo to the dolphin has a upgrade. Grains can be loaded into any hatch of the carrier from the dolphin through eight chutes provided under the longitudinal dolphin conveyor. The present running rate is 2,500 t/day but this could be increased to a maximum of 6,000 t/day. COTRUIJI is planning additional installation of loading facilities to increase the capacity to 5,000 t/day for general cargo carriers and 10,000 t/day for exclusive grain carriers.

In the case of grain warehouses in the new port area, facilities for unloading four waggons at a time are provided only for the second row of warehouses and portable conveyors are set in front of waggons to carry grains into other warehouses. Their receiving capacity is poor relative to COTRUIJI's silos. Grains are reclaimed from these warehouses by means of hoppers, bucket elevators, overhead conveyors just as in other ports. Grain carried

to the roof of warehouses are dropped onto the mobile loaders through the chutes. If no such reclaiming conveyor is installed, grains are carried by movable from the warehouse to the apron and unloaded onto the mobile loader. There are six 100 t/h loaders but only three of them seem to be put in daily loading operation. It can therefore be concluded that these warehouses have a loading capacity of 1,500 t/day and their usual running rate is 1,000 t/day. The ship loading capacity of the silos in the new port area is about 3,000 t/day.

(c) Cold Warehouses

There are two cold warehouses in the new port area. One of them is small and the other has a capacity of 6,500 tons. Products are carried into them by trucks and waggons from the platform in front and back. Inside these warehouses are provided elevators (4.5 x 2 units and 5.5 x 2 units) which carry the products up to the designated floors. Sorting and stowage of products are performed by means of forklift trucks and hand truck. The reported loading capacity is 30 t/h. Since they are far from the wharf, products are carried by trucks and loaded by the carrier's derrick. The two warehouses handle 70 thousand tons of meat annually, but the greater portion of this volume is handled during the January ~ September period.

A contract has already been concluded for using the 10 thousand ton cold warehouse to be constructed in the super port area. It is planned that forklift trucks will be used for sorting and handling of products inside the warehouse and a 30 ton hoisting load container crane will be used for loading products by means of temporary containers. The crane's hoisting load may seem too large in comparison with the container capacity of about 8 tons, but its installation can be justified in the light of the planned development of the entire super port area.

4-4-2 Port Improvement Plan

(1) Estimate of Cargo Handling Volume

Under the export corridor plan it is planned that 2,700 thousand tons of grains and 150 thousand tons of meat will be shipped from Rio Grande port in 1976.

The port authority of Rio Grande port has its own estimate of cargo handling volume formed for respective ports in the state (see Table 4.7). On the basis of this estimate, the authority predicts that the grain export from Rio Grande port will reach 2,285 thousand tons in 1976. With inter-state export of wheat and rice and import of fertilizers added to this volume, the authority considers that the port will handle about 7,000 thousand tons (6,960 thousand tons to be exact) in 1976.

(2) Port Improvement Plan

The total capacity of all grain silos which are either existing or under construction in the new port area is 155 thousand tons. Of this total, 35 thousand ton capacity is provided by the existing SAMRIG's silos, 60 thousand

tons will be secured by CESA's additional silo construction, and the remaining 60 thousand tons will be offered by the new silo construction. Since grain export from the existing -8.7 m wharf is the premise to the additional and new construction now in progress, the silo layout plan involves notable restrictive factors detrimental to efficient silo operation. To be more precise, the silos are being constructed behind or in between transit sheds or general merchandise warehouses, with belt conveyors planned to be installed to cover the long and twisted course to the wharf. Further, floating loaders are planned to be introduced because the -8.7 m wharf does not permit berthing of large vessels.

There is another grain terminal in Rio Grande port, i.e., COTRUIJI's terminal in the super port area. This terminal has -13 m dolphin berth and a 110 thousand ton silo which will shortly be expanded to provide a total storage capacity of 220 thousand tons. The 100 thousand ton silo which is given second priority under the export corridor project will be constructed in this super port area. It is planned that the construction of this silo, whose site will be determined in November 1972, will be carried out in parallel with the construction of a -13 m wharf having a length of 250 m.

By the target year set under the export corridor plan therefore, Rio Grande port will have grain silos with a total capacity of 475 thousand tons, of which 155 thousand tons will be in the new port area and 320 thousand tons in the super port area.

(3) Evaluation of Port Improvement Plan

(a) Navigation Channel Improvement Plan

The existing access fairway of the port stretches almost due west from the outer sea to the end of the training dike where it turns to north-northwest and enters the harbour area. The channel is maintained at a depth of about -11 m and a width of 200 m. However, the chart shows that the depth is as large as -20 m or -14 m inside the dikes but declines to -6 - -7 m in the circular area extending within a radius of about 2 km from the end of the dikes. This suggest that sand flushed by the training dikes is deposited in the off-shore area about 7 km from the end of the dikes.

Dredging work is now being carried out to create another navigation channel by May 1973. The new channel will have a depth of -14 m and a width of 200 m, and is designed to form a gentle arc-shape with a radius of curvature of about 4 km as well as to cover a distance of about 3.5 km from the end of the dike to the off-shore point where the depth registers -14 m. This alignment is better than that of the existing channel for smooth operation of vessels. The mission wishes to point out, however, that it will be considerably difficult to dredge the -7 m shallow shoal to a depth of -14 m and maintain that depth throughout the year.

It will therefore be necessary to establish a system under which sounding will be conducted in and around the channel at intervals of one to two months and maintenance dredging will be immediately carried out whenever there is any sign of silting up. The causes and nature of littoral sand drift may also have to be cleared up so as to provide against the silting up by

creating pocket holes on either side of the channel to prevent sand intrusion, conducting periodical dredging of such pockets or extending the training dikes.

(b) Cold Warehouse and Silo Construction Plan

Cold warehouses now existing and under construction will provide a capacity of about 17 thousand tons, and they can probably operated at an annual turnover rate of 10. However, since the turnover rate of large warehouses is generally low, careful technical studies should be made in future on the construction site, facilities for carrying in and out, and so on.

As regards the silo construction plan, the -8.7 m wharf in the new port area will not allow for berthing of large vessels but will provide a large loading capacity. Further, since loading from barges by floating loaders is planned, a total loading capacity of 3,500 thousand tons per year be expected from the new silo construction by SAMRIG, CESA and others (approx. 1,300 thousand tons per year using floating loaders), COTRIJUI's silo construction (approx. 800 thousand tons per year by the additional installation of on-land loading facilities and some more capacity by the use of floating loaders), and silo contruction planned under the project (100 thousand tons). This capacity may appear excessive, but need to be reexamined because of the possible decline of loading capacity which could arise from the off-shore loading operation using floating loaders.

Rio Grande port handles a large volume of wheat. During the off-peak season of soybeans and maize, the port will naturally have surplus capacity for handling wheat.

Comments on Rio Grande Port

Considering the development potential of Brazilian economy, it is likely that there will be sharp increase of demand for raw materials of highly processed goods such as petro-chemical and aluminum products. It is also probable that there will arise accelerated demand for petroleum products including gasoline whose consumption is expected to grow rapidly with the progress of motorization. This prospect calls for the import of crude oil and ores from overseas and processing of these materials into finished products to be supplied to the domestic market. Such import and processing will be largely facilitated by the construction of a sea-front industrial estate functioning in close coordination with a sea port allowing entry of large ocean-going vessels.

The super port area provides the site of such sea-front industrial estate because it is close to the -14 m navigation channel and also appears to promise the availability of a wide land area required for such estate. However, since the ground in the super port area seems to be soft, careful investigation will have to made to check if the bearing capacity of soil is large enough to suport heavy production facilities.

Brazil is a vast country covering a land area 22 times as large as Japan. Probablity is high, therefore, that the problem of distance consequent upon the vastness of land will remain one of the restrictive factors in future development. The best conceivable way to overcome this problem would be to

establish a navigation system connecting the Southern Atlantic and inland rivers because long-distance mass transportation costs far less by water than by other means. What is more, the Atlantic Ocean is generally very calm and its highest wave height is only about 2 m.

By the completion of the navigation plan on the Jacui and the Taquari which flow into Patos lagoon, vessels of 1,000 DWT or larger class will be enabled to navigate as far upstream as 300 km from Porto Alegre. If these vessels are allowed to sail on the outer sea by further navigation development, it will become possible to transport wheat, rice and other agricultural products directly from the producing area to Santos port and Rio de Janeiro port which are close to consuming areas, and this will open up the possibilities of transporting products turned out in the aforementioned sea-front industrial estate by coasters.

Table 4-2 Statistics of Cargoes Handled at Rio Grande Port (1968 - 1971)

Unit: Thousand t
Source: D.E.P.R.C.

Item	year	1968	1969	1970	1971
Ocean Navigation	Import	731,223	807,899	865,998	937,896
	Export	321,478	507,237	502,714	657,292
Coastal Navigation	Import	645,249	44,714	46,044	25,870
	Export	105,020	745,653	783,813	1,062,496
Lake Navigation	Import	15,134	463,681	365,743	467,739
	Export	720,410	21,118	38,489	34,047
River Navigation	Import	25,098	21,832	18,489	2,367
	Export	33,732	25,952	20,865	18,688
Sub-total	Import	1,416,704	1,338,129	1,296,274	1,433,872
	Export	1,180,640	1,299,960	1,345,881	1,772,523
Total		2,597,344	2,638,089	2,642,155	3,206,395

Table 4-3 Statistics of Cargoes Handled at Porto Alegre Port (1968 - 1971)

Unit: Thousand t
Source: D.E.P.R.C.

Item	year	1968	1969	1970	1971
Ocean Navigation	Import	325,740	341,186	375,585	387,825
	Export	344,217	368,900	376,576	459,893
Coastal Navigation	Import	99,709	100,238	126,541	91,999
	Export	92,682	127,105	252,038	518,901
Lake Navigation	Import	998,944	250,907	276,585	166,316
	Export	24,794	477,653	585,722	475,803
River Navigation	Import	1,666,706	1,653,038	1,910,896	2,313,499
	Export	67,984	26,979	3,032	4,054
Sub-total	Import	3,091,099	2,345,369	2,689,607	2,959,639
	Export	529,677	1,000,727	1,217,368	1,458,651
Total		3,620,776	3,346,096	3,906,975	4,418,290

Table 4-4 Statistics of Cargoes Handled at Pelotas Port (1968 - 1971)

Unit: Thousand t
Source: D.E.P.R.C.

Item	Year	1968	1969	1970	1971
Ocean Navigation	Import	3,023	1,700	1,463	493
	Export	665	586	-	4,737
Coastal Navigation	Import	5,024	8,656	4,047	8,164
	Export	29,249	24,258	62,567	108,788
Lake Navigation	Import	15,787	13,100	40,441	31,749
	Export	6,773	252,458	216,930	184,130
River Navigation	Import	6,855	4,600	2,210	64,658
	Export	2,131	1,018	518	160
Sub-total	Import	30,689	28,056	48,161	105,064
	Export	38,818	278,320	280,015	297,815
Total		69,507	306,376	328,176	402,879

Table 4-5 Existing State of Mooring Facilities at Rio Grande Port

Area	Depth	Extension	Type
Old Port Area	-8.7~9.6m	586	Wharf
New Port Area		2,082	
Super Port Area	-14m	160	Dolphin

Table 4-6 Berthing Efficiency at Rio Grande Port (1971)

Warehouse	A - 1	885 t/m year	150 m long wharf
"	A - 2	1,720 t/m "	150 m "
"	A - 3	656 t/m "	160 m "
"	A - 4	1,344 t/m "	150 m "
"	A - 5	1,663 t/m "	150 m "
"	A - 6	757 t/m "	160 m "
"	A - 7	525 t/m "	160 m "
"	A - 8	2,828 t/m "	170 m "
Pump District		6,285 t/m "	280 m "
Meat Exporte's Wharf		240 t/m "	220 m "
Petroleum Terminal		1,476 t/m "	332 m "

Table 4-7 Estimate of Cargo Handling Volume at Rio Grande Port

Unit: Thousand t

Commodity	Export/ Import	Year	Total	Rio Grande Port	Porto Alegre Port	Pelotas Port	Railway Road
Wheat	Inter-state export	71/72	1,440	720	360	70	290
		75/76	3,160	1,770	785	130	475
		80/81	4,440	2,670	980	135	655
Soybeans	Export	71/72	600	420	180	-	-
		75/76	1,790	1,530	260	-	-
		80/81	3,635	3,110	525	-	-
Pellet	Export	71/72	455	455	-	-	-
		75/76	755	755	-	-	-
		80/81	1,555	1,555	-	-	-
Rice	Inter-state export	71/72	870	870	-	-	-
		75/76	940	940	-	-	-
		80/81	1,025	1,025	-	-	-
Fertilizers	Import	71/72	515	515	-	-	-
		75/76	985	985	-	-	-
		80/81	1,380	1,380	-	-	-

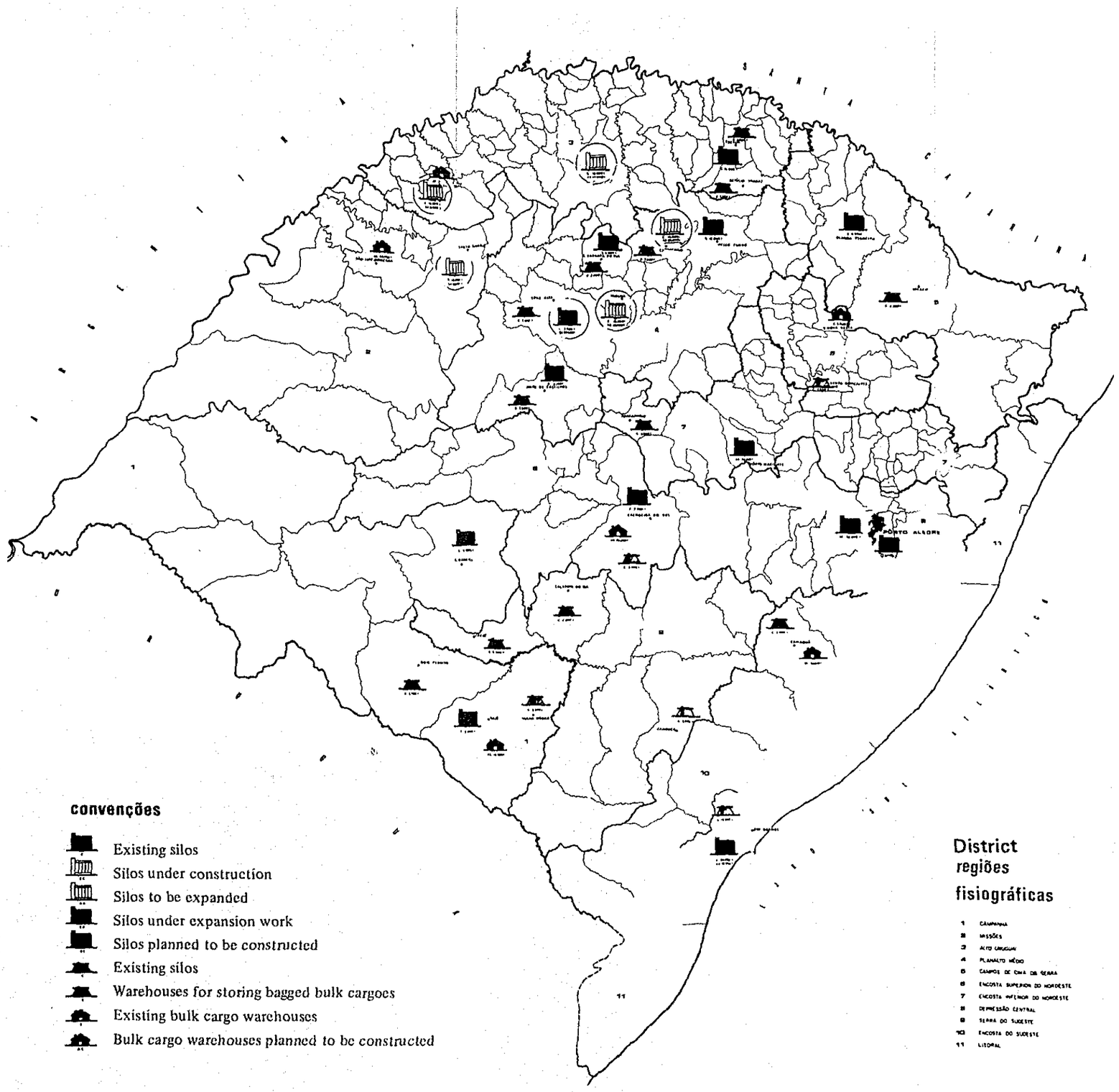


Fig. 4.1 **Distribution and Planned Construction of Grain Silos in Rio Grande do Sul State (CESA-Related Silos) Circles Indicate Silos to be Constructed under the Export Corridor Plan.**

Fig. 4.2 Canal Navigation Improvement Plan for the Taquari and the Jacui

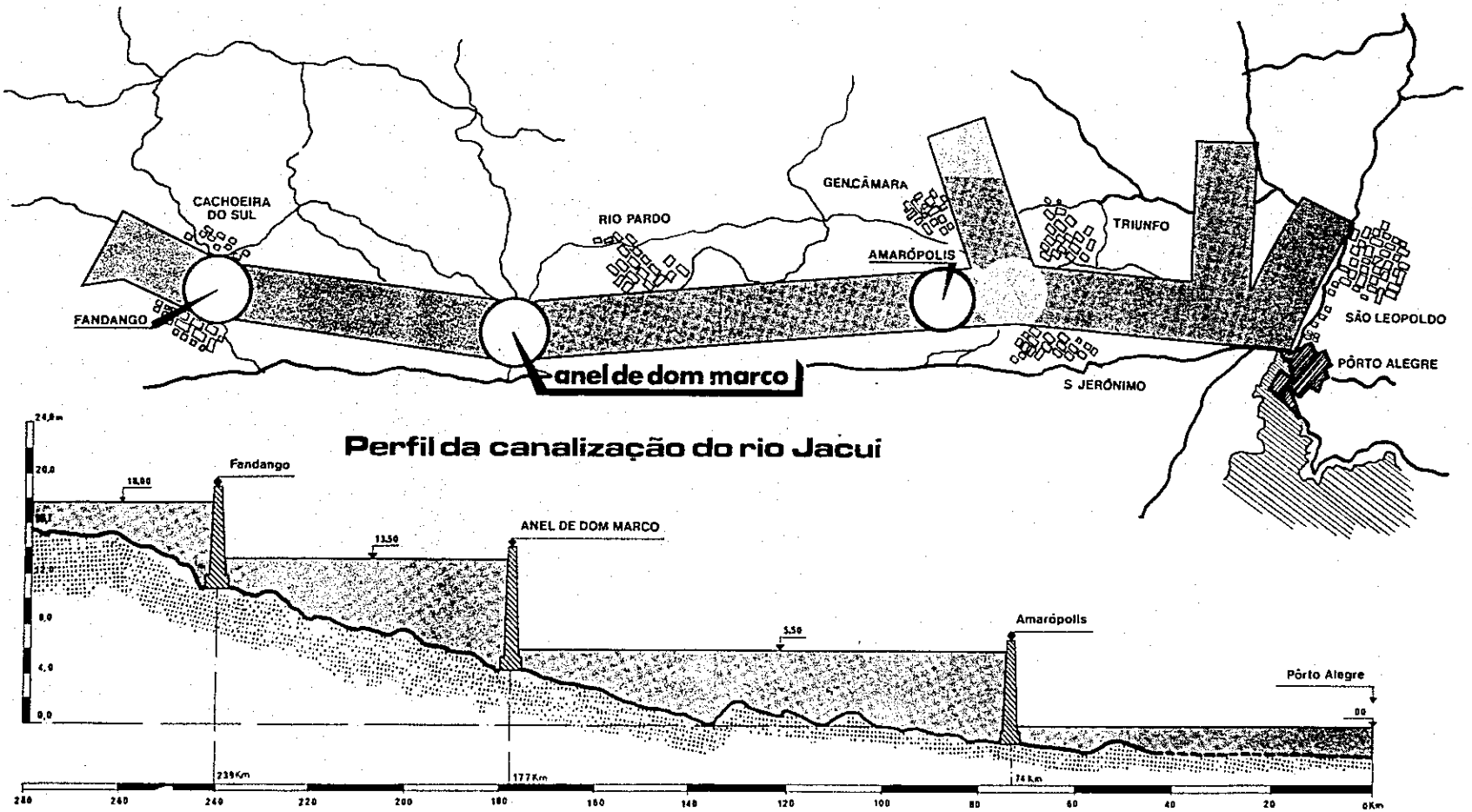


Fig. 4.3 Canal Navigation Improvement Plan for the Taquari and the Jacui

BARRAGENS DO RIO TAQUARÍ

Bom Retiro do Sul (PK 122) iniciada pelo DEPRC continuada pelo DNPVN
Represamento máximo 12 m
Estirão navegável 33 km

Arroio do Meio (PK 155) prevista
Represamento máximo 8 m
Estirão navegável 18 km

Roca Sales (PK 187) prevista
Represamento máximo 15 m
Estirão navegável 32 km

BARRAGENS DO RIO JACUÍ

Amarópolis (PK 75) em construção pelo DNPVN
Represamento máximo 6 m
Estirão navegável 103 km

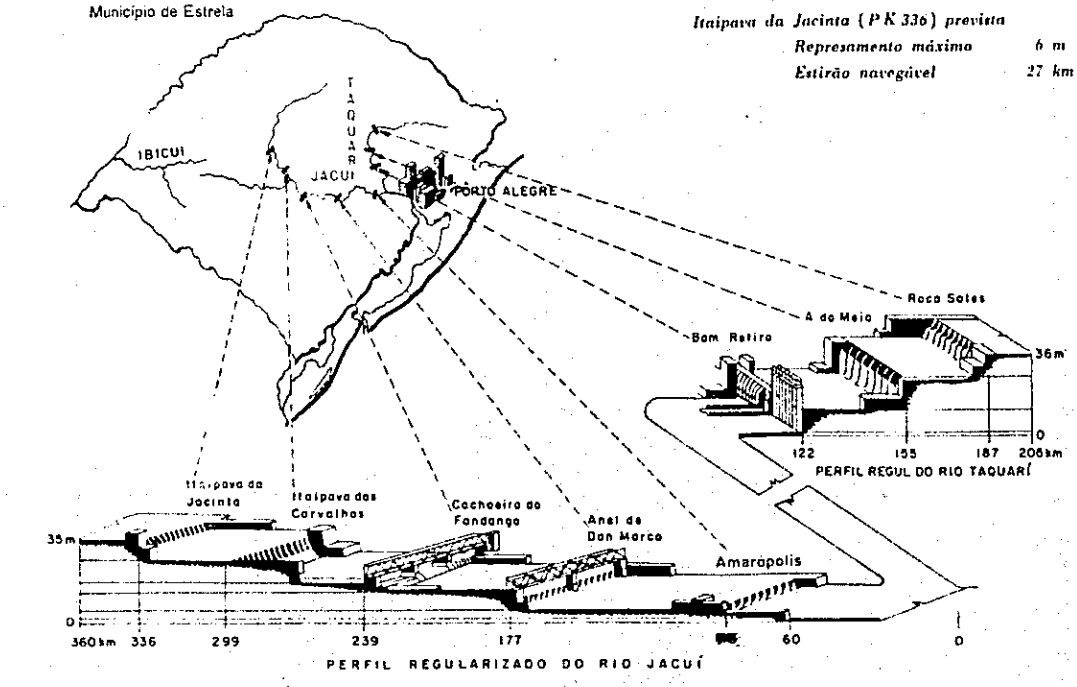
Anel de D. Marco (PK 177) construída pelo DNPVN
Represamento máximo 7,5 m
Estirão navegável 62 km

Fandango (PK 239) construída pelo DNPVN
Represamento máximo 4,5 m
Estirão navegável 60 km

Itaipava dos Carvalhos (PK 299) prevista
Represamento máximo 10 m
Estirão navegável 60 km

Itaipava da Jacinta (PK 336) prevista
Represamento máximo 6 m
Estirão navegável 27 km

ENTRONCAMENTO RODO-FERRO-HIDROVIÁRIO DO RIO TAQUARI
Município de Estrela



GRUPO IPRANGA

DEPOSITO DE CARVÃO

ENTREPOSTO FRIGORIFICO

FRIG

C-1

C-2

C-4

C-5

B-1

B-2

B-3

B-4

B-5

A-1

A-2

A-4

A-5

A-6

New Port

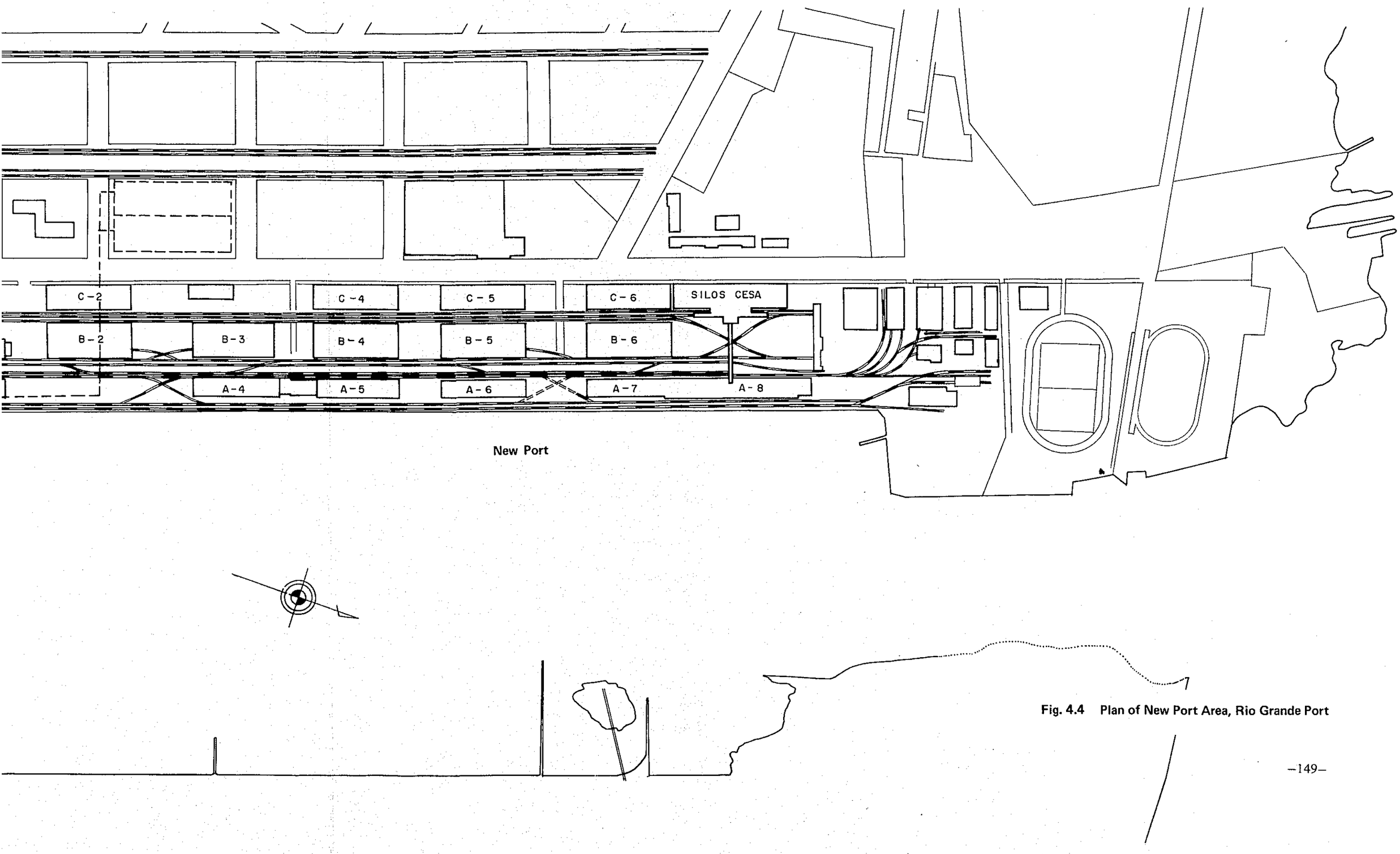


Fig. 4.4 Plan of New Port Area, Rio Grande Port

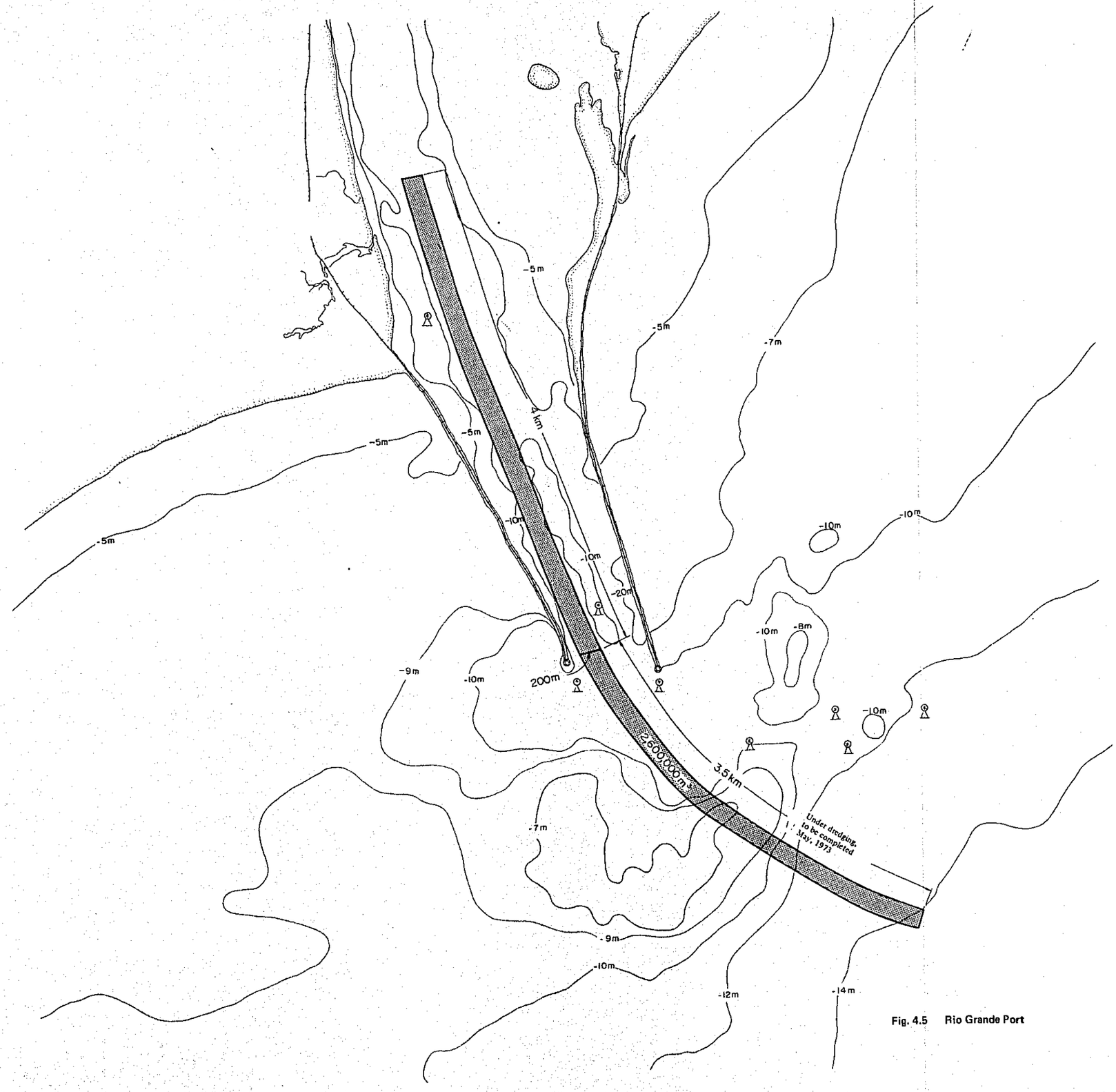


Fig. 4.5 Rio Grande Port

Fig. 4.6 Grain Loading Terminal of GOTRIJUI