CHAPTER 4.
FORECAST OF REGIONAL ACTIVITIES

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4-1 Population and Economic Structure

In planning a port, it is important to predict the change of the economic structure of the hinterland of the port and estimate its likely volume of cargoes. Assuming a future economic structure is a major undertaking and involves complicated work. The advance of econometrics has contributed to the increase of precision of this predicting work.

But to make metric estimation, a great many past data are necessary and, in planning for the Port of Irene, this is almost impossible. So, with respect to the future of the regional economy concerned, the "Development Plan" of the Philippine Government as the basis are used, as described later. As far as the results of compilation and analysis of data collected are concerned, there are no factors that require any drastic amendment of the "Development Plan".

The development of Region II has been promoted under the Cagayan Valley Five-year Development Plan (hereinafter referred to as the Five-year Plan), which predicts the expected values of accomplishment in 1987, although the target year is 1982. The year of 1987 falls on the target year of the development project of Port of Irene. Under the situation, the development of the Region II will reach, in 1987, what the Five-year Plan has aimed at, while the target values in 2000, which is the target year of Master Plan, shall be prepared based on those provided in the Long-term Philippine Development Plan up to the Year 2000 (hereinafter referred to as the Plan for the Year 2000).

The Five-year Plan has forecasted the population of the Region in 1987 to be 2,696 thousand (Table 4-1). According to the reported value of 1980 Census, the population in the said year was 2,220 thousand, which is slightly below the forecasted population of 2,208 thousand in the Five-year Plan. The population in 1987 is estimated at 2,730 thousand based on the Census figure and the increase rate in the Five-year Plan. The population in 2000 is forecasted in the Philippine Statistical Yearbook 1979. The forecasted population (Medium Assumption) for 1980 in the Yearbook slightly differs from that in the Census 1980. Therefore, the population in 2000 was obtained in the following manner: the estimated population for 1980 had been rectified with the actual population for that year, and the rate of expected population increase from 1981 onwards would be assumed to be the same as that forecasted every five years in the Statistical Yearbook. The estimated population in 2000 is 3,830 thousand. Strictly speaking, however, the forecasted population for 1987 is different in nature from that estimated in the process of forecasting the population for the year 2000. But no particular consideration is given to this matter, since such difference does not seem to seriously affect further study.

Table 4-1 Projection of Population, Region II

(.000 Persons)

	1975	1978	1979	1980	1987	2000
Philippine	42,071*			48,510*		80,178
Region II	1,933*		2,159*	2,220	2,730	3,830
Five Year Plan for Region II	1,904	2,093	2,150	2,208	2,696	

Source: * Philippine Yearbook 1979

The general view on the GRDP (GVA-wise) economic activities in Region II is illustrated in the following. The past activities of the Region are shown in the following Table 4-2.

The actual GRDP values for both 1979 and 1978 fulfill the target values set in the Five-year Plan. The average growth rate for the period from 1975 to 1979 was 10.18 percent which is considerably higher than the target value of 9.17 percent, although the yearly values largely fluctuate in the range between 5 and 15 percent. From the GVA's sector-wise viewpoint, there is a different trend between the target values and the actual values. That is, the share of the agriculture sector decreases whereas that of the other two sectors steadily increases. The decrease in the share of the agriculture sector seem to be caused by the fact that an export restriction has been imposed on the material log business and that the palay production has not reached its target level due to delay in provision of necessary irrigation facilities. On the other hand, the industry sector's high growth rate has been supported by booming construction works such as of the Magat dam, Chico river dam and various irrigation facilities.

Table 4-2 Gross Value Added by Region II (1975–1979)

(1972 Prices, Million Pesos)

	1975		1976		1977		1978		1979	
Philippine			73,631		77,990		82,566		87,328	
Region II	1,774	100	2,040	100	2,149	100	2,329	100	2,615	100
Agriculture	1,157	65.2	1,033	50.6	1,062	49.4	1,160	49.8	1,310	50.1
Industries	208	11.7	414	20.3	431	20.1	499	21.4	602	23.0
Services	410	23.1	593	29.1	656	30.5	670	28.8	703	26.9
Five Year Plan	1,774		—		—		2,342		2,520	

Source: NEDA, Statistical Coordination Office, Five-Year Plan

Such a change in structural shares in GVA, however, does not always mean the definite change of economic structure in Region II. Because the scheduled palay production increase,

which will be secured by successful construction of the irrigation facilities, will help raise the production of the agriculture sector, while completion of the construction of the dams and other related works will inevitably compel the production of the industry sector to stagnate to some extent. The services sector, although it is difficult to forecast its growth, has had no sign of change. In due consideration of these matters, the GRDP growth rate up to 1987 shall be target at 10.0 percent per annum, which is higher than that presented in the Five-year Plan but lower than the actual values achieved in the past years. The predicted GRDP for 1987 is 5,600 million pesos, whereas the Five-year Plan forecasted it at 4,953 million pesos.

The GVA structure for 1987 is expected to be Agriculture 50 percent, Industry 26 percent and Service 24 percent. According to the Five-year Plan, the future economy of Region II is defined so that the agriculture sector should be emphasized more than the other two. Although the Region's economy is largely dependent upon agriculture at present, the development of the industry sector is the most effective and shortest way to catch up with the economically advanced regions of the country. Based on this fact in the GVA structure for 1987, the share of the industry sector's production shall be slightly increased from the previous level.

Table 4-3 Forecast of Gross Value Added of Region II

(1972 Prices, Million Pesos)

	1979		1987		2000		Growth Rate (%)	
							'79–'87	'87–2000
Region II	2,615	100	5,600	100	16,700	100	10.0	8.8
Agriculture	1,310	50.1	2,800	50	7,014	42	10.7	7.3
Industries	602	23.0	1,456	26	5,511	33	10.9	10.8
Services	703	26.9	1,344	24	4,175	25	7.8	9.3

In the next step, the GRDP for the year 2000 is estimated. The Plan for the year 2000 aims at correcting the regional disparity in gross domestic product (GDP) per capita. The said Plan proposes that the GDP per capita of Region II should be lifted up to 76.1 percent of the national average. Judging from the actual results obtained, the disparity in GDP per capita of the Region will be narrowed by some 10 percent within 20 years. The GRDP of Region II in the year 2000 is estimated at 16,700 million pesos taking into account the population of the Region in that year. The estimated value of the GRDP in 2000 means that the economy will grow at the annual rate of about 8.8 percent from 1987. The Plan for 2000 forecasts the national average growth rate of the GDP will be 8.0 percent. Consequently, the expected value of 8.8 percent for Region II is considered reasonable.

The NGA report expects the GRDP of the Region in 2000 to be about 19,000 million pesos, which, if realized, will correct the regional disparity by 87 percent or so.

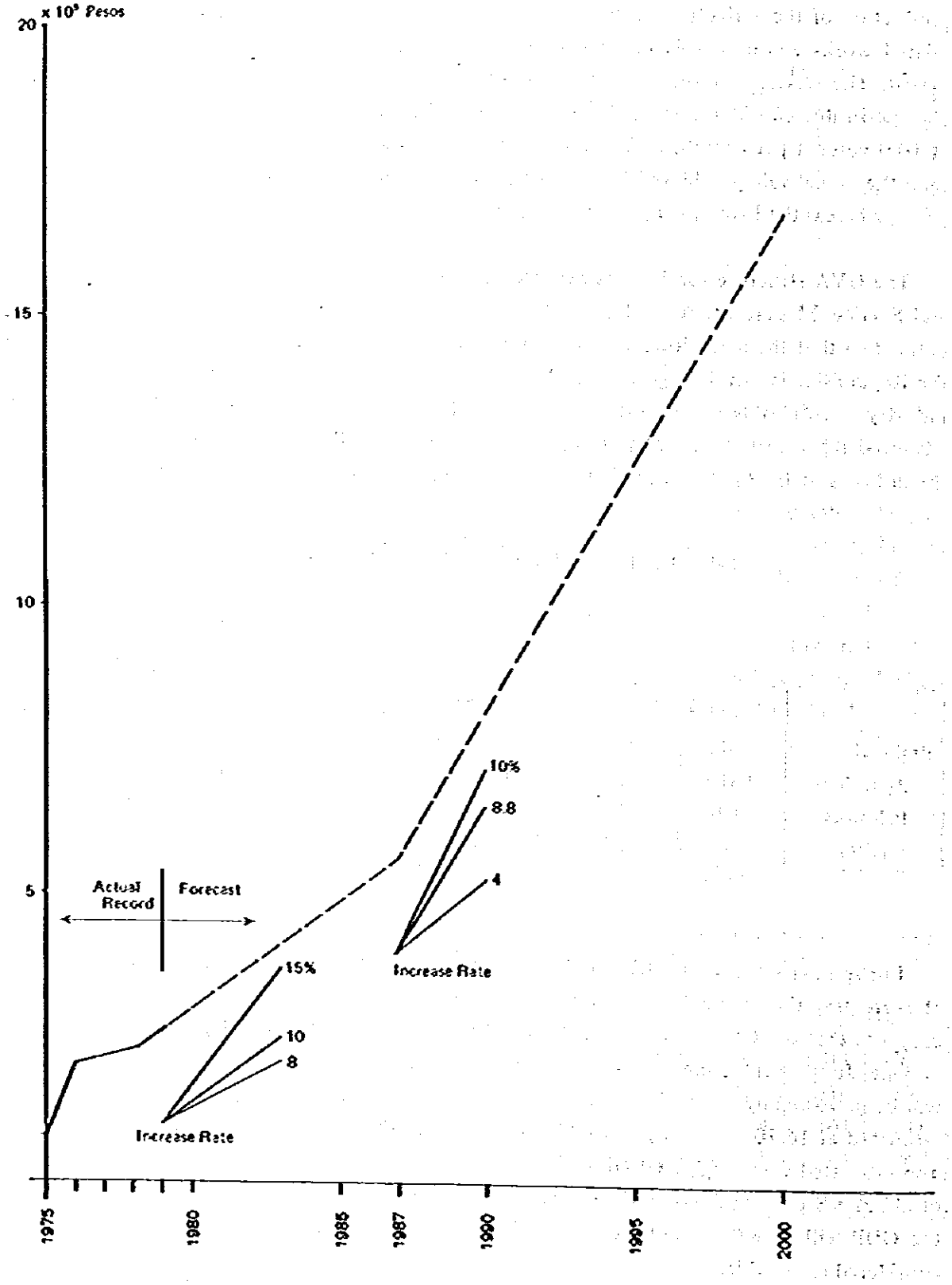

Fig. 4-1 Projection of GVA in Region II

Table 4-4 Per Capita Gross Domestic Product in Region II

(In peassos at 1972 prices)

	1975	1976	1977	1978	1979	2000
Philippines	1,617	1,699	1,756	1,815	1,875	5,724[1]
Region II	917	1,025	1,054	1,115	1,222	4,356[2]
Disparity	56.7	60.3	41.4	65.2	65.2	76.1[1]

Source: 1) The Plan for the Year 2000
2) Estimated from national value and disparity of 2000

4-2 Condition of Regional Development in 2000

The structure of the regional economy of Region II as of 2000 is assumed in accordance with the Plan for the Year 2000, as stated already.

But to prepare a port plan for the Port of Irene, it is necessary to assume more specifically the change of the regional structure, particularly the change of port-related economic activities, especially because various development projects are being planned or are in progress in hinterland of Port of Irene and the trends in these projects must be predicted and, if necessary, reflected on the port plan as a matter of course. Hereunder is the assumption of the conditions of the main projects as of 2000.

The port development plan for 2000, the target year of the master plan, must presuppose that regional development taking advantage of the abundant natural resources is well underway. And the master plan must be such that it makes the realization of this regional development program possible. Those of the coastal industries which suit Region II will include fish and fruit canneries, feed mills, cement mills, limestone found in the vicinity of Santa Ana, wood processing plants and fertilizer plants. These are, indeed, important in that they not only can make effective use of resources but also mean the creation of opportunities for the employment of inhabitants its vicinities. Basic industries formed through the effective use of local resources will be the foundation for realizing heavy and chemical industries in the future.

Fishery resources are abundant in Region II, particularly the Pacific side. At present, these resources are hardly utilized due, partly, to the fact that the domestic market for them is still undeveloped. The production of pineapples and other fruit and carabeef, beef and other meat can be expected to increase hereafter but there is no plan to process them and transport them to other areas including foreign countries.

The Philippine canning industry is at a high level of production techniques, as exemplified by the production of canned pineapples in Mindanao. It would, therefore, be the availability of large quantities of superior water, rather than a technical problem, whether a cannery can be constructed in the vicinity of the Port of Irene or not. It is also important to clearly define the

programs of production increase of fishery products, meat and fruit proposed for the hinterland of the Port of Irene and arouse the interest of related companies in these programs. Establishing the functions of processing fishery products, meat and fruit and the mutual supplementation of producing seasons would also be worth studying. In any event, it is considered important to incorporate a fishing port area into the Port of Irene project. The construction of canneries is certain to greatly contribute to the development of fisheries, and so on.

As for feed mills, the construction of one is now in progress at province of Isabela with the object of supplying the hog and poultry growers in Region II and also exporting products to foreign countries.

Constructing another feed mills in Region II seems to be necessary in view of the production of corn in Region II, the distribution of consumer areas and the transportation of products.

A plan to construct feed mills at three places in the province of Cagayan reportedly is being studied at present. It is believed that under this plan, the construction sites are being studied according to the distribution of producing areas and the conditions of transportation of processed goods. In this connection, it would be advisable to delve further into the merits of marine transportation.

For the convenience of exportation and transportation to other parts of the country, this mill had better, if possible, be located near port of Irene. Thus, corn producers and the NFA can select whichever feed mill involves a lower transportation cost. The consumers will also enjoy a lower cost benefit.

As for grains, the Port of Irene might be used to receive some of the wheat, soybean cakes, etc. imported from the U.S.A. and Canada, thereby easing the congestion of the port of Manila now used for this purpose. But in realizing this plan, it is necessary to study complicated factors including the weighing of the advantages and disadvantages of using the Port of Irene as a base for this import, especially in view of the increasing self-sufficiency of wheat and the national network of marine transportation. So, this is put aside in planning the present port project.

There is still no cement mill in Region II. However, limestone is known to exist in Sta Ana. The environmental conditions for the production of cement are changing. Coal is replacing oil as fuel required to produce cement. A cement mill located inland near a limestone producing area will be faced with the problem of mass transportation of coal. The ability to cut the cost of coal transportation will profoundly affect the competitive power of a cement mill in the cement market. If a cement mill has to depend on coal brought from abroad or from other parts of the country, it must by all means be located in a coastal area.

Further, if coal is to be developed in Region II, the development must, of course, presuppose transportation to other areas, foreign and domestic. In other words, coal must be transported through ports. So, a cement mill using coal to be developed in the region must be located on the coast. A cement mill constructed near port of Irene will be convenient also for the transportation of its products to foreign countries and other parts of the Philippines.

The cement mill whose construction at Sta Ana is being studied reportedly will have a daily production capacity of 3,000 tons. To ensure this production, about 90,000 tons of coal, about

900,000 tons of limestone and about 260,000 tons of clay, etc. will be annually required provided that the rate of operation of the mill is 70%.

Region II produces an abundance of wood. Due, partly, to the government restriction on the export of logs, the export (and domestic shipment) of lumber is increasing. Furthermore, the production of plywood and veneer, with their high added values, has increased in recent years. In the future, it is desirable to further diversify products and thereby stabilize production. There are, for example, desks, chairs, blackboards and gymnastic equipment that are used at schools. Also, there is the possibility of producing high-class furniture primarily for export to Europe since wood produced in Region II resembles African mahogany. Since these are all products from locally available materials, their production may well be realized by taking advantage of the existing collection system for lumber at Port of Irene although it involves such problems as the training of technicians and the development of markets.

It is difficult to metrically estimate port cargoes related to this but it must be considered as a factor in planning the port for 2000.

The Export Processing Zone Authority (EPZA) and the other Organizations concerned are promoting the establishment of Irene-EPZ.

This project is specifically the establishment of an export processing zone in the area situated along the coast from Tapel River, Gonzaga, Cagayan, to San Vicente, Sta. Ana, Cagayan.

Initial action undertaken by the Philippine Government towards the realization of the project is Presidential Proclamation No. 1265, which announces that the 400 hectares of land from the boundary along Tapel River in Gonzaga to San Vicente, Sta. Ana be reserved for Port of Irene and an Export Processing Zone, that will be established. Another action is the inclusion of Casambalangan, Sta. Ana by the EPZA as one of the areas to be developed and has scheduled development for year 1984. And for 1983, CIADP in coordination with Ministry of Public Works and Highways has programmed the physical palnning of the area. This activity was provided for in the regular budget of CIADP for 1983. Last year (1981), survey in the area was undertaken by the Bureau of Lands, and for this year parcellary mapping is currently being undertaken.

Generally, the relation between EPZ and a port is rather small, judging from the example of Bataan-EPZ, because EPZ consists mostly of light and medium industries and does not handle raw materials and products that require mass transportation. But this does not deny the necessity of a port related to EPZ.

Bataan-EPZ, which is close to the port of Manila, uses this port for export and import and the two places are linked by truck transportation. But in the case of Irene-EPZ, using Manila port for export and import is totally uneconomical because of additional transportation cost. Hence, the relation between Irene-EPZ and Port of Irene will become important.

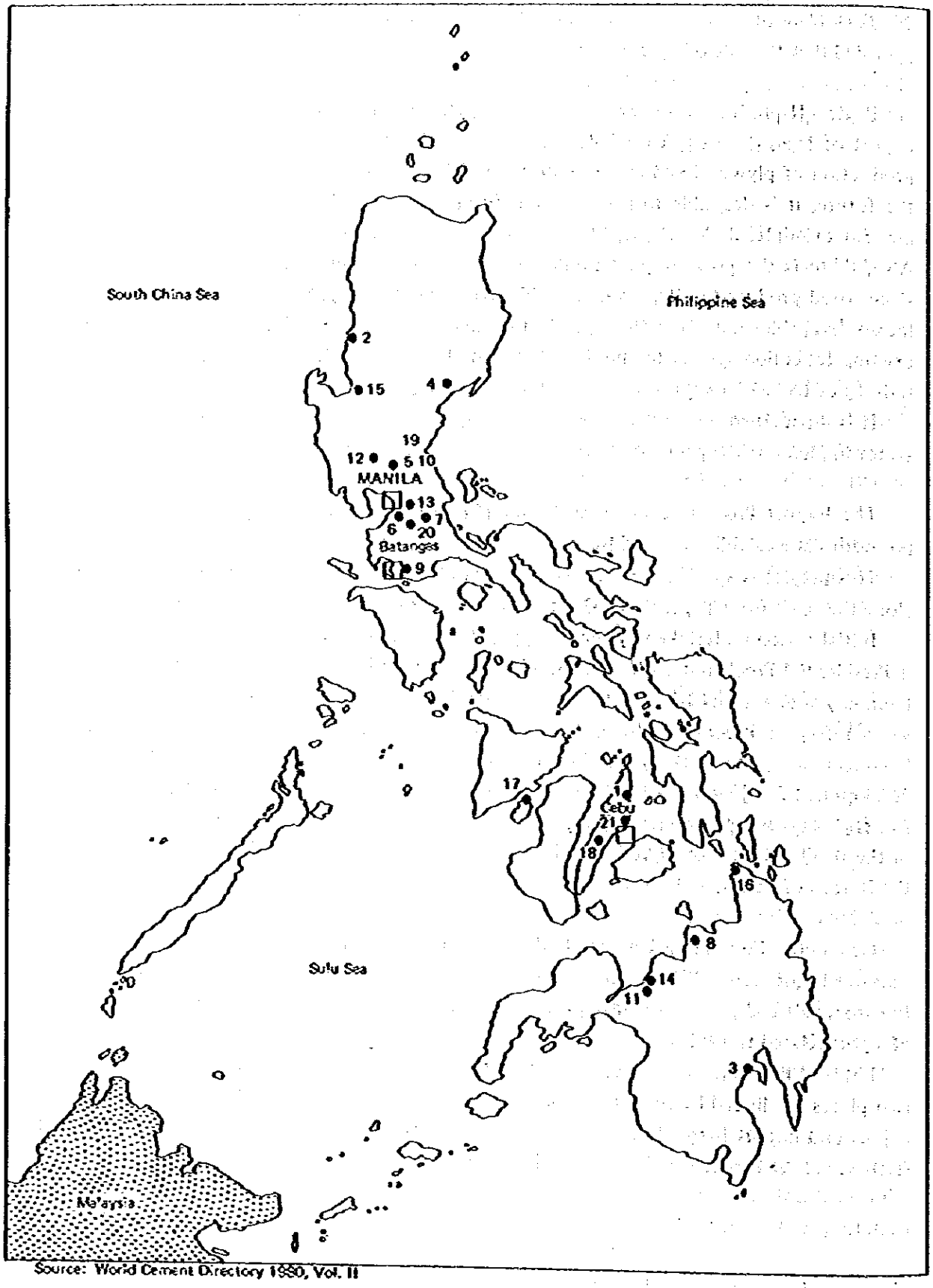

Fig. 4-2 Cement Factory in the Philippines

The relation between the two cannot yet be clearly seen since the EPZ plan is not still concrete. However, the improvement of Port of Irene is most important as a sales point necessary for the realization of Irene-EPZ. Reversely, the definition of the Irene-EPZ plan will accelerate the development of Port of Irene. The relation between the two is clearly one of mutual supplementation.

The effect of Irene-EPZ on the master plan differs by the types of industries to be constructed for the EPZ. Irene-EPZ reportedly proposes to process coarse materials at the EPZ and export them to Japan, the Republic of Korea and Taiwan which lie at relatively short distances from Port of Irene. If the export is mainly to Japan and the Republic of Korea, goods exported will be either finished goods or intermediate processed goods close to finished goods. These goods can hardly be bulk cargoes. The types of goods to be imported cannot yet be foreseen.

Container transportation in foreign trade is developing under a strict economic principle. The base of the Philippine foreign-trade container transportation is the international port of Manila. Judging from the geographical distance between port of Manila and Port of Irene, the volume of container cargoes estimated from the economic structure of the sphere of hinterland of Port of Irene and the conditions of the foreign trade container network in Southeast Asia, it is highly improbable for Port of Irene to become a foreign trade container base.

Domestic container transportation has yearly increased. Container transportation, started in 1975 between port of Manila and port of Cebu, expanded the container run network and the transportation volume increased from 44,000 TEUs in 1978 to 134,000 TEUs in 1980. The runs consist mainly of direct calls between port of Manila (North Harbour) and regional ports.

The amounts of container cargoes handled by the Philippine ports other than port of Manila are by far the largest at port of Cebu and port of Davao. Container runs other than the one with North Harbour are between Davao and Zamboanga, between Cagayan de Oro and Iligan, between Cebu and Iloilo and between Bacolod and Iloilo. Container ships now in use are as shown in Table 4-5. They are mostly in the 3,000–4,000 DWT class and their transporting capacity is about 130 TEUs. Cargoes now handled by container transportation comprise general cargoes, agricultural products, cereals and animal feeds, processed food and beverages, lumber/plywood/veneer, etc.

It is extremely difficult to estimate the volume of container cargoes in the total cargoes of Port of Irene as of 2000. This is because of the difficulty in estimating the progress of regional development in Region II and the extent of change of the formula of marine transportation, for example, the use of ships specialized in the transportation of palay, etc. But in the light of the volume of cargoes in the year 2000 to be described later, it is small wonder if container ships are on the run between Port of Irene and port of Manila by that time. Let it be assumed that weekly service container transportation is then available between the two ports. Supposing that the size of ships used in 3,000 DWT and their loading capacity is 130 TEUs, the annual volume of container cargoes concerned is about 100,000 tons. It is, indeed, likely that in 2000, the volume of these container cargoes will be 100,000 tons or so. The volume may be even larger, depending

Table 4-5 Description of Domestic Containership Fleet

Ships	DWT	LOA (m)	TEU Capacity	Routes and Frequency
Concarrier I	4,833	97.0	172	Manila-Cebu 5 days round trip
Concarrier II	3,450	85.5	126	Manila-Davao 7 days round trip
Concarrier III	2,400	82.0	130	Manila-Cagayan de Oro, 7 days round trip
Concarrier IV	1,700	65.3	64	Manila-General Santos, 7 days round trip
Concarrier V	1,345	65.5	69	Manila-Davao 7 days round trip
Concarrier VI	5,486	97.0	220	Manila-Cebu 5 days round trip
(1) P. Aboitiz	3,569	89.4	160	Manila-Cebu 5 days round trip
Wilcon I	3,618	99.3	122	Manila-Davao 7 days round trip
Wilcon II	3,400	84.0	88	Manila-Cebu-Iloilo, 7–9 days round trip
Wilcon III	2,199	91.0	66	Manila-Davao-Zamboanga, 8–9 days round trip
Wilcon IV	4,822	102.3	40	Manila-General Santos, 7 days round trip
Wilcon V	3,738	76.8	128	Manila-Cagayan de Oro-Iligan 7–10 days round trip
(2) Dona Virginia	2,100	143.6	56	Manila-Cebu 3 ½ days round trip
Davao Transport	4,300	92.4	146	Manila-Davao 7 days round
(3) Sulcon I	3,500	83.8	109	Manila-Davao 7 days round trip
Sulcon II	5,897	96.5	124	Manila-Cebu 6 days round trip
Panay	1,980	85.3	105	Manila-Davao 10 days round trip
San Sebastian	4,431	86	200	Manila-Baçolod-Iloilo, 7 days round trip

Source: Manila port project, Domestic container terminal, PPA.
Note: (1) P. Aboitiz sank in November 1980.
(2) Dona Virginia is a "luxury container – passenger ship".
(3) Sulcon I was lost due to foundering in September 1980.

on the economic development in the sphere of hinterland of Port of Irene, and container ships of the 5,000-DWT class may be on the Manila-Irene run.

Feasibility study has already been made for the development of black sand. According to the report concerning this study, the plan proposes to develop for 15 years the approximately 9,000 thousand tons of black sand deposited along the coast from the estuary of the Cagayan River to Claveria. The black sand will be transported overland by trucks from the place of mining to the point of shipment at Claveria and exported from there by 30,000 DWT ore carriers. The outline of this project concerned with the port plan is as follows:

Amount to be mined	Approx. 10,000 thousand tons
Period of mining	15 years
Annual shipment	600 thousand tons
Stockpile	200 thousand tons
Maximum height of stockpile	15 m
Weight per unit volume	2.6 t/m^3
Capacity of cargo handling equipment used for loading	700 t/h
Ore carriers	20,000 – 30,000 DWT
Full draft	–9.2 m – –10.3 m
Planned depth	13 m

Detailed studies are necessary to see if port facilities meeting the above plan can be constructed at Port of Irene. But the success of this project seems to depend on whether the cost of land transportation from the place of mining to Port of Irene can be absorbed by the export price. In the future, it is necessary to study as to whether the amount of volume that can be mined economically exist on the east side of the estuary of the Cagayan River and whether the cost of land transportation from the west side can be absorbed. It can be said that Casambalagan Bay has sufficient space necessary to provide these facilities.

It can be expected that, with the progress of development of the infrastructure in Region II, main roads related to the Port of Irene will have been completely improved by 2000 and have no difficulty in the use by heavy trucks. Also, it is believed that power distributing and transmitting equipment, water supply equipment, communications equipment and other basically necessary equipment of a city will have become available to the extent of supporting regional development. These can well be achieved in view of the steady growth of the Philippines economy and the degree of accomplishment of the Five-Year Plan.

Among of these infrustructure development plans, the energization program in Region II is as follows:

This project is phased into three stages to be accomplished in a span of 10 years starting 1979, through large capacity hydroelectric plants in Magat and Chico River and the Ambuklao Power Plant.

1st Stage 1979–1982:

At this stage, all municipalities in the Region will be linked with each other by 13.2 KV trunk distribution lines (69 KV transmission lines and sub-stations will be provided in some municipalities) and low voltage distribution lines will be extended to cover main barrios in each municipality where high investment efficiency can be expected. Residential electrification rate will be 33.6% by 1982.

At this stage, the power plant at Magat had been switched on last September 9, 1981, which marked the flow of electricity from the Magat River hydro-electric plant to serve Region II and this month (February, 1982) installation of distribution lines had been completed in Sta. Ana, which started the energization of the town.

2nd Stage 1983–1984:

In this stage, distribution lines will be built in all the barrios and the rate of residential electrification will be raised to 50% and the necessary facilities for supply of power to irrigation projects, industrial plants such as agricultural processing plant, ice plant, sugar refinery, sawmill and public facilities, all of which are expected to be developed by then, will be provided in 1984. Three additional sub-stations will be required at this stage.

3rd Stage 1985–1990:

The rate of residential electrification in Region II will reach almost 100% by 1990 and extension of transmission lines, installation or expansion of sub-stations and expansion of distribution networks will be carried out to meet the increased demands of irrigated projects, various industries following the expansion of industrial activities and public facilities and also of the tertiary industry including educational, recreational and transportation facilities for modernization of communities in Region II. Five additional sub-stations will be provided at this stage.

4-3 Future Prospect of Ports in Region II

The PMU Irene is the authority to administer all of the ports located in Region II. The cargoes handled in the ports under the PMU Irene administration amount to about 200 thousand tons per annum. The major handling items are material wood and petroleum products. The said authority administers ten ports in the Region, the main ports of which are Port of Irene, port of Aparri, port of Claveria, and port of San Vicente. There are no well equipped port facilities except Port of Irene in the Region. The PPA has a plan to upgrade Port of Irene but there are only maintenance plans for other ports.

Port of Aparri, with long history is provided with such organizations as customs office, quarantine, etc. The city of Apari, developed as a distribution center of various goods in the area has effective commercial functions such as financing, wholesaling, and collecting information. In addition, the city is located so conveniently at the northern end of the Pan-Philippine Highway that it has an advantage in inland transportation. Consolidation of the necessary port facilities is

essential to develop the city as a modern port city. Port of Aparri has been handling a considerable amount of material wood and petroleum products, which is expected to be the main cargoes in future as well. Upgrading of the port of acilities, however, may be difficult since it entails a large investment and further development of the port is hardly expected either quantitatively or qualitatively.

Port of Claveria is officially a government controlled port, but, in reality, it is managed by local enterprises. Main cargoes are limited to logs and wooden products. They are offloaded due to lack of the necessary port facilities. The future development of the hinterland and increase in handling cargoes can be little expected even if port of Claveria is benefited by improvement of the road network between Claveria and Magapit. On the other hand, when the transportation facilities are improved, it is more likely that the straw effect of Port of Irene would be strengthened.

Port of Maconacon is privately operated and it specializes in the handling of the wooden products. The road network between the port and its hinterland is extremely poor and this unfavourable situation is expected to remain unchanged, preventing the port from functioning as the keystone for the development of the area.

It is improbable that the functions of ports under PMU Irene, with the exception of the Port of Irene, will have greatly changed by 2000, much less by 1987. Thus, cargoes in Region II will be increasingly attracted to the Port of Irene when it is improved, the local goods collecting structure is strengthened and the level of various services at the port improves. With the growing tendency for cargoes related to Region II to be concentrated on the Port of Irene, the other ports will function as a feeder port for the Port of Irene. Particularly, the Port of Irene will be central to the flow of foreign trade cargoes and it will also be necessary to initiate measures aimed deliberately to encourage this tendency.

CHAPTER 5.
PREDICTION OF PORT ACTIVITIES

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5-1 Cargo Traffic in 1987

1. Macroscopic Estimation of Cargo Volume

The cargoes generated in the hinterland are closely linked with the regional economic activities. In general, forecast of the amount of port handling cargoes is made on the basis of the economic indices. The indices commonly used for such estimation are those of population, gross regional development product and production of manufacturing and minings. When no major changes in regional economic structure and social structure are observed, yearly values of these indices and the amount of the port handling cargoes can be employed for the estimation.

The macroscopic analysis of future amount of the port handling cargoes in Port of Irene is hardly possible by the conventional method, because for one thing, the yearly data are not available. In addition, since the hinterland of each port in Region II overlaps and thus ambiguous, it is logically impossible to estimate the amount of the cargoes at Port of Irene with reference to the economic indices of its hinterland.

In making necessary estimation, the cargo volume of the entire PMU Irene in 1987 is first estimated in relation to the economic indices for Region II and the cargo volume of the cross section. The remainder obtained by deducting the present cargo volume of ports under PMU Irene other than the Port of Irene from this estimated value is deemed to be the cargo volume of the Port of Irene in 1987. This is based on the assumption that the cargo volumes (port capacity) of ports other than the Port of Irene in 1987 are the same as their present cargo volumes.

The first method employs the relationship between the cargo amount handled in PMU Irene in 1979 and GRDP of Region II in 1979. The cargo handled in PMU Irene in 1979 totaled about 218.5 thousand tons (including 20.8 thousand tons for Port of Irene).

Table 5-1 Cargo Tonnage of PMU Irene, 1979

Port / Trade	Aparri	Irene	Claveria	Maconacon	Total
Domestic	76,685	2,968	4,174	0	83,827
Foreign	72,532	17,839	19,643	24,694	134,708
Total	149,217	20,807	23,817	24,694	218,535

Source: 1979 Statistical Yearbook.

On the assumption that the amount of the cargoes increase along with the growth of GRDP of Region II after 1979, the amount of cargoes to be handled by PMU Irene in 1987 is forecasted 469 thousand tons. If the capacity of port of Aparri and other existing ports in the PMU Irene

remain unchanged until 1987, the amount of the cargoes to be handled at Port of Irene in that year will be about 271 thousand tons. For further information, the rate of increase of the cargo handled by Port of Irene to the GRDP growth rate in the Region (elasticity index) is 1.006.

The second method of estimation employs the population factor. Per capita amount of the port handling cargoes of the certain regions is assumed to have almost the same value in any given region under the same conditions in terms of economic scale and structure, and geography. As shown in Table 5-2, there is a considerable difference in the values of per capita cargo amount handled by PMU San Fernando and PMU Legaspi from that by PUM Irene. The difference indicates that the economic structure of Region II is such that the dependency on the maritime transportation is minimum and that the PMU Irene is less active in its port transaction.

Table 5-2 Per Capita of Cargo Handling Volume by PMU

PMU	Region	Cargo 1979 (000 ton)	Population 1975 (000 head)	Per Capita Cargo
San Fernando	I	1,276	3,270	0.390
Irene	II	219	1,904	0.115
Legaspi	V	740	3,194	0.232
Tacloban	VIII	1,208	2,600	0.465
PPA	Philippine	75,143	42,071	1,786

Note: Per capita of Cargo in San Fernando is 0.207 to the exclusion of copper and related items.

If the economic structure and the living standard of a given region do not change from what they are at present, the port handling cargo amount will increase at the rate of the population growth. Generally, both the economic structure and the living standard change year by year and the increase ratio of cargo amount exceeds the rate of population growth and this trend is particularly remarkable in the developing regions. In the case of PMU Irene, however, due to the delay in provision of social infrastructure to support port activities, the increase rate of port cargoes is lower than that of the economic expansion and development. When the per capita cargo amount to be handled by PMU Irene in 1987 is assumed to reach 0.161, the average of PMU Irene present value and that of geographically similar PMU San Fernando (excluding copper and related items), the amount of port handling cargoes by PMU Irene in 1987 can be estimated at 436 thousand tons based on the per capita cargo and population. The average growth rate between 1979 and 1987 will be slightly below 9 percent. If other ports in the PMU Irene continue to handle approximately the same amount of cargoes as present, the cargo amount handled at port of Irene will be about 238 thousand tons in 1987.

2. Selection of Major Cargo Item to be Handled

Study of the kind and type of handled cargoes is important in port planning. The major cargoes handled at Port of Irene are estimated with reference to the data and information on the

national trend and to the regional characteristics because no substantial data are available for Port of Irene. According to the 1979 Statistical Yearbook (PPA), conventional cargoes handled in large amount are listed in Table 5-3.

Table 5-3 Major Cargoes Handled at Main Ports in the Philippines

	Base Port	Sub Port
Outward	Corn	Copra
	General Cargo	General Cargo
	Copra	Empty bottles
	Palay & Rice	Palay & Rice
	Consumer goods	Corn
	Empty bottles	Molasses
	Animal feeds	Live animal
	Sugar	Seaweeds
	Other cereals	Coal
	Bottled cargo	Fertilizer
Inward	General Cargo	General Cargo
	Corn	Cement
	Petroleum Products	Bottled Cargo
	Copra	Petroleum Products
	Consumer Goods	Fertilizer
	Cement	Corn
	Palay & Rice	Consumer Goods
	Bottled Cargo	Palay & Rice
	Lumber & Logs	Metal & Metal Products
	Empty Bottles	Copra

The items cited herein are classified into four categories. Corn, general cargoes, copra, palay and rice can be found in all four categories, and consumer goods, empty bottles and bottle cargoes can be found in three categories.

They seem to be the major items in maritime transportation throughout the nation.

On the other hand, Table 5-4 shows the Cargo items whose aggregate amount is more than 80 percent of the total according to the Commodity Flow Survey in 1975.

This table lists the major cargoes which flow to and from Region II by land in other words, these commodities have a close relationship with economic activities in Region II.

Since the purpose of preparing this table is to know the general outline, no seasonal adjustment has been made.

Table 5-4 Major Cargoes by Land-Freight (Region II)

Outward		Inward	
Processed Timber	51.6%	Beverages	24.4%
Palay	13.5	Petroleum Products	18.9
Rice	6.2	Cement	17.0
Logs and Forestry	5.2	Metal & Metal Manufacture	7.4
Unmilled Corp	3.9	Processed food	7.0
Milled Corn	3.3	Fish	6.9
	83.7		81.6

Source: National Transportation System Study, Commodity Flow Survey, September 1975.

Taking into account the major cargoes found in both the sea-freight and land-freight, the present situation of cargo handling by PMU Irene and the direction of development of Region II, the commodities that are to be conveyed via Port of Irene are presumed to be palay (rough rice), corn, petroleum products, cement, fertilizers, logs, lumbers, veneer, plywood, sugar, molasses and others. Bottle cargoes (beverage), although a major item in statistics, is not included in the above. The reason for this omission is as follows. Port of Legaspi, located at the southern end of the Luzon island, have been handling bottled cargoes, having the same advantage that the land transportation is available. Therefore, the bottle cargoes could be a major item of Port of Irene. However, considering that port of Legaspi has re-exported the said cargo and that Port of Irene has not established commercial practices related to the dealing of the bottle cargoes, it is omitted from the list of the major cargoes at Port of Irene, in 1987.

3. Forecast of Amount of Port Handling Cargoes

The amount of port handling cargoes is forecasted, in principle, from the production (consumption) of Region II in its relation to economic indices or to the past economic results, taking into account the market conditions and port conditions in PMU Irene. For some cargoes, it is necessary to compute the amount in province of Cagayan from the production (consumption) in Region II, based on which the amount of cargoes at Port of Irene is estimated. The amount of foreign trade cargoes is estimated referring to the ratio of the import/export amounts to the national production (consumption).

(1) Wood products

In Region II, the production of wood products, with high value added, has been on the increase with the exception of log on which the export restriction is imposed. But log production has slightly declined. The reason for the decline is not clarified, about whether the forest resources are becoming exhausted or that the forest roads and other infrastructures have not been well provided yet. The estimation for the year of 1987 is made on the assumption that the forest resources would be sufficiently secured for production.

Table 5-5 Production of Wood Products in Region II

(,000 m^3)

	Log	Lumber	Veneer	Plywood
1975	584	–	32	19
1976	1,204	494	43	20
1977	840	376	28	24
1978	1,024	594	41	30
1979	945	397	52	35
1980	916	384	–	–

Source: NTPP Internal Paper, Annual Report 1980 (BOFD)

Rapid increase in processed wood production has been observed throughout the country. The average growth rate of lumber, plywood and veneer production in the past five years in 9.8 percent, 15.7 percent and 26.0 percent respectively. The production growth rates for plywood and veneer in Region II are 16.5 percent and 12.9 percent, while the average annual lumber production in the past five years is marked by 450 thousand cubic meters, although heavily fluctuating from year to year. The trend of plywood and veneer production in Region II corresponds to the increasing trend of the nation, which makes it possible to estimate the production of these items in the Region for 1987 on the basis of the rate of production increase in 1979. Plywood and veneer production in 1987 will be 118 thousand cubic meters and 137 thousand cubic meters, respectively.

On the other hand, lumber production in the Region in 1987 is estimated at 500 thousand cubic meters, the amount slightly over the average in the past years.

The log requirements for producing the estimated amount of processed products will be 1,370 thousand cubic meters, which slightly exceeds the maximum requirements in the past five years in the Region. The proposed log requirements, however, are equivalent to 50 percent of the maximum allowable cut in the past, well within the potential in Region II.

Furthermore, the amount of processed wood products to be handled via Port of Irene is estimated. Port of Irene is to deal primarily with the products of province of Cagayan considering the road conditions, conventional business practices, transportation costs to Manila, etc. For reference, the export products are commonly quoted on the FOB Manila basis which means that the inland freight is borne by the manufacturers. Interview survey conducted in the Region has revealed that the inland freight to Manila costs about ₱90/m^3, while that to Port of Irene would be 50–70% less. Under the situation, it would be expected that a greater part of products originated in province of Cagayan could be handled via Port of Irene. The production in province of Cagayan can be estimated based on province-wise forestry product capacity of Region II.

Table 5-6 Forestry Product Capacity of Region II

Province	Saw Mill (000 BDF)	Plywood (Sq.F)	Veneer (Sq.F)
Cagayan	232	616	272
Isabela	465	192	256
Nueva Vizcaya	165	0	0
Quirino	97	0	0

Source: Wood Industry of Region II 1979.

A greater part of the Cagayan products would be handled via Port of Irene. However, a particular attention should be paid to the transportation of the process wood products originated in Claveria, the western part of the Cagayan.

This is because there are some problems with traffic conditions between Magappit and Claveria. Although the roads are sufficiently wide and the embankment in relatively good conditions except for several places, there are 10 temporary wood bridges with the maximum loading restriction of 8–10 tons.

Ongoing road rehabilitation works are expected to successfully improve the road conditions including embankment consolidation in the future. For estimation of the amount of cargoes in 1987, however, Claveria products is excluded from the cargo to be handled in port of Irene, taking the unfavourable road conditions into account.

The production of province of Cagayan (excluding that of Claveria) is estimated at 67 thousand tons for lumber, 37 thousand tons for plywood and 35 thousand tons for veneer. The export amount of these products is estimated on the basis of the processed wood products export ratio to the total national production. Difference between production and export is domestic consumption, which can be classified into the consumption in the production area and the consumption outside the production area.

The amount of cargoes handled via Port of Irene can be obtained by deducting the amount of cargoes handled via port of Aparri from the sum total of export and consumption outside the Region. The consumption within the Region is supposed to be 1/3 of the total domestic consumption for lumber and 1/4 for plywood and veneer, respectively. The expected processed wood products to be handled by the port are, for export, 17 thousand tons of lumber, 29 thousand tons of plywood and veneer, and for outward trade, 33 thousand tons of lumber and 32 thousand tons of plywood and veneer.

(2) Logs

In addition to unstable production, export restriction has been imposed on the log business. Hence, increase in log export cannot be expected, whereas increase in outward business may be expected to some extent. However, as the processing of the forestry products is most beneficial to the economy of Region II, it is difficult to foresee fundamental changes in the amount of outward bound log.

The amount of material wood handled at Port of Irene is affected by the amount handled at anchorage in port of Aparri to a certain extent. This means that there would be a possibility of transferring the cargoes from port of Aparri to Port of Irene. This will be feasible considering the loading charge and demurage cost of vessels. However, judging from the conventional business practice of investing in the timber basin at the back of port of Aparri, the situation will not change in the near future. Thus, the log handling amount is expected to be 10 thousand tons for export and 20 thousand tons for outward trade taking into account the results in 1979 and 1980.

Table 5-7 Logs Cargo Volume Handled in PMU Irene

(,000 ton)

Name of Port	Export		Outward	
	1979	1980	1979	1980
Irene	11.9	10.7	2.6	18.6
Aparri	66.1	39.3	13.7	21.9
Claveria	11.6	17.1	2.8	3.0
Maconacon	19.9	41.1	0	1.0
Total	109.5	108.2	19.2	44.5

Source: PMU Irene

(3) Cement

The national cement production has marked over 4,000 thousand tons per annum for the last few years, 70 percent of which is produced in Luzon island. The national consumption has kept the level of some 3,500 thousand tons annually for the recent years. Difference between the production and the consumption is the export.

The share of consumption in Region II to the national production can be obtained by calculating the rate of GVA of construction in Region II to that in the whole nation.

Cement consumption of Region II in 1979 is estimated at 192 thousand tons. And approximately 87 percent of the GVA of construction in Region II was reportedly yielded by Magat and Chico river dams and variety of irrigation projects. There was also a report indicating that these projects had consumed about 160 thousand tons of cement in 1979. These reports prove that cement consumption by private enterprises is extremely low.

Table 5-8 GVA Construction of Region II, 1976–1979

(In Million Pesos)

Year	Philippines	Region II
1976	5,254	262
1977	5,568	272
1978	5,953	321
1979	6,368	423

Source: Philippine Yearbook 1980 NEDA, CIADP

Consumption in 1987 can be estimated by the growth rate of GRDP in Region II and consumption in 1979. However, 1979 should be considered as an unusual year in cement consumption as mentioned previously. Consequently, some adjustment is required. As a general rule, the public works play a vital role in uplevelling the local economy in less developed regions. Therefore, it is safe to assume that there will always be made substantial amount of public works even after the completion of the dams. Upon this assumption, the cement consumption in 1979 is estimated at 112 thousand tons and that in 1987 at 240 thousand tons.

The marketing channel of cement has not yet been definitely established but a minimum transportation cost system seems to be established between the producers and the consumers, considering that the retail price is said to be fixed. Most cement factories are concentrated around Manila, and in the north luzon, only two are located near San Fernando. The distribution of cement factories in Luzon indicates that the transportation of the products is fully dependent upon trucks. The report of "Commodity Flow Survey, September, 1975" reveals that the amount of incoming cement to Region II has reached 17 percent of the total truck-transported incoming cargoes. Under the situation, there will be little possibility to convey cement by sea to the Region, much less possibility, because of the cost factor, of using Port of Irene for cement export. Therefore, it is assumed that cement to be exported from the Region will be nil in 1987 and that inward consumption will be only five thousand tons for very limited local use around Port of Irene.

(4) Sugar

Cagayan Sugar Corporation (CASUCO) is the only one sugar plant located in the north Luzon. The raw sugar production of the CASUCO was 22 thousand tons in 1979, which accounts for about 30 percent of the production capacity (4000 t/day) of the CASUCO. It is pointed out that the low productivity of the CASUCO results from i) inadequate planting materials, ii) inadequate irrigation facilities and iii) lack of skilled cutters. These factors, which are fundamental problems in factory operation, will seriously affect the production increase in future.

For the production forecase for 1987, it is necessary to estimate the changing cropping acreage of sugar canes. The Five-year Plan proposes that 12 thousand hectare of fields be prepared to supply sugar canes sufficiently to the CASUCO; it is encouraged that 12 thousand ha of field should be secured as soon as possible, because the plant is already equipped with the annual raw sugar production capacity of 70 thousand tons. The adverse factors which hamper the expansion of sugar cane fields, however, will not be eliminated easily in a short period. Under the situation, the cropping acreage is estimated to increase by 50 percent by 1987. For reference, 500 ha of fields was expanded between 1978 and 1979.

The yield per unit acreage is a prerequisite for the estimation of sugar cane production. The national average of the yield since 1947 ranges from 40 to 60 tons per hectare with considerable fluctuations by years and regions. The average yield of Luzon in 1973 was 49.2 t/ha, while it was reportedly 31 t/ha around the CASUCO (1979).

The estimation in this study is made on the assumption that the average yield would come up to 50 t/ha in the whole Luzon island in 1987 with considerable productivity increased. Based on the above-estimated yield, the raw sugar production in 1987 is forecasted at 43 thousand tons.

Table 5-9 Average Yield of Sugarcane

	Philippines		Luzon
	1973	1974	1973
Planted Area (ha) (A)	434,733	468,283	108,192
Cane Production (1000TC) (B)	22,640	26,084	5,319
Sugar Production (1000ST) (C)	2,475	2,695	559
(B/A)	52.08	55.70	49.21
(C/B)	0.0992	0.0937	0.0953

Source: Statistical Series on Sugar Volume V
Note: ST = 1 short ton = 907.1 Kg

Sugar produced by the CASUCO has been transported by trucks to the Metro Manila sphere. The ports controlled by PMU Irene have never handled the CASUCO's products. It is the NASUTRA's policy that determine whether this situation will continue or not. But the assumption here is made, with reference to the export ratio, that all export cargoes are to be handled via Port of Irene.

The share of export in the production for these three years (1977–1979) exceeds 60 percent on an average, which has been largely affected by the export volume in 1977. (The said share from 1975 to 1979 is about 57 percent on an average.) In due consideration of these matters, 50 percent of the CASUCO's products is assumed to be exported via Port of Irene in 1987, while the balance 50 percent will be transported to Manila by conventional way of trucks. The amount of export is 22 thousand tons. The quality of the sugar produced in the country is highly evaluated in the international market and the prospect of exporting CASUCO's products is bright. However, most of the sugar importing countries of the world have the pneumatic unloading facilities in their ports and do not welcome products in bags. The prerequisites of Port of Irene for its successful sugar export trade are not only to expand the sugar cane cropping acreage but to be provided with the modern port facilities to meet the requirements of the sugar importing countries.

Table 5-10 Production, Export and Consumption of Sugar, Philippines

(.000 tons)

	Production	Export	Consumption	Stocks
1977	2,624	2,575	968	818
1978	2,273	1,142	1,087	862
1979	2,390	1,157	1,159	936

Source: Statistical Bulletin.

(5) Molasses

The production of molasses can be estimated easily from the consumption of sugar canes. Namely, 3/100 of molasses can be produced from sugar cane 1. Therefore, the production of molasses in 1987 is estimated at 14 thousand tons. Field surveys conducted by CASUCO revealed that about 60 percent of molasses production has been exported, and all of the exported molasses was shipped from Port of Irene. Molasses for domestic consumption shall be transported by tank lorries. The estimated export amount in 1987 is about 8 thousand tons.

(6) Palay (Rough Rice)

The palay harvest area has been decreasing recently (Table 5-11). The reasons have not been thoroughly investigated yet. The actual palay harvest area is smaller than planned, which is probably due to the delay in the irrigation projects such as Magat River Multi-purpose Project (MRMP), Chico River Irrigation Project (CRIP), CIADP, etc. According to the original schedule, the MRMP project was for the 1982–1984 period and the CRIP will have been completed in 1982. Actually, however, completion of these projects are considered to take another seven years or so.

These projects, although behind the schedule, have been steadily progressing. Therefore, the harvest area in 1987 can be estimated on the basis of the actual acreage in 1979 and the average annual increase rate (1979–1987) set in the Five-year Plan. The harvest area estimated for 1987 is 500 ha.

Table 5-11 Palay Production Region II, 1975–1979

	Harvest Area (.000 Ha)	Production (.000 M.T)	Average Yield (M.T/Ha)
1975	414.0	796.0	1.92
1976	418.7	741.0	1.77
1977	432.6	812.9	1.88
1978	413.8	808.7	1.95
1979	416.1	969.6	2.33

Source: Five Year Development Program (1975), Philippine Agriculture Fact Book (1976, 1977), BAEcon (1978, 1979).

In the next step, changes in the average yield are studied. The yield has been steadily increasing with the improvement of farming techniques, execution of Massagana 99, advancement in fertilization, and expansion of irrigated area. This trend is expected to continue in future as well. The expected average yield for 1987 was computed based on the actual results in 1979 and the actual average increasing rate of 4.95 percent (1975–1979). The average yield in 1987 is 3.43 MT/ha, and the palay production in 1987 is forecasted to be 1,715 thousand tons.

The self-sufficiency rate of rice in Region II was 355.4 percent as of 1979. In 1980, production increase made it possible for the Region to export about 218 thousand bags of rice

(equivalent to 11 thousand tons) which is equal to 17 thousand tons in palay. The palay self-sufficiency rate in the nation is shown in Table 5-12, which indicates that Region IV and many other regions have suffered from palay shortage.

Region II is a supplier of palay and is considered to be the largest source of its supply to Region IV. What should be used as the means of transportation of palay from Region II to the consumer areas is a major problem. It can be presumed that, in the past, all was transported to the consumer areas by trucks. A port of palay was transported to Manila is believed to include what was transhipped by sea via the Port of Manila to other areas. To cite an example, rice exported in 1980 was not routed through PMU Irene.

Table 5-12 Palay Production and Consumption by Region 1977

	Population (.000 persons)	Production (.000 M.T)	Consumption (.000 M.T)	Surplus/ (deficit)
Region I	3,510	511	552	(41)
II	2,139	813	337	476
III	4,636	1,035	729	306
IV	11,479	820	1,806	(986)
V	3,381	658	532	126
VI	4,545	895	715	180
VII	3,674	132	578	(446)
VIII	3,123	233	491	(258)
IX	2,263	319	356	(37)
X	2,568	200	404	(204)
XI	3,080	310	485	(175)
XII	2,229	528	351	177
Total	46,627	6,454	7,336	(882)

Source: Philippine Year Book 1979 (Population), Philippine Year Book 1979 (Production), Calculated from Population x 100.7 kg/Cap./year ÷ 0.64 (Consumption)

The shares of harvest area and storage capacity of province of Cagayan to Region II are both a little over 20 percent as illustrated in Table 5-13. It shows that Cagayan is not a main granary of palay in Region II. Such geographical conditions and consideration of the transportation cost may have established the transportation practices of palay.

Progress of the irrigation projects is well expected to change transportation routes and means of transportation. But with this change of transporting conditions, it becomes necessary to make physical facility improvements, such as the improvement of warehouses and roads. It is, therefore, assumed that all palay for domestic consumption -- but not palay for export -- will be transported overland in 1987, as in the past.

The palay export is estimated at 40 thousand tons since the production is supposed to double in 1987.

The minimum export value is quoted herein, because Region II is located close to the big consuming area Region IV and per capita consumption is expected to increase largely, although Region II itself will be able to secure considerable surplus of palay for export.

Table 5-13 Shares of Harvest Area and Storage Capacities of Cagayan to Region II

	Harvest Area	Storage Capacities
Cagayan	24.4	22.2
Others	75.6	77.8
Total	100	100

Source: Grain Business Profile 1975, NGA and Agriculture Profile 1977, CIADP

(7) Corn

The harvest area of corn in Region II has recently been decreasing as shown in Table 5-14. It is said that the farmers have been converting from corn to peanut, cotton, etc. which are the highly marketable cash crops. In spite of the decrease in harvest area, the production of corn has increased by upgrading of farming techniques and applying of Massagana 77.

Table 5-14 Corn Production in Region II

	Harvest Area (.000 Ha)	Production (.000 M.T)	Average Yield (M.T/Ha)
1975	346	277	0.80
1976	352	293	0.83
1977	350	286	0.82
1978	337	337	1.00
1979	330	338	1.02

Source: Five Year Development Program (1975), Philippine Agriculture Fact Book (1976, 1977), BAEcon (1978, 1979)

The future trend of harvest area and average yield is forecasted on the basis of the actual results in 1979 and the annual average increase rate (1979–1987) of 0.6 percent and 7.0 percent set in the Five-year Plan. The forecasted harvest area and the average yield in 1987 are 336 thousand ha and 1.75 MT/ha, respectively, and the corn production in 1987 is computed to be 588 thousand tons.

Nationally, corn is in oversupply but in Northern Luzon alone, its production is short in all Northern Luzon except Region II.

Region II is the supplier of corn to the adjacent areas, and the transportation has been conventionally made by trucks. The Commodity Flow Survey shows that Region II has had a

large outward corn business. In corn business as well as palay business, specific commercial practices seem to have been established. Furthermore, with the completion of a feedmill in Isabela, the corn will be concentrate in Isabela, from there trucks will distribute the products to consuming areas. In this prospect, Port of Irene will have no corn handling in future either.

Table 5-15 Corn Production and Consumption by Region 1977

	Population (.000 persons)	Production (.000 M.T)	Consumption (.000 M.T)	Surplus/ (deficit)
Region I	3,510	26	144	(118)
II	2,139	286	88	198
III	4,636	35	190	(155)
IV	11,479	292	470	(178)
V	3,381	95	138	(43)
VI	4,545	149	186	(37)
VII	3,674	241	150	91
VIII	3,123	121	128	(7)
IX	2,263	143	93	50
X	2,568	101	105	(4)
XI	3,080	911	126	785
XII	2,229	443	92	351
Total	46,627	2,843	1,910	933

Source: Philippine Year Book 1979 (Population), Philippine Year Book 1979 (Production), Calculated from Population x 26.6 Kg/cap. Year ÷ 0.65 (Consumption), Food Balance Sheet 1976

(8) Fertilizers

The national production of fertilizers has been ranging from 220 to 300 thousand tons for these few years, while the demand has been gradually increasing. The gap between demand and supply has been filled with the imports as shown in Table 5-16. About 70 percent of the consumption has been covered by import goods, and this pattern has not changed for the last 10 years. There are no data available on the fertilizer consumption in Region II.

In order to estimate it, the national consumption of fertilizers and the region-wise acreage ratio for all crops are used. The acreage ratios of Region II to the national total in 1977 and 1978 were 7.49 percent and 6.82 percent, respectively. Since the data on the yearly charges of the ratio are not available, the ratio is assumed to be seven percent. Based on this ratio, the consumption of Region II in 1980 is estimated at 57 thousand tons.

Table 5-16 Production, Importation and Consumption of Fertilizer

(Unit: .000 tons)

Year	Production	Importation	Consumption
1973	278	347	677
1974	297	956	736
1975	292	236	578
1976	306	193	645
1977	228	448	687
1978	290	550	792
1979	234	734	848
1980	230	752	820

Source: Philippine Agriculture Fact Book & Buyer's guide.
NTPP Internal Paper.

It is predictable that the fertilizer consumption in the Region II will steadily increased in future with the consolidation of irrigation facilities, extensive implementation of Massagana 99 and Maison 77, and the expansion of sugar cane cropping acreages, etc. The consumption in Region II is estimated from the average national increase ratio per annum for the years 1977–1980. For the trend from 1977 onwards, the data in 1977 is taken as the base for estimation, since the effect of sharp increase of import in 1974 has almost foded by that year. As a result, the consumption in 1987 is estimated 86 thousand tons.

Table 5-17 All Crops Area by Region

(.000 ha)

Year / Region	1977	1978
I	512	515
II	883	837
III	611	540
IV	1,393	1,766
V	988	960
VI	1,211	874
VII	895	839
VIII	953	897
IX	800	797
X	880	902
XI	1,535	1,573
XII	1,119	1,212
Total	11,787	12,179

Source: Philippine Agriculture Fact Book & buyer's guide.

Port of San Fernando handled about 36 thousand tons of imported fertilizers in 1978 and 1979, while port of Manila handled about 100 thousand tons in 1979. Fertilizers in Luzon has been supplied mainly from these imported goods, and the shortage has been covered by domestic products.

The Commodity Flow Survey also indicates that supply to Region II has been made by trucks mostly from Manila and this supply pattern is not anticipated to change in future. However, it is considered possible for Port of Irene to directly import some of the imported fertilizers. Then, it is reasonable to that the amount equivalent to the consumption in province of Cagayan would be imported via Port of Irene, in view of the current transportation cost of ₱10/bag from Manila to Tuguegalso, and an additonal ₱9/bag is required for further transportation from Tuguegalso to Claveria or Conzaga. Hence, the assumption is reasonable from economic view point. The amount of fertilizers to be imported via Port of Irene in 1987 is estimated at 20 thousand tons from the harvest area ratio of province of Cagayan to that of Region II.

(9) Petroleum products

The philippines' national consumption of petroleum products has been on a slight increase after 1974, the so-called first oil crisis, but has decreased since 1980 due to the second oil crisis in the latter 1979. The consumption will continue to increase appreciably year by year in future while gasoline is going to be converted to diesel oil. When all the petroleum products consumed in Region II are assumed to be imported via port of Aparri, the consumption per capita in the Region is largely below the national average. Even if Region I and II are combined as one unit and all the consumption of the unit area is assumed to be imported via port of San Fernando and port of Aparri, the consumption per capita is still below the national average. Considering these facts and the result of Commodity Flow Survey, petroleum products seem to be transported into Region II via two ports of Aparri and San Fernando and from Manila.

Field survey around port of Aparri has revealed that its service area is province of Cagayan and a part of province of Isabera, and the consumption in the service area has remained unchanged for the past few years. The maritime transportation of the products is carried out from October to April, but not during the May to September period since it is rainy season and typhoon season. The sufficient stockpile is secured to meet the demand during the service interruption. The port owns the 13 feet deep entrance at the right bank of the Cagayan river mouth for small tankers. From time to time a large tanker (3,000 DWT) carries oil to the anchorage of port of Aparri, from where flat bottom barges do the secondary transportation. It is the oil companies judgement that the current transportation method can adequately cope with increasing demand in the future, if available tank yards and other facilities are effectively utilized. In other words, the companies have no plans to construct an oil stockpile base in Port of Irene.

The two oil companies based in port of Aparri, handling almost 80 percent of the incoming oil, have the tank capacity of 230 thousand BBLS, equivalent to 36,300 tons in storage capacity.

The monthly average of oil unloaded at the port of Aparri in 1979 was about 5,000 tons. Assuming that oil is stored for five months, the period of rains and typhoons, a tank capacity of 25,000 tons is necessary.

In view of the storage capacity, the present facilities still have room for 11 thousand tons of additional oil. This means that the monthly landing oil (or the monthly demand) can be increased to 7 thousand tons (84 thousand tons annually) with the present facilities.

Although the national consumption of petroleum products has increased by 4.2 percent per annum from 1975 to 1979, (the consumption in 1980 decreased by about six percent compared to that in 1979). The oil handing amount at port of Aparri is forcecasted to be 84 thousand tons in 1987. This means that the ratio of increase of landing oil at Aparri will be four percent per annum in and after 1979. Considering that the largest consumer of petroleum products is the Metro Manila, the present capacity of the unloading facilities of Aparri is sufficient to meet the forecasted demand in 1987. Therefore, Port of Irene will not be required to provide unloading facilities for petroleum products by the year of 1987.

(10) Others

Bottled cargoes, machineries, metal products, etc. can be calssified into the other items. Port of Irene has not yet developed the efficient marketing systems of these cargoes in its hinterland. Although the development plans for its hinterland suggest no rapid increase of these cargoes before 1987, the physical planning for the port should be such that the facilities have room for handling these cargoes when necessary. Consequently, about five percent of the total amount of specific cargoes (lumber, sugar, etc.) is counted into Others. The amount of cargoes specified as others in 1987 is estimated at seven thousand tons for foreign trade and five thousand tons for domestic trade.

The item-wise estimation of the cargoes to be handled at Port of Irene in 1987 amounts to 248 thousand tons. According to the macroscopic estimation, the volume of total cargoes is to be 271 thousand tons (estimated by GRDP) or 238 thousand tons (estimated by population). The estimations by these three methods are all around 250 thousand tons. Therefore, 248 thousand tons based on the item-wise estimation shall be adopted as the expected cargo amount to be handled at Port of Irene in 1987.

Most of these cargoes comprise both exports in foreign trade and outward in domestic trade except fertilizers which are imported from foreign countries and cement which is an incoming from other parts of the Philippines. Other cargoes are believed to comprise imports in foreign trade and domestic trade.

The above estimation is made, however, on the conditions that at least, the road facilities between Dugo and San Vicente are well consolidated and necessary functions are upgraded to support efficient port activities by 1987. The cargo amount to be handled at Port of Irene in 1987 will be unavoidably below the estimation, if these prerequisites are not satisfied.

The current improvement program of the Dugo-San Vicente Road (DSVR) is as follows. The Project consists of cementing the total length and construction/imptovement of about 30 bridges. There are, however only 4 long bridges namely: Tapel; Baua; Mission and Paleng. For year 1982, the amount of P20 M had been appropriated for the construction of the four bridges. For the same year (1982) Phase I of the DSVR has been programmed and the amount of P70 M had been

appropriated. This includes improvement/construction of some of the small bridges. Phase I consists of cementing the road from Dugo to Gonzaga-Sta. Ana boundary with total length of 53 kilometers. Actual work will commence February 1982. Phase II will be done in 1983 and this will finish the remaining 20 kilometers up to San Vicente, Sta. Ana. The amount of P30 M was submitted for approval under the 1983 Ministry of Public Works and Highways.' budget.

Table 5-18 Projection of Cargo Volume in Port of Irene by Commodity (1987)

(Unit: 1000 t)

	1987		1979	
	Foreign	Domestic	Foreign	Domestic
Lumber	17	33	3	
Plywood/Veneer	29	32		
Cement	0	5		
Fertilizer	20	0		
Sugar	22	0		
Palay	40	0		
Corn	0	0		
Petroleum	0	0		
Molasses	8	0	3	
Logs	10	20	11	3
Others	7	5		
Total	153	95	17	3

5-2 Cargo Traffic in 2000

The limits to the supply of logs in Region II are not necessarily clear. The amount of allowable cut is considerably large but the actual log production is 1/2–1/3 of the allowable cut or even smaller. Even assuming that the production will increase from 1987 by an annual rate of 1.5 percent, the log requirement in 2000 will be 50 percent more highest figure in the past. Though predicting an output is extremely difficult, the production can be expected to increase by an annual rate of at least 1.5 percent.

The wooden products at Port of Irene in 2000 is estimated on the assumption that the port's hinterland in 1987 (province of Cagayan) will expand to include part of the province of Isabela. The export in 2000 is 46 thousand tons for lumber and 64 thousand tons of plywood/veneer and the outward shipment is 84 thousand tons for lumber and 66 thousand tons for plywood/veneer. The export and the outward shipment of logs are estimated at 60 thousand tons and 30 thousand tons, respectively, by referring to the volume handled at port of Aparri and Port of Irene in the past.

As stated already, the increase of sugar production involves such problems as the expansion of planted area. Assuming that in 2000, the proposed planted area of 12 thousand hectare can be ensured and the per-unit-area output reaches the national average of 55.7 TC/ha, sugar production of CASUCO in 2000 will be 64 thousand tons. To attain this production, the CASUCO working ratio will have to be hight, higher than the national average. As for export, 38 thousand tons will be exported, assuming that 60 percent of the output is exported, as is the case with the national production/export ratio. It is assumed that sugar for domestic consumption will be transported overland by trucks, as in the past. The production of molasses is estimated at about 20 thousand tons and it is assumed that 12 thousand tons will be exported and that molasses for domestic consumption will be transported by tank lorries.

The prediction of demand for fertilizers is based on the area of cultivated land. The area of cultivated land in Region II is smaller than the target value under the Five-Year Plan. Since the annual rate of increase in the area of cultivated land from 1975 to 1987 is 2 percent, it is assumed that it will increase by 2 percent yearly from the actual value (838 thousand hectare) in 1978 until 1987. The area is 871 thousand hectare in 1980 and 1,000 thousand hectare in 1987. An annual increase rate of about 1.5 percent is assumed for the period from 1988 to 2000, taking the increase rate of about 1.5 percent is assumed for the period from 1988 to 2000, taking the increase of irrigated area for palay and other factors into consideration. The area of cultivated land in 2000 is 1,214 thousand hectare. Meanwhile, fertilizer consumption is 57 thousand tons in 1980 and 86 thousand tons in 1987. Fertilizer consumption in 2000 can be determined from these values by the following formula:

$$F_t = F_n(1 + K_{t/n})^{t-n}$$

$$K_{t/n} = \gamma_{t/n} \cdot \frac{K_{n/o}}{\gamma_{n/o}}$$

F_t : Fertilizer consumption in target year
F_n : Fertilizer consumption in basic year
K : Annual average growth rate for fertilizer consumption
γ : Annual average growth rate for area of cultivated land
t/n : From base year (n) to target year (t)
n/o : From first year (o) to basic year (n)

The above calculating formula takes note of the fact that the increase of fertilizer consumption is in accordance with the expansion of the area of cultivated land and the increase of per-unit-area fertilization. Fertilizer consumption in 2000 can be estimated at 153 thousand tons. Of this total, the amount of fertilizers imported via port of Irene is estimated at 46 thousand tons on the assumption that they are for the province of Cagayan and part of the province of Isabela.

Cement consumption is 192 thousand tons in 1979 and 240 thousand tons in 1987. Cement consumption in 2000 is estimated on the assumption – similarly to the estimation for 1987 – that the increase rate of cement is the same as the rate of GRDP until 2000. It is 718 thousand tons. If a cement mill with a daily production capacity of 1,500 tons located in Irene district is in operation by 2000, it can supply most of the regional needs. It is assumed that the shortage will

be supplied from Region I, as in the past.

Some of the cement produced at the cement mill of Port of Irene may be exported or shipped to other parts of the country.

However, the quantities that are routed through the Port of Irene are unlikely to be considerable in view of the local supply and demand.

The production of palay is estimated from the relation between harvest area and average yield. According to the Five-Year Plan, the additional hectares irrigated during the period from 1988 to 2000 is 94 thousand hectare. Since, however, progress under the Five-Year Plan is behind schedule, it is assumed that the target for 1987, 550 thousand hectare, will not be achieved until 2000. Meanwhile, 4.1 t/ha, the average yield target under the Five-Year Plan, is a fairly large value by national and international standards. So, 3.5 t/ha, somewhat larger than the assumed value for 1987, is adopted. then, the per-capita consumption in 2000 is assumed 256 kg/year, in anticipation of the improvement of living standard. From these results, surplus palay in Region II can be estimated at 945 thousand tons. Since about 20 percent of this surplus rice is likely to be produced in the province of Cagayan, 190 thousand tons will be exported or shipped to other parts of the country via port of Irene. Since the export in 1987 is estimated at 40 thousand tons, 120 thousand tons will be exported and 70 thousand tons in 2000 will be shipped for domestic consumption elsewhere in the country by referring to figures in the light of the GRDP growth rate.

The corn harvest area is now decreasing but it is assumed that the area in 2000 will recover to the target value for 1987. The harvest area in 2000 is 370 thousand hectare. Also, a harvest yield of 1.84 t/ha is assumed from a similar point of view. Thus, corn production in 2000 can be estimated at 681 thousand tons. The transportation of corn in Region II will concentrate on the province of Isabela as long as the feed mill capacity there is not exceeded and then the corn will be distributed to different areas. Under these circumstances, not much can be expected of the chances of corn being transported via Port of Irene.

But if the feed mills said to be presently being planned for several places in the province of Cagayan come into existence, the conditions will be different. And using one of them primarily for export to oversea markets may well be strategically advisable. A certain cargo volume is set up in consideration of such future change.

50 thousand tons is estimated as the amount to be handled by Port of Irene on the assumption that about 10 percent of the 500 thousand tons surplus will be exported.

Assuming that the consumption of petroleum products is in accordance with the ratio of GVA industry in each region, their per-capita consumption in Region II in 1979 is estimated at 0.095 ton from Table 5-19. This value is considerably small, compared with the national value and the values in Region I and III. On the assumption that, though no great increase is likely in the future, the consumption will, at least, reach the present level in Region I, 0.13 ton per capita is adopted. (This is equivalent to the increase of per-capita consumption by an annual rate of 1.5 percent.) As the result, the amount of oil consumption in Region II in 2000 is about 500 thousand tons. If 50 percent of the total consumption is to be the charge of port Irene, it is

necessary for facilities capable of handling 250 thousand tons a year to be constructed at this port. It is assumed that, by that time, the oil handling function of port of Aparri will have been completely transferred to Port of Irene.

Table 5-19 Per Capita Consumption of Oil Products 1979

	GVA of Industry		Consumption	
	Million Pesos	Percent	.000 ton	Per Capita (ton)
Philippine	78,323	100	10,400	0.220
Region I	3,266	4.2	437	0.123
II	1,570	2.0	208	0.095
III	6,589	8.4	874	0.185
Metro Manila	36,234	46.3	4,815	0.810

No large quantities for "others" in foreign trade can be expected in view of the economic structure of Region II. As "others" in domestic trade, meanwhile, Port of Irene is likely to handle the products of companies to be located in its vicinity as well as beverages and foods. In the instance of other ports, "others" exist in a cargo volume amounting to about 30 percent of the volume of such specific cargoes as lumber and sugar, etc. So, 150 thousand tons is estimated as "others" for this port.

Table 5-20 Relation of Specific Cargoes and Others
(Domestic Trade at Berth, January to June 1980)

(ton)

	Inward			Outward			Total
	Specific Cargo	Others	Subtotal	Specific Cargo	Others	Subtotal	
CEBU	470,636	245,673	716,309	222,175	172,883	395,058	1,111,367
ILOILO	154,238	30,371	183,609	176,143	12,316	188,459	373,068
DAVAO	61,907	53,290	115,197	32,632	12,234	44,866	160,063
ZAMBOANGA	188,745	48,460	237,205	89,228	22,129	111,357	348,562
CAGAYAN DE ORO	67,081	36,111	103,192	109,146	9,399	118,545	221,737
GENERAL SANTOS	43,082	14,618	57,700	152,115	4,702	156,817	214,517
SAN FERNANDO	141,324	85	142,409	358	–	358	142,767
ILIGAN	53,708	17,722	71,430	36,764	3,741	40,505	111,935
BATANGAS	70,001	2,450	72,451	13,613	8,132	21,745	94,196
TACLOBAN	69,429	21,657	91,086	54,493	5,901	60,394	151,480
DUMAGUETE	55,922	18,737	74,659	31,904	10,263	42,167	116,826
SURICAO	34,430	20,431	54,861	42,615	6,639	49,254	104,115
BUTUAN	17,064	9,946	27,010	25,092	4,880	29,972	56,982
LEGASPI	32,936	601	33,537	6,589	796	7,385	40,922
PUERTO PRINCESA	30,366	14,544	34,910	8,545	2,536	11,081	45,991
JOLO	19,780	3,392	23,172	14,044	477	14,521	37,693
IRENE	21,880	39	21,919	195	11	206	22,125
TOTAL	1,522,529	538,127	2,061,656	1,015,651	277,039	1,292,690	3,354,346

Source: 1979 Statistical Yearbook (PPA)

The cargo volume in 2000 is about 750 thousand tons if the cargo volume at Port of Irene in 1987, 248 thousand tons (excluding petroleum products), increases similarly to the GRDP growth rate. The estimated cargo volume is 850 thousand tons (excluding petroleum products) from Table 5-21, which shows the results of estimation of cargo volumes by the above items.

Values estimated item by item are used for the cargo volume in 2000 since the estimated results of cargo volume item by item generally agree with the cargo volume determined from the correlation with the rate of economic growth. Of these cargoes, all are imports in foreign trade and inward is domestic trade except the whole of fertilizers and petroleum products and a few other items.

The Master Plan for 2000 requires the construction of facilities for these 850 thousand tons and facilities to handle 250 thousand tons of petroleum products.

Table 5-21 Projection of Cargo Volume in Port of Irene (2000)

(Unit: 000 tons)

	Foreign	Domestic	Total
Lumber	46	84	130
Plywood/Veneer	64	66	130
Sugar	38	0	38
Molasses	12	0	12
Fertilizer	46	0	46
Cement	0	0	0
Petroleum Products	0	(250)	(250)
Palay	120	70	190
Corn	50	0	50
Logs	60	30	90
Others	14	150	164
Total	450	400 (250)	850 (250)

CHAPTER 6.
NATURAL CONDITIONS OF THE PROJECT AREA

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6-1 Geography and Geology

1. Overall Geological Features at the Project Area

The Project Area is situated in the north-east of Luzon Island and in the division of administration district, belongs to Region II. The province of Cagayan, which covers the northern part of this Region II, is geographically separated into an mountainous range and an plain range. That is, the east and west part of this province are represented by high mountains named Sierra Madre Mountains and Cordillera Mountains respectively. Sierra Madre Mountains rise 5,900 feet above sea level and Cordillera 6,500 feet. The Cagayan River which originates from the province of Isabera, passes through these mountainous range, flowing out to the Babuyan Channel in the vicinity of Aparri.

Geologically speaking, the subsoil feature of the northern Luzon Island are composed of a variety of strata namely Jurassic system, Palaeogene system, Neogene system and Quaternary system. Furthermore, the bed rock are also composed of a wide range of rocks named Sedimentary rock, Intrusive rock, metamorphic rock and volcanic rock.

2. The Geography and Geology of the Casambalangan Bay

The Casambalangan Bay where the Project Port is located, is shaped like a cove with the width of 2 Km and depth of 3 Km, and the mouth of this bay opens to northwest. The coastal area of this bay can be classified into these three zones.

i) Hilly area expanded along the both sides of the coast
ii) Alluvial lowland in the inner part of the bay
iii) Coral reef and sand bar offshore

The cape west of the bay projects out westward and most part of this cape is characterized by rolling hills with the highest elevation of as low as 77 m above the sea level. The southeast part of the Alluvial lowland in the inner part of the bay skirts the range of the Sierra Madre Mountains, the elevation of which is about 500–600 m above the sea. On the east side of the bay there extends low hills with an elevation of around 150 m. The Casambalangan River which flows into the center of the bay, plays a role of furnishing the sand deposit for the 10 m high Alluvial land in the inner parts of the bay.

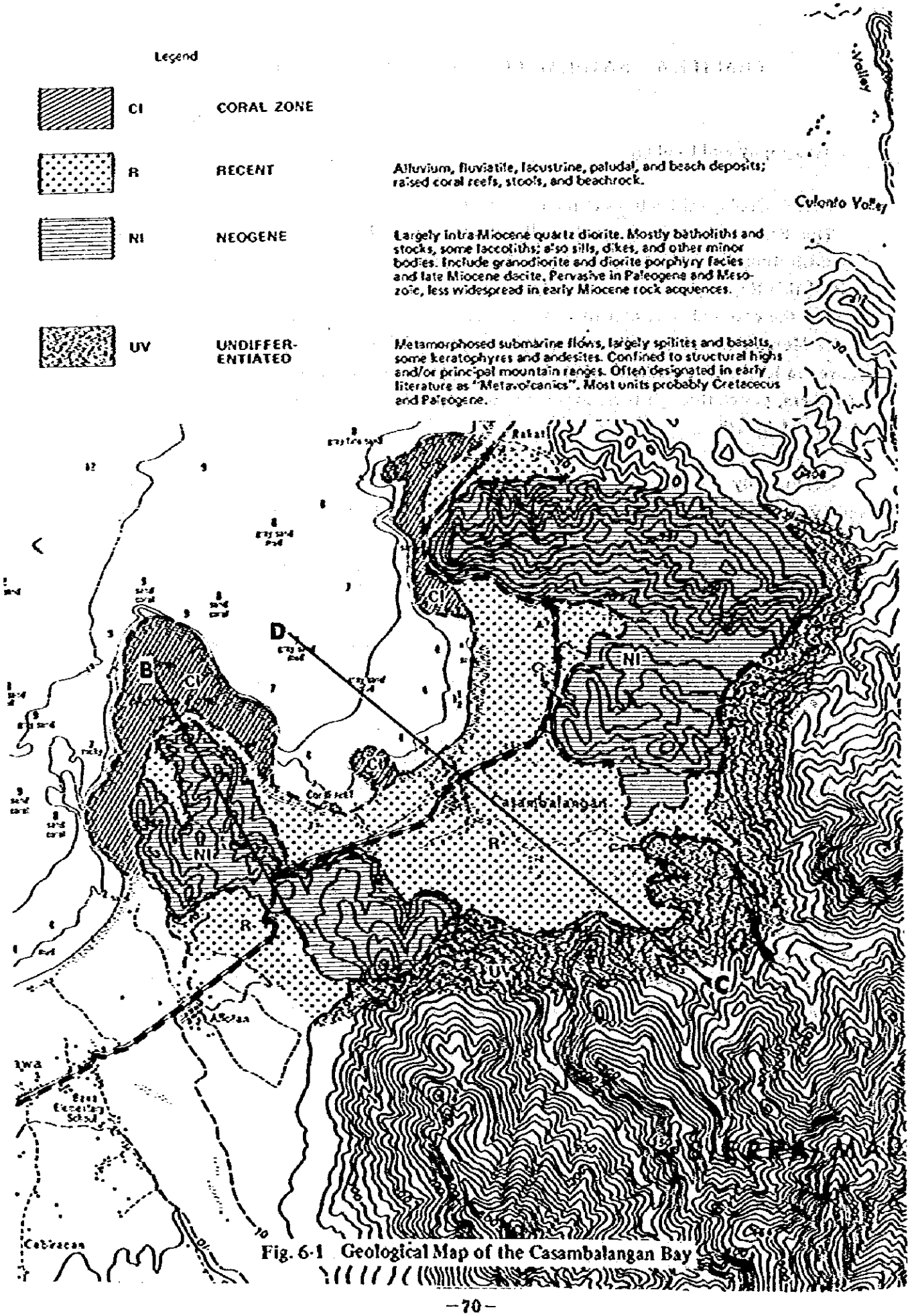


Fig. 6-1 Geological Map of the Casambalangan Bay

This Alluvial lowland lies in the form of cuspate bar with 3 Km shoreline length and 3 Km depth. The Casambalangan River flows winding, joining and branching through this delta area down to the open sea.

The coral reef which is developed sufficiently on the tip of the west cape named Matara point, is projecting to the northeast direction. On the east side of the bay mouth, 100 m–500 m wide coral reef extends continuously along the shoreline, and in the center of the bay there is also a coral reef in the form of projected group with 400 m width and 500 m length. The depth of these coral reef sometimes reaches down to 5–18 m. This fact shows the evidence of the past change of sea elevation.

Geologically speaking, these area is characterized in the strata as follows: most part of the Alluvial strata is composed of the former half of the Tertiary Period and the later half of the Quaternary Period and the Alluvial strata between these Periods is considerably scarce.

The geological map of the Bay is shown in Fig. 6-1. The hill in the cape west of the bay has three or four regular triangles. The cross section at the A–B line in Fig. 6-1 is illustrated in Fig. 6-2. This pattern, regarded as a type of CUESTA topography, can be developed where an alternation of strata with different resistence to erosion is widely distributed with gentle slope. In other words, the strata susceptible to erosion have been collapsed, while the strata resistible to erosion remain unchanged, resulting in the existence of triangles.

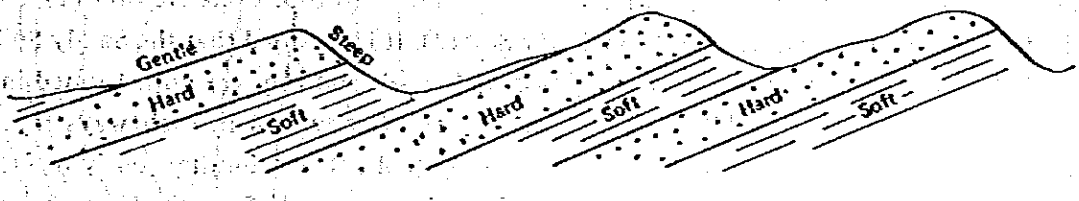


Fig. 6-2 Schematic Profile of CUESTA

The strata observed on the cliff in the vicinity of Matara Point is mainly composed an alternation of throughly hardened sandstone, shale, taffaceous silt stone, etc. forming at places marl and reef limestone lens. It is considered that these strata was formed from Oligocene epoch to Miocene epoch in the Tertiary Period of Cenozoic era.

The cross section of the Alluvial lowland at the C–D line in Fig. 6-1 is illustrated as shown in Fig. 6-3.

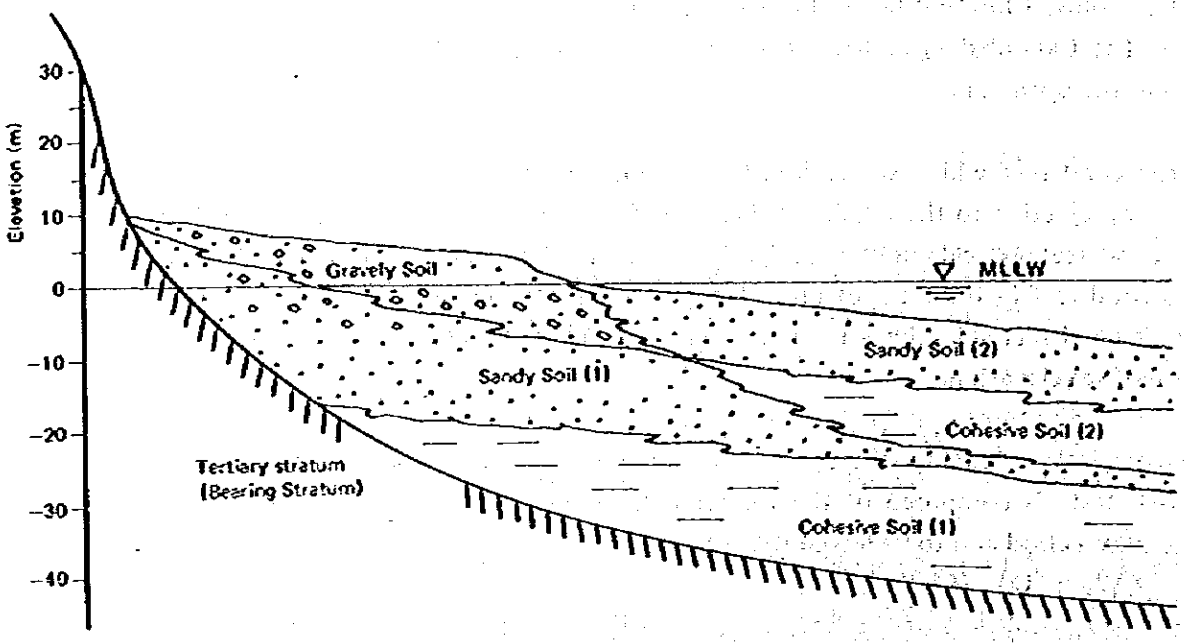


Fig. 6-3 Schematic Profile of Alluvial Lowland in the Casambalangan Bay

It is considered that the bearing stratum in the alluvial lowland was formed in the Tertiary Period and several types of sedimentation overlay this strartum.

This sedimentation lies in the following order from down to top: Cohesive Soil (1), Sandy Soil (1), Cohesive Soil (2), Gravely Soil and Sandy Soil (2). It is regarded that the Sandy Soil (1) and the Cohesive Soil (2) that is mainly composed of fine silt and clay are both formed in the Deluvial epoch. The Recent of Alluvial epoch overlies this Sandy Soil in such ways that the Gravely Soil was formed in the mountain side and Sandy Soil (2) was simultaneously formed in the sea side. These two layers have been growing up by sediment supply from the Casambalangan River.

The Study Team has conducted a total of 5 test borings mainly in the west side of the bay. The isobatic map of assumed bearing layer and the location of test boring are shown in Fig. 6-4 and Fig. 6-5 respectively. Fig. 6-6, 6-7, 6-8 show the assumed soil profiles.

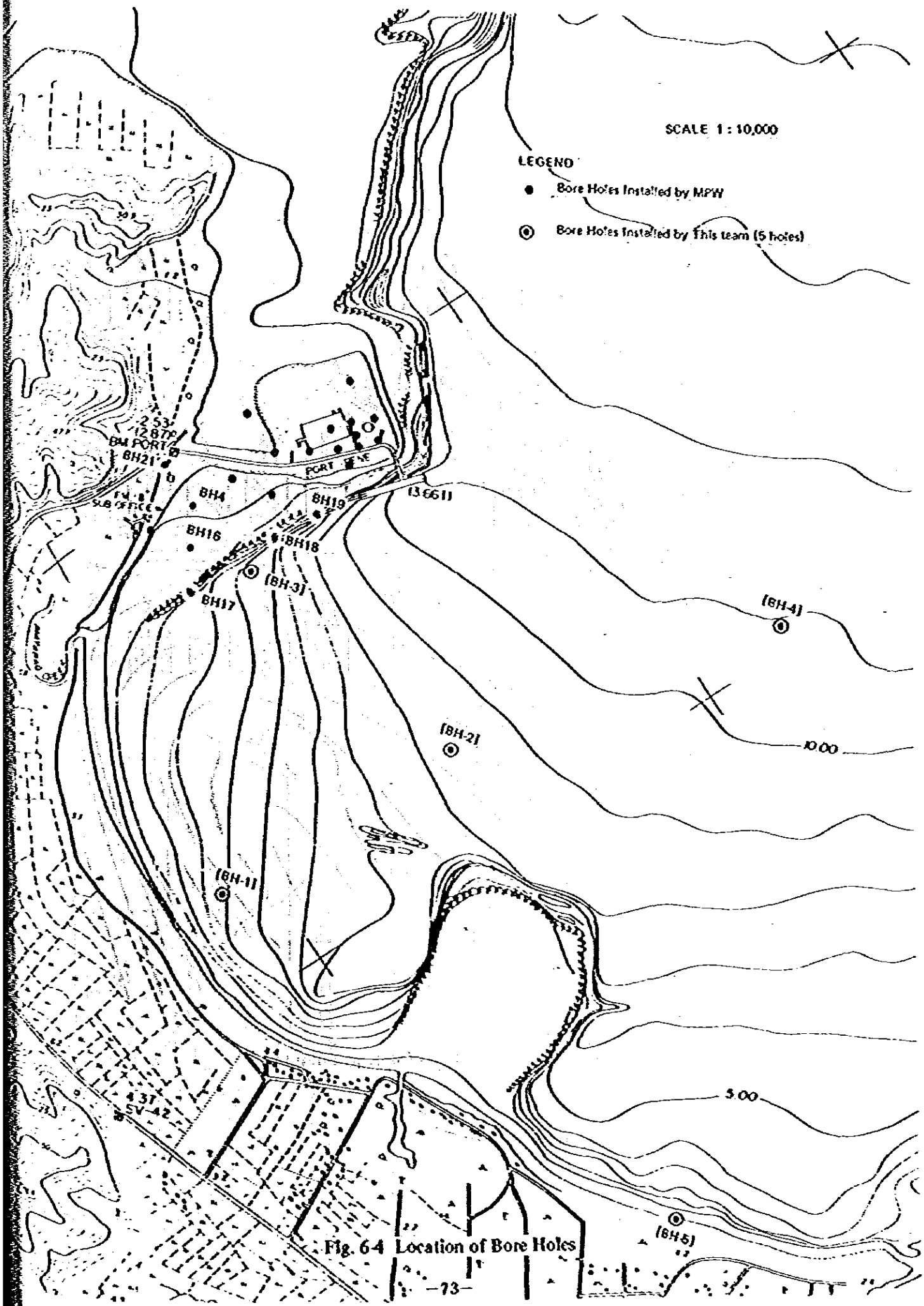
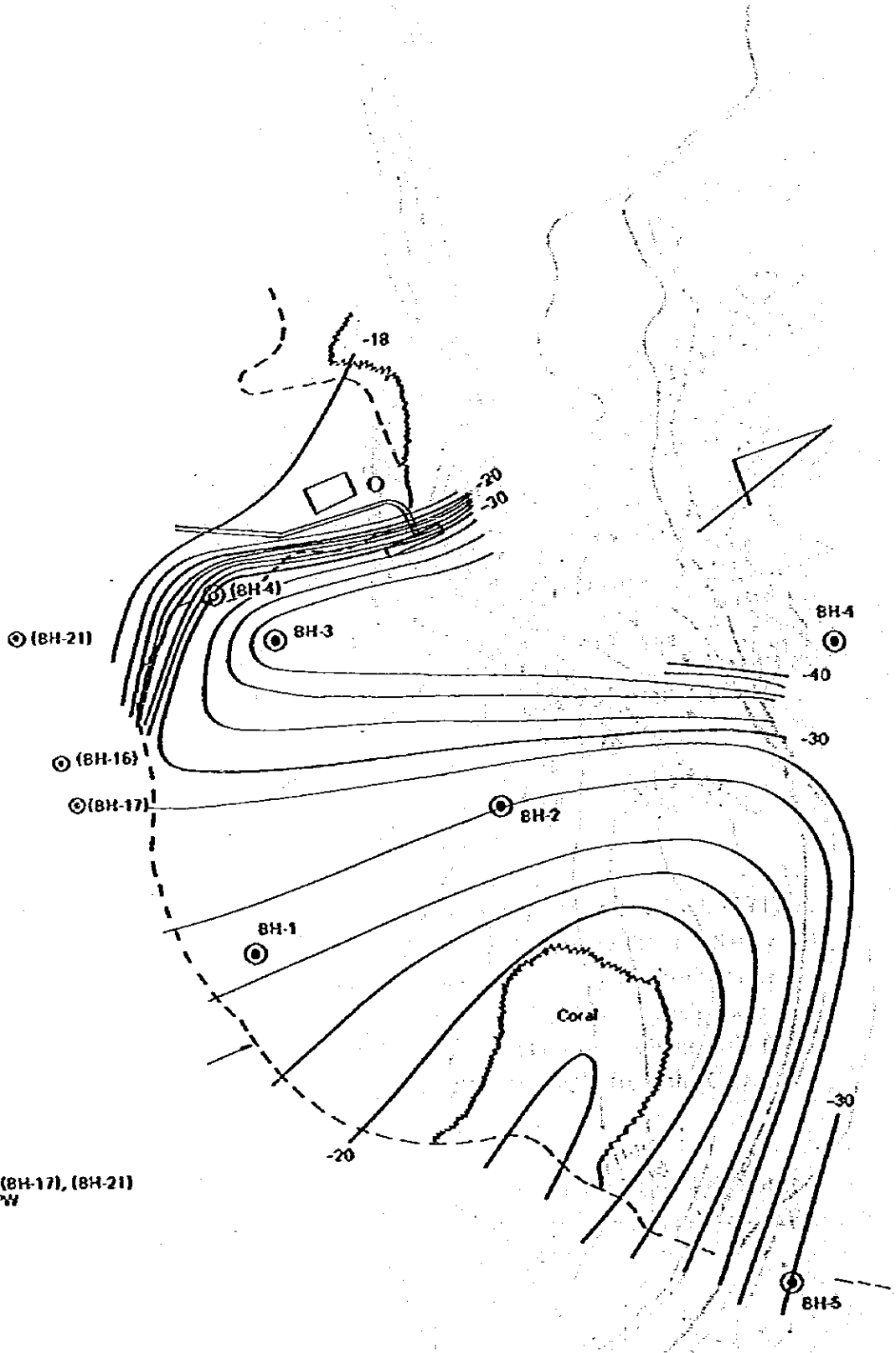


Fig. 6-4 Location of Bore Holes



Note:
(BH-4), (BH-16), (BH-17), (BH-21)
carried out by MPW

Fig. 6-5 Isobatic Map of Bearing Stratum

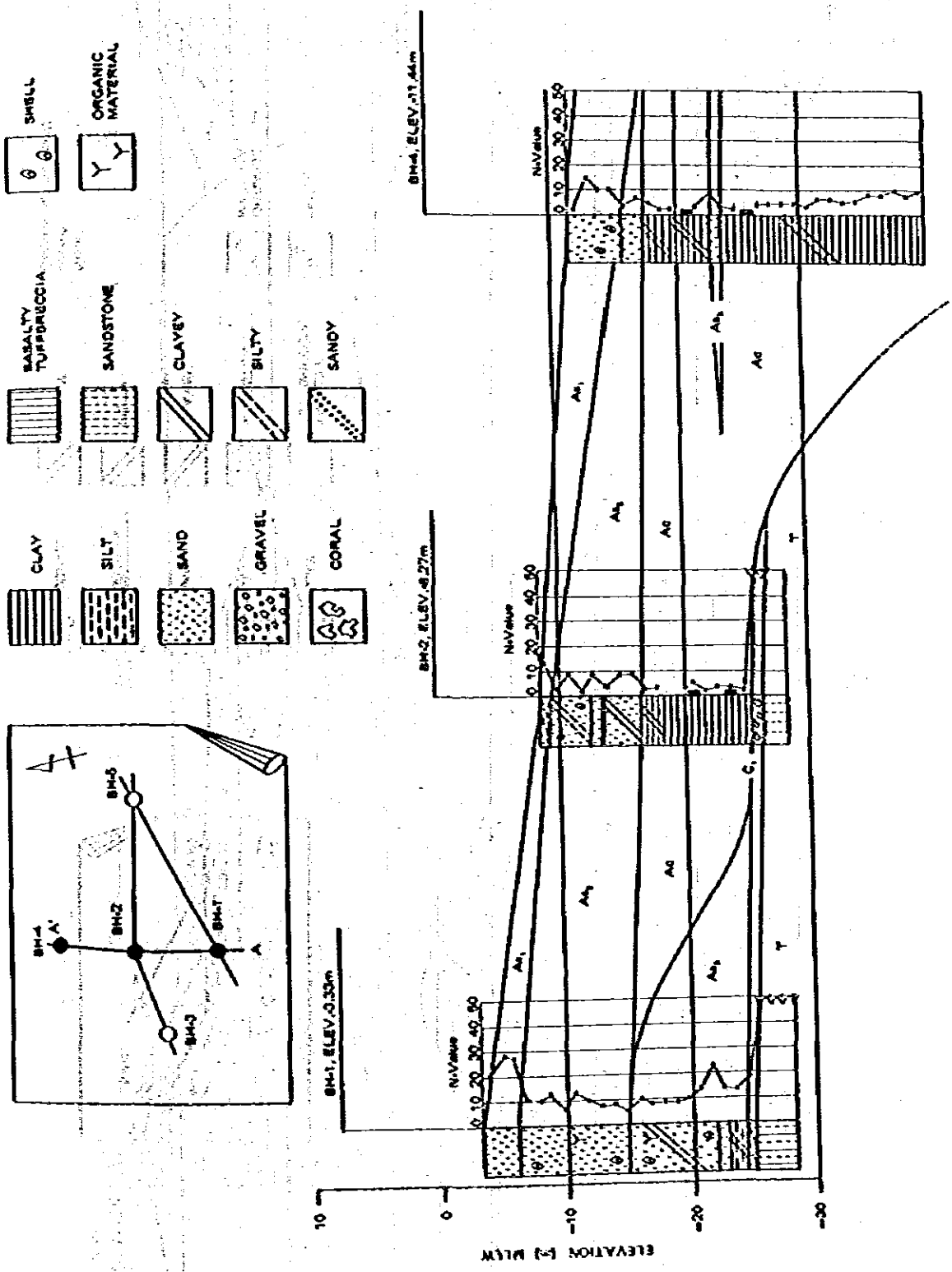


Fig. 6-6 Soil Profile (A-A')

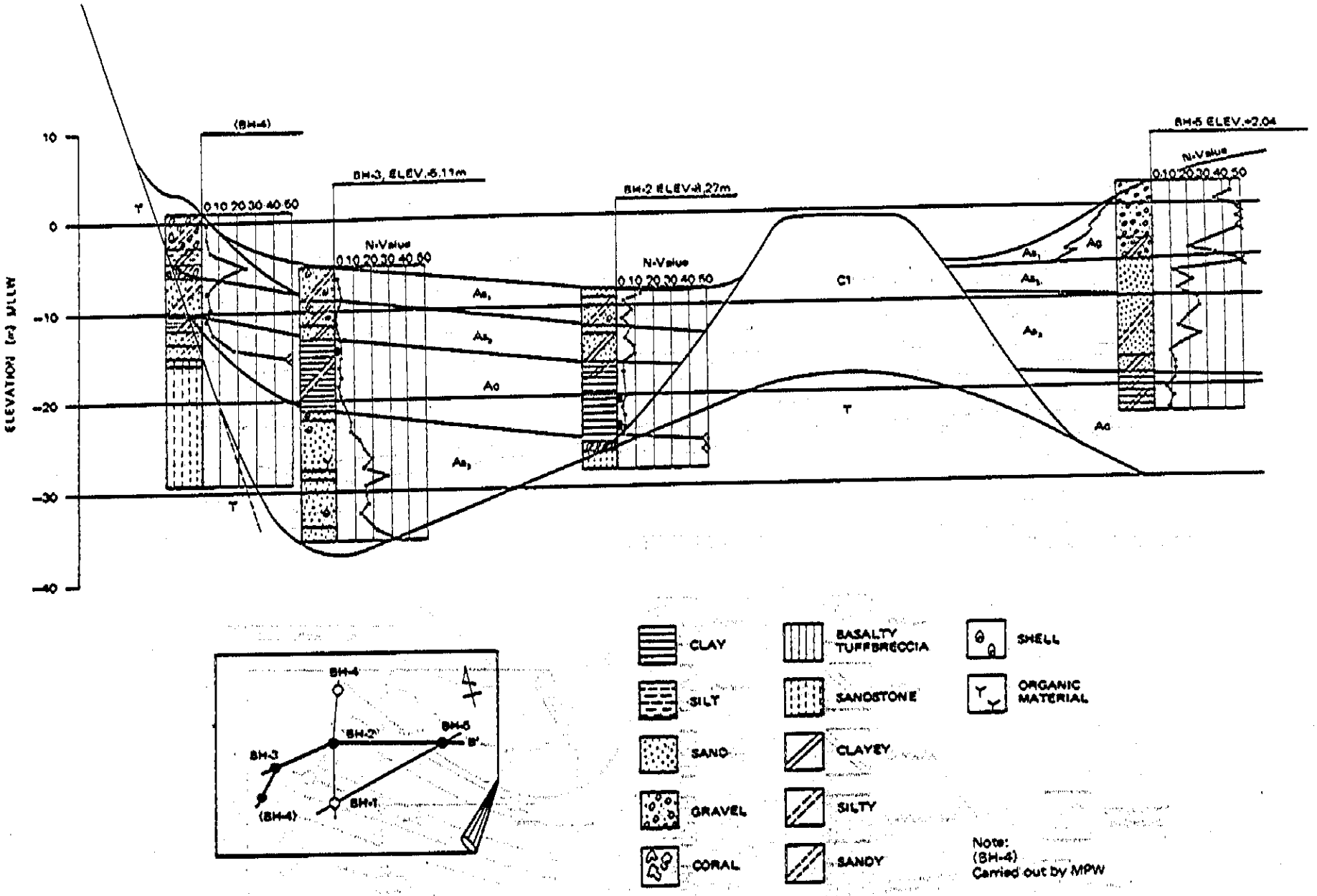


Fig. 6-7 Soil Profile (B-B')

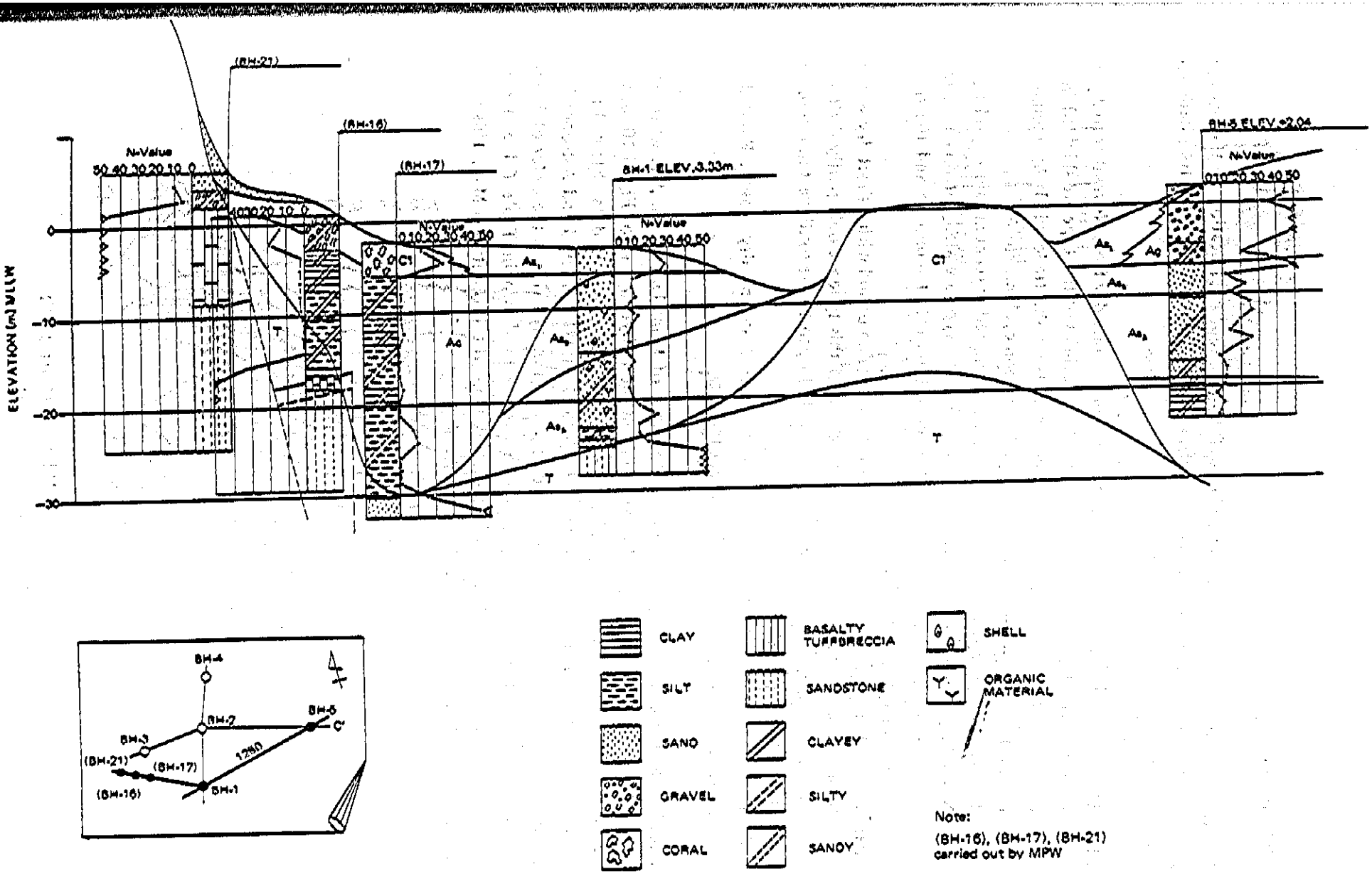


Fig. 6-8 Soil Profile (C-C')

6-2 Meteorology

The climate zone in Philippines falls within the following four classification on the basis of the presence/absence of wet season or dry season. In wet season, the intensity of precipitation is definitely higher than neighboring months.

Type I: This is characterized by two pronounced seasons – one dry from November to April, the other wet during the rest of the year. The localities of this type are shielded from the northeast monsoon and even in good part from the trade winds by mountain ranges. They are open only to the southwest monsoon cyclonic storms.

Type II: This is characterized by no dry season with pronounced maximum rain period from November to January. The regions experiencing this type are along or very near the eastern coast and are sheltered neither from the northeast monsoon and the trade winds nor from cyclonic storms.

Type III: This is characterized by no pronounced maximum rain period with a short dry season lasting from one to three months. The localities of this type are only partly sheltered from the northeast monsoon and trade winds and open to the southwest monsoon or at least to frequent cyclonic storms.

Type IV: This type has no pronounced maximum rain period and no dry season. Rainfall is more or less evenly distributed throughout the year.

According to the Climate Map, Barrio Casambalangan of Municipality Sta. Ana where the Project Port is located belongs to type IV. As shown in the isohyetal map of Fig. 6-10, in the vicinity of casambalangan an annual precipitation is about 3,500 mm. The data obtained from Apparri branch office of the PAGASA (Philippine Atmospheric, Geophysical and Astronomical Services Administration) shows that the annual precipitation in Aparri is in the order of 1,700 mm, rainy days being 165 days per year on an average as shown in Table 6-1 and 6-2. Accordingly the precipitation in Aparri is half of that from the Precipitation Map. This table show the existence of dry season from February to April.

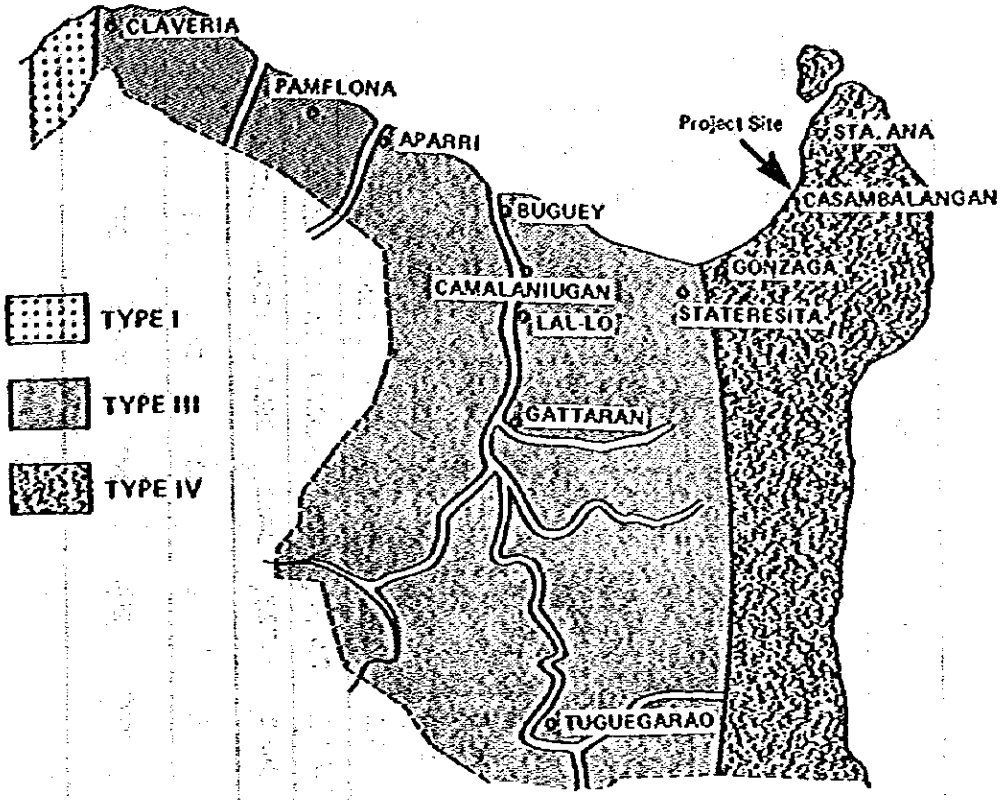


Fig. 6-9 Climate Map

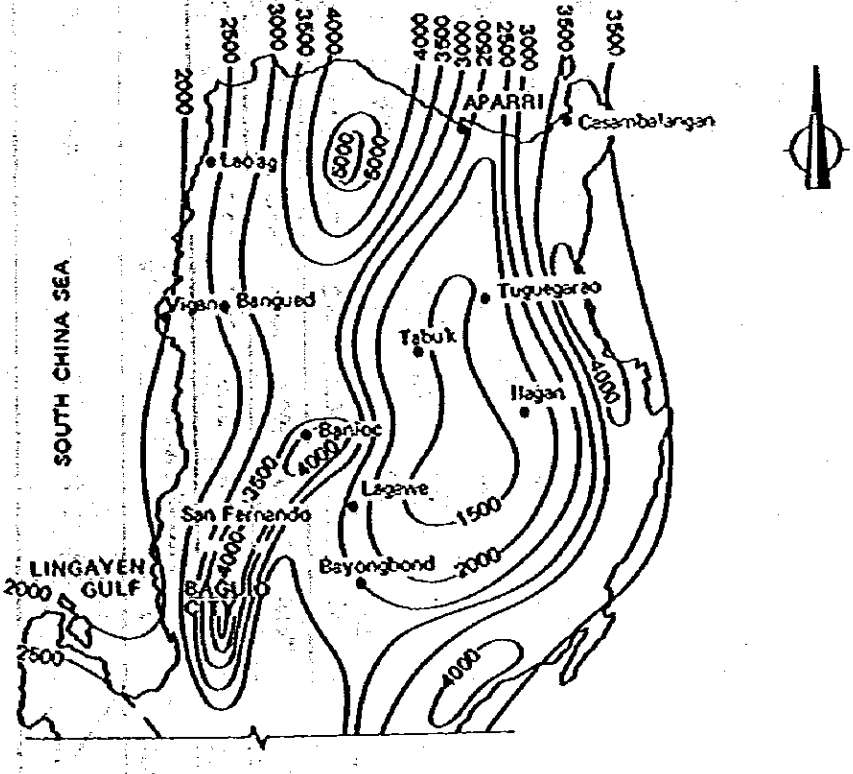


Fig. 6-10 Isohyetal Map
(Annual Average Rainfall in mm)

Table 6-1 Monthly Rainfall (mm/month)
(1971–1980)

Month / Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1971	262.5	102.2	126.0	26.5	15.8	117.1	416.7	158.0	159.0	611.2	566.1	283.5	2,845.3
72	135.8	168.4	106.9	31.4	182.9	67.5	237.3	159.3	170.1	175.7	191.4	37.4	1,664.1
73	111.0	0.2	1.3	0	16.8	143.5	93.6	268.0	208.4	841.0	1,342.2	140.2	3,166.2
74	145.6	67.3	0.9	10.2	7.9	27.4	40.4	216.8	240.5	469.3	528.9	175.7	1,930.9
75	207.4	59.6	17.8	32.8	103.9	124.5	96.1	217.9	40.6	327.6	98.5	179.0	1,505.7
76	17.6	2.0	5.1	4.7	134.4	151.3	50.1	245.2	186.9	303.9	307.8	90.6	1,499.6
77	150.3	63.0	2.1	7.1	36.2	110.1	271.3	54.7	362.0	133.2	270.4	18.2	1,478.6
78	33.9	91.5	46.5	7.7	160.5	108.5	42.1	362.0	346.7	502.2	240.0	199.2	2,140.8
79	2.2	106.2	0	16.5	239.5	18.0	250.0	59.0	80.5	346.5	338.2	73.0	1,529.6
80	111.1	30.2	38.2	12.6	170.5	3.5	408.5	37.2	278.5	395.5	444.4	355.7	2,285.9
Total	1,177.4	690.6	344.8	149.5	1,068.4	871.4	1,906.1	1,778.1	2,073.9	4,106.1	4,327.9	1,552.5	20,046.7
Average	98.1	57.6	28.7	12.5	89.0	72.6	158.8	148.2	172.8	340.2	360.7	129.4	1,670.6

Source: PAGASA-APARRI

Table 6-2 Rainy Day (time/month)
(1971–1980)

Year \ Month	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total
1971	20	14	12	6	8	16	21	9	19	19	29	27	200
72	17	11	10	7	15	12	22	19	15	11	23	14	176
73	14	4	4	2	2	18	17	22	9	24	23	26	165
74	17	12	3	7	10	6	6	19	14	18	22	20	154
75	19	11	10	5	8	19	10	23	6	24	17	24	176
76	23	4	10	4	15	11	6	19	14	20	26	16	167
77	18	12	6	7	9	11	13	9	14	11	26	6	142
78	9	8	5	5	14	10	11	21	30	25	21	22	181
79	3	10	2	5	11	8	16	13	17	17	24	13	139
80	15	6	5	6	10	5	14	5	20	23	22	23	154
Total	155	92	67	54	102	116	136	159	158	192	232	191	1,654
Average	15.5	9.2	6.7	5.4	10.2	11.6	13.6	15.9	15.8	19.2	23.2	19.1	165.4

Scource: PAGASA APARRI

Since the nearest weather station to the Casambalangan Bay is Aparri, the weather data in Aparri has been tentatively used for the study. The occurrency of the average wind by direction and velocity are shown in Table 6-3. From September to March there is the northeast monsoon and during the remaining season the prevailing winds are from the south monsoon. The occurrency of the NE wind and the S wind are 55.5% and 24.8% respectively.

Table 6-3 Occurrency of the Average Wind by Direction and Velocity (1971–1980)

Velocity (knot) / Direction	0		1–6		7–16		17–27		28–40		41–		Total	
	F	%	F	%	F	%	F	%	F	%	F	%	F	%
Clam	7	0.2											7	0.2
N			44	1.3	41	1.2	2	0.1					87	2.5
NW			42	1.2	43	1.2	3	0.1					88	2.5
W			4	0.1	4	0.1							8	0.2
SW			167	4.8	101	2.9							268	7.6
S			699	19.9	168	4.8	3	0.1	1	0.0			871	24.8
SE			39	1.1	33	0.9	1	0.0					73	2.1
E			7	0.1	12	0.3							19	0.5
NE			1180	33.6	697	19.9	69	2.0	3	0.1			1949	55.5
VRBL			67	1.9	72	2.1							139	4.0
Total	7	0.2	2249	64.1	1171	33.4	78	2.2	4	0.1			3509	100.0

F: Frequency VRBL: Variable
Source: PAGASA APARRI

Predominant wind direction of the daily maximum winds is from NE, accounting for 68.2% the all wind data and if inclusive of N and NW winds, constituting about 80%. It's means the land-winds (SW–E wind) is diminished by surrounding geography, while the seawinds (N–NW wind) directly travel over the sea to the weather station. The occurrency of wind speed over 28 knots, which is the critical wind velocity for stevedoring in port operation, accounts for 6.6% and the historical maximum wind speed was 145 knots in NE direction on Oct. 27, 1974.

Table 6-4 Occurrency of the Daily Maximum Wind by Direction and Velocity (1971–1980)

Velocity (knot) / Direction	0		1–6		7–10		17–27		28–40		41–		Total	
	F	%	F	%	F	%	f	%	F	%	F	%	F	%
N			6	0.2	117	3.2	27	0.7	27	0.7	8	0.2	185	5.1
NW			8	0.2	153	4.2	45	1.2	9	0.2	8	0.2	223	6.1
W			2	0.1	153	4.2	3	0.1					22	0.6
SW			17	0.5	170	4.7	23	0.6	6	0.2	5	0.1	221	6.1
S			72	2.0	268	7.4	24	0.7	4	0.1	3	0.1	371	10.2
SE			11	0.3	72	2.0	7	0.2	3	0.1			93	2.6
E			1	0.0	28	0.8	6	0.2	1	0.0	1	0.0	37	1.0
NE			209	5.8	1593	44.0	504	13.9	123	3.4	40	1.1	2469	68.2
Total			326	9.0	2418	66.8	639	17.6	173	4.8	65	1.8	3621	100.0

F: Frequency
Source: PAGASA APARRI

6-3 Oceanography

(1) Tide

The Study Team carried out tidal observation at the site for one month. The result of the tidal observation is shown in Fig. 6-11. The datum line which is equal to M.L.L.W. has been derived from the bench mark, BM-PORT: MLLW + 2.865 m, established at the reclamation area near to the existing pier. As can be seen from these results, there is slight diurnal inadequancy. The highest tidal elevation during the investigation term was 1.25 m and the lowest one was −0.45 m.

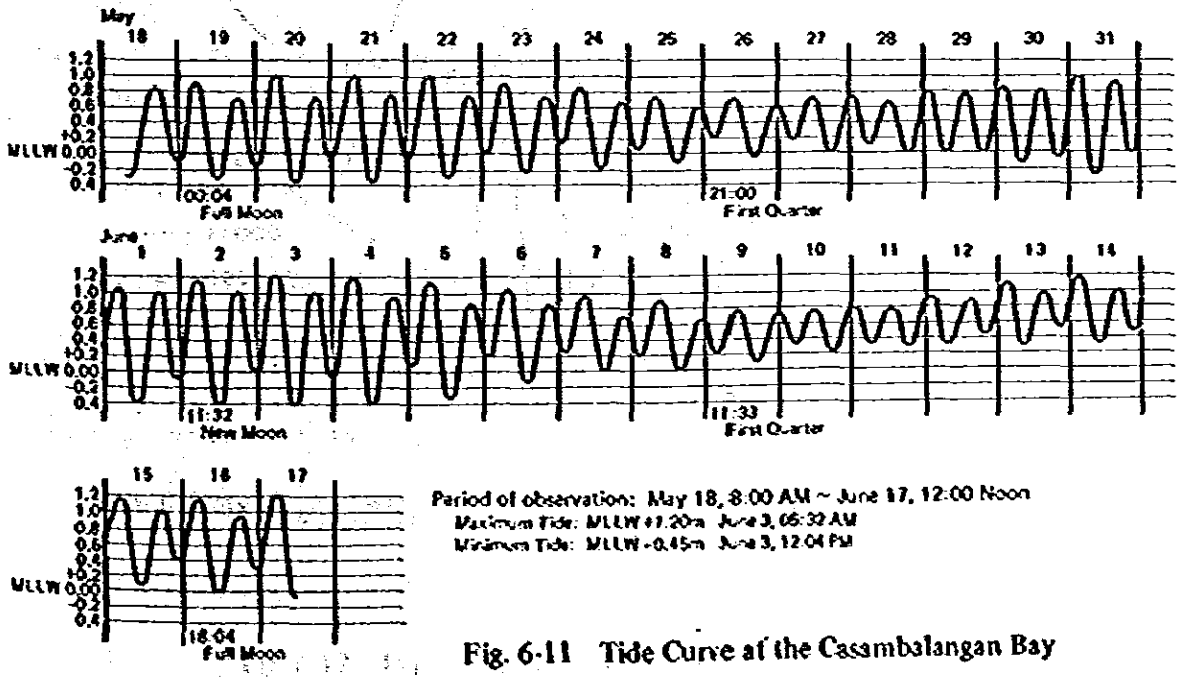
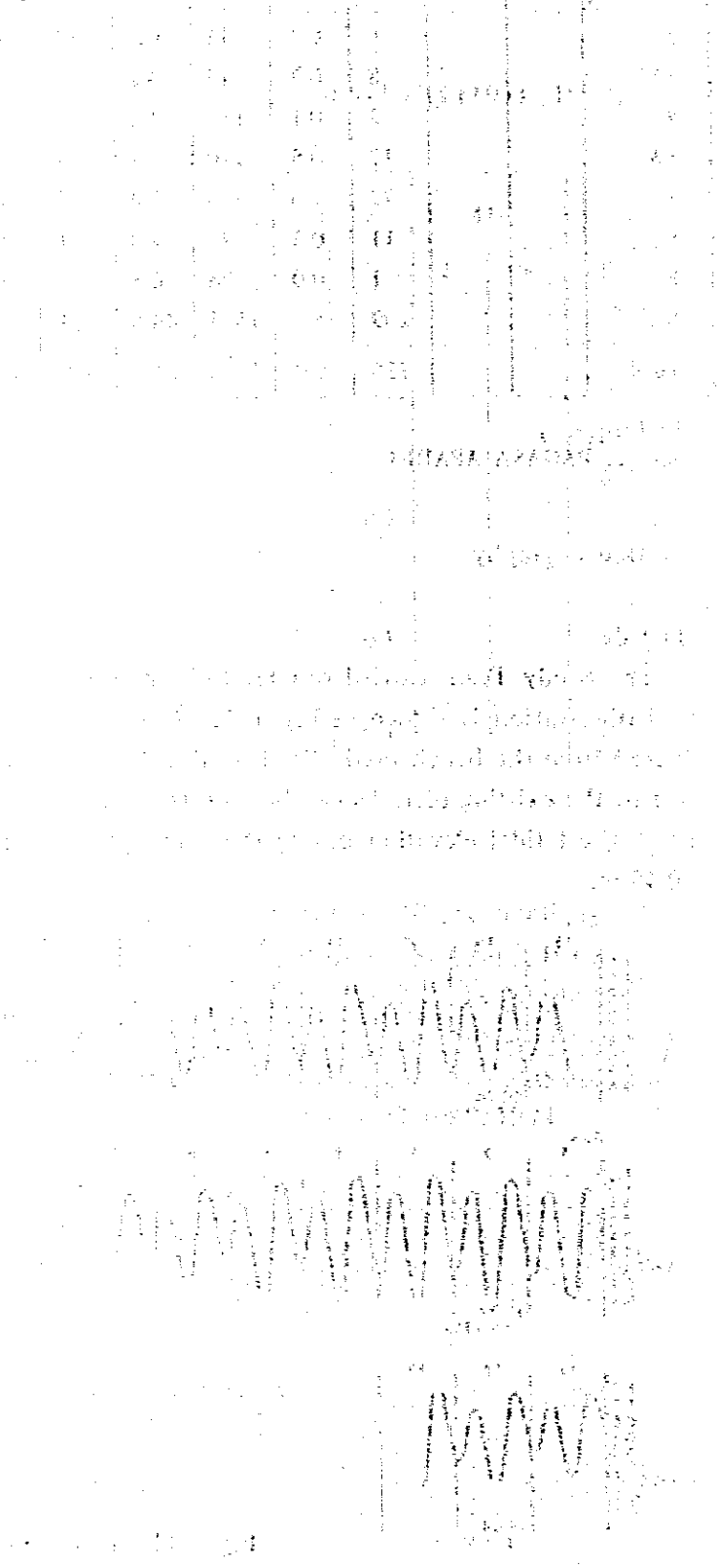


Fig. 6-11 Tide Curve at the Casambalangan Bay

(2) Tidal Currents

The Study Team measured the tidal current at the Casambalangan Bay by use of floats. This tidal current measurement has clarified the prevailing current direction which is in the direction of SSE–SSW at flooding tides and in the direction of NNE–NE at ebbing tides. The maximum speed of the tidal currents observed during the investigation period was about 0.15 m/sec.



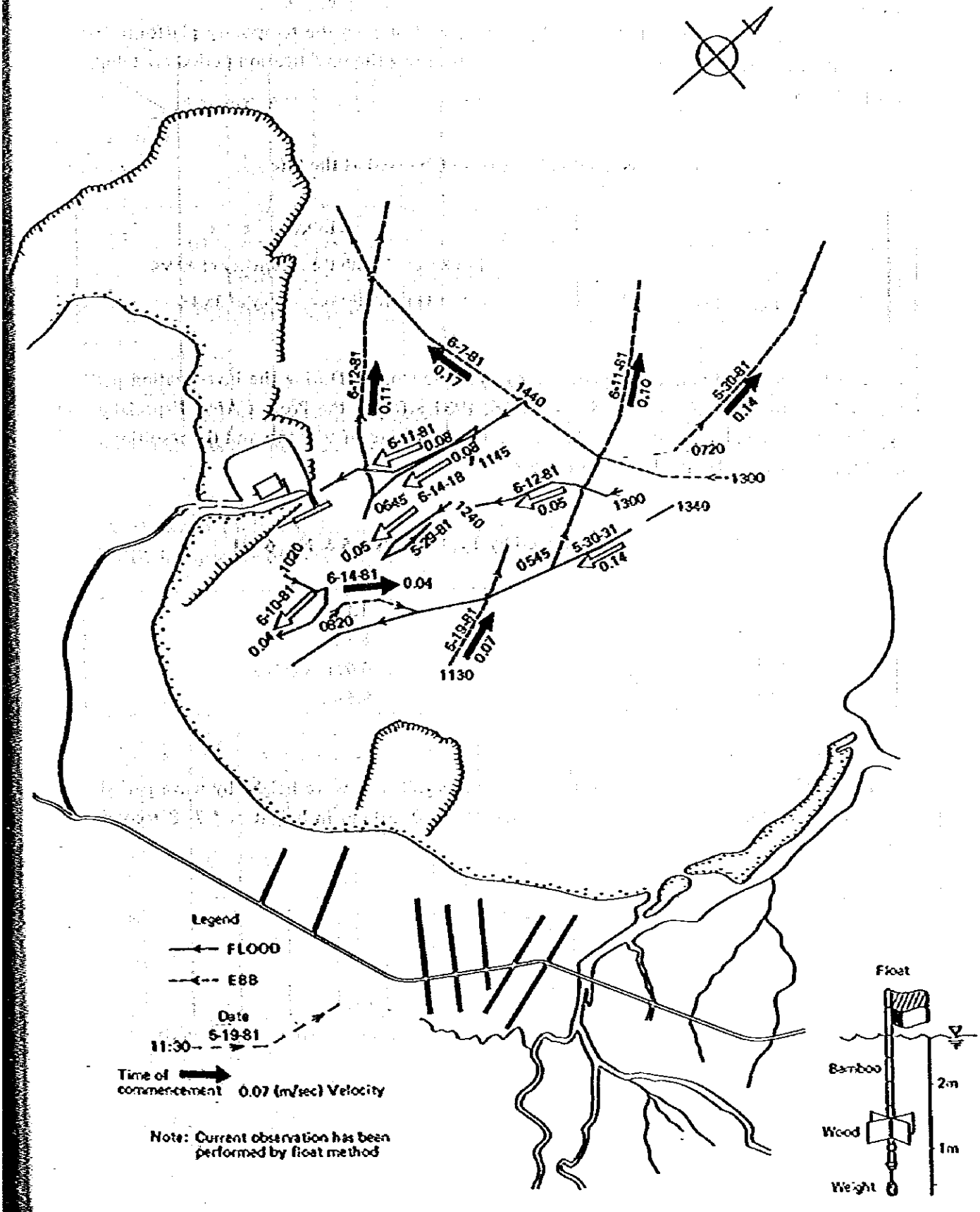


Fig. 6-12 Typical Tidal Currents at Casambalangan Bay

(3) Waves

The Study Team conducted wave observation by installing the temporary platform 750 m east of the existing pier. The significant wave heights during the investigation period are tabulated on Table 6-5.

Table 6-5 Predominant Wave Observed at the Site

Direction	N to NW
Period	7 to 8 seconds with the occurrency of 49.9%
Hight (H1/3)	0.2–0.3 m with the occurrency of 38.4%

The Luzon Island is frequently striken by cyclonic storms. During the investigation period, the cyclonic storms typhoon No. 5 and No. 6, 1981 affected the Project Area. Especially the typhoon No. 5 was large scaled one with the central pressure of 970 mb and the resulting wave heights recorded was H max 1.15 m at the site.

Table 6-6 Wave Developed by Typhoons No. 5 & No. 6 '81

H max	1.15 m
T max	8.3 sec
H1/3	0.60 m
T1/3	9.6 sec

Table 6-7 shows the frequency of maximum and significant wave height by wave period. In most of the times, the significant waves are less than 20–30 cm in height and 7–8 seconds in wave periods.

Table 6-7 Frequency of Wave Height by Wave Period

Wave Height / Wave Period	H 1/3m 0.00 ≤ 0.20	0.21 ≤ 0.30	0.31 ≤ 0.40	0.41 ≤ 0.50	0.51 ≤ 0.60	Total	MAXIMUM WAVE 0.00 ≤ 0.60	0.41 ≤ 0.50	0.51 ≤ 0.60	0.61 ≤ 0.70	0.71 ≤ 0.80	0.81 ≤ 0.90	0.91 ≤ 1.00	1.01 ≤ 1.10	1.11 ≤ 1.20	Total
0.0 - 5.0 (sec)																
5.1 - 6.0		1 (3.3)				1 (3.3)										
6.1 - 7.0		3 (10.0)				3 (10.0)	1 (3.3)		1 (3.3)	1 (3.3)						3 (9.9)
7.1 - 8.0	3 (10.0)	9 (30.0)	1 (3.3)	1 (3.3)	1 (3.3)	15 (49.9)		3 (10.0)	4 (13.3)	1 (3.3)	3 (10.0)	1 (3.3)				12 (39.9)
8.1 - 9.0		2 (6.7)	3 (10.0)	2 (6.7)		7 (23.4)	1 (3.3)	4 (13.3)	1 (3.3)			1 (3.3)			1 (3.3)	8 (26.5)
9.1 - 10.0	1 (3.3)	1 (3.3)	1 (3.3)	1 (3.3)		4 (13.2)		1 (3.3)	1 (3.3)	1 (3.3)			1 (3.3)			4 (13.2)
10.1 - 11.0												1 (3.3)				1 (3.3)
11.1 - 12.0										1 (3.3)		1 (3.3)				2 (6.6)
Total	4 (13.3)	16 (53.3)	5 (16.6)	4 (13.3)	1 (3.3)	30 (100)	2 (6.6)	8 (26.6)	7 (23.2)	4 (13.2)	3 (10.0)	4 (13.2)	1 (3.3)		1 (3.3)	30 (100)

Note: The figures in parenthesis mean the percentages.

As shown in Table 6-8, the wave directions of significant waves are concentrated between NW and NNW irrespective of wave heights.

Table 6-8 Frequency of Wave Height by Wave Direction

Direction / Height(m)	S	SSW	SW	WSW	W	WNW	NW	NNW	N	NNE	NE	ENE	E	ESE	SE	SSE	TOTAL
0.00 - 0.20							46 (22.7)	6 (3.0)	1 (0.5)								53 (26.1)
0.21 - 0.30							69 (34.0)	6 (3.0)	3 (1.5)								78 (38.4)
0.31 - 0.40					4 (2.0)		30 (14.8)	3 (1.5)	4 (2.0)	3 (1.5)							44 (21.7)
0.41 - 0.50					3 (1.5)		13 (6.4)	4 (2.0)	2 (1.0)								22 (10.8)
0.51 - 0.60							4 (2.0)		2 (1.0)								6 (3.0)
TOTAL					7 (3.4)		162 (79.8)	19 (9.4)	12 (5.9)	3 (1.5)							203 (100%)

Note: The figures in parenthesis mean the percentages

As easily understood from the above tables, the predominant waves at the site are swells. This is based on the fact that the waves of 4–6 sec which is generated in the vicinity of the Republic of China travel through the islands up to the Casambalangan Bay with decreasing wave heights and increasing wave periods.

The data collected through a series of site investigation mentioned hereabove is limited to only one month (May 24 '81–Jan. 22 '81), so that these data is not sufficient enough to conclude the port layout and proceed with the detailed designing of the port facilities.

The data of wave observation and wave prediction at the Babuyan Channel has not been collected, so it is required that the wave forecasting is carried out using the wind data obtained at the site. Since the Casambalangan Bay where the project port is planned opens to northwest, the winds from northeast and east are sheltered by the Palaui Island and San Vicente peninsula respectively, and on the west also sheltered by the coral reaf extending at the mouth of the bay. This natural condition keeps calm inside the Casambalangan Bay. However, the offshore waves from northwest prevails inside the Bay directly without an interference. Therefore this waves is most critical waves for port planning. In the direction of northwest, several islands are located 50–120 Km away from the Casambalangan Bay, namely the Camiguin Island, Calayan Island, Fuga Island and etc.. These islands protect the Bay against the offshore waves, so that the wave forecasting has been carried out inside this area.

The offshore waves for the Casambalangan Bay has been developed by S.M.B. method in which the wind data observed, the assumed fetch length and the shoaling effect are fully used. As mentioned before, the wave directions concerned are limited to N, NNW and NW, since the mouth of the bay is open to N–NW. The effective fetch length to be applied for the Saville formula are between 30–50 Km, depending on wave directions as tabulated in Table 6-9.

Table 6-9 Effective Fetch Length

Direction of Wave	Effective Fetch
N	34 Km
NNW	58 Km
NW	57 Km

In terms of planning the port layout, it is quite essential to estimate the workable days inside the port throughout the year. It is said that the critical wave height in front of the berth allowing the work of stevedoring is 70 cm. The wind speed capable of developing this wave height at the berth area can be figured out to be about 10 m/sec. The corresponding wave periods are in the order of 4–5 seconds.

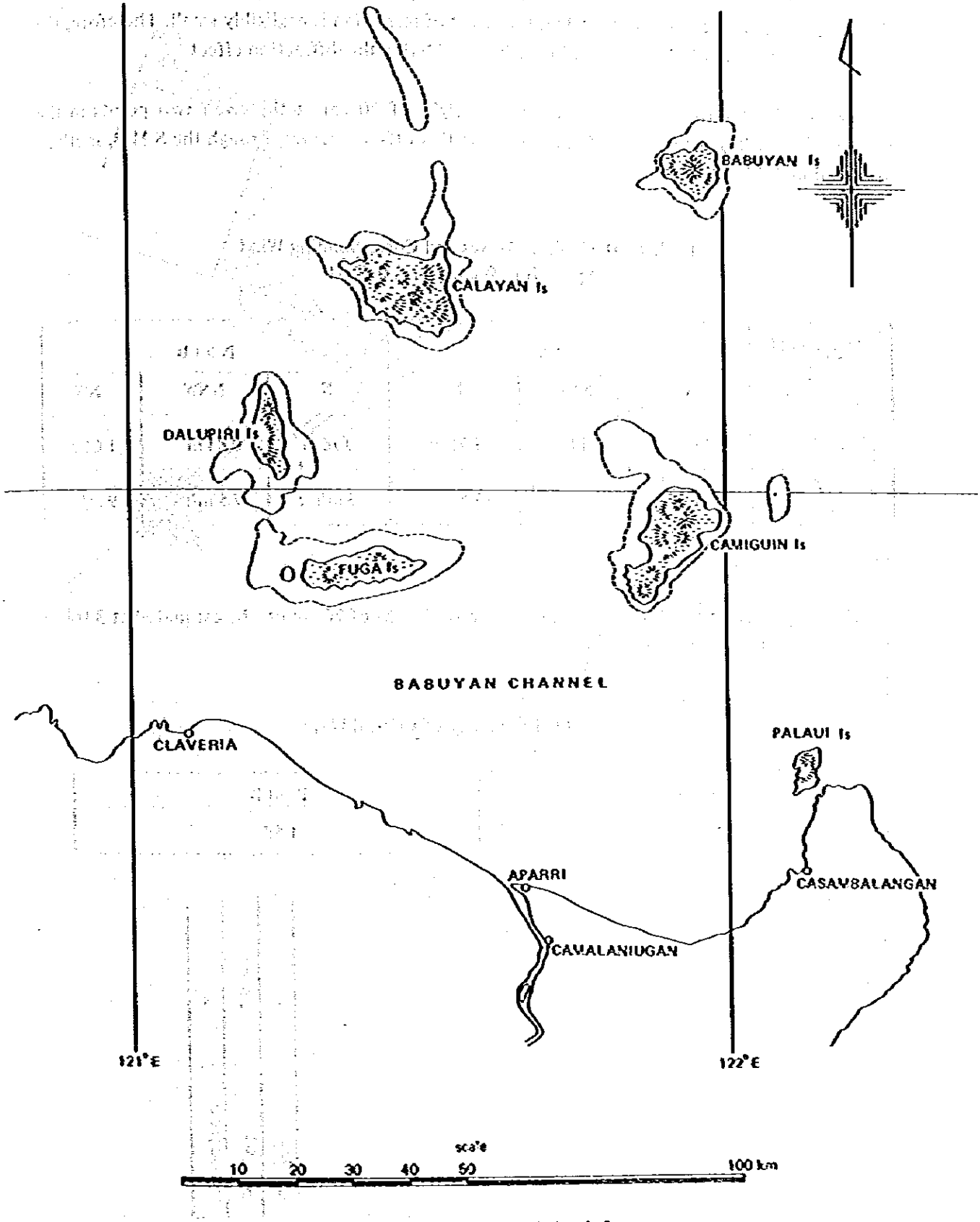


Fig. 6-13 Sea Chart of North Luzon

These short-period waves are slightly affected by shoaling effect, so that even in case of dredging the port area down to −10 m, the effect of refraction is negligibly small. Therefore, the shallow water waves can be developed only by considering the diffraction effect.

The offshore waves resulting in the wave height of 70 cm at the given two points in the Casambalangan Bay, and the wind speed causing this offshore waves through the S.M.B. method are listed in Table 6-10.

Table 6-10 Offshore Waves and Corresponding Wind Speed for 70 cm Waves in Port

Direction of Wave / Item	Point A			Point B		
	N	NNW	NW	N	NNW	NW
Offshore wave height	0.98 m	1.17 m	1.75 m	0.76 m	0.84 m	1.06 m
Wind velocity for the above	9.5 m/sec	9 m/sec	13.5 m/sec	8 m/sec	7.5 m/sec	9 m/sec

The frequency of winds causing the critical wave height of 70 cm can be estimated at 3.0% at the point A and 1.5% at the point B.

Table 6-11 Frequency of Critical Waves

Point A	Point B
3.0%	1.5%

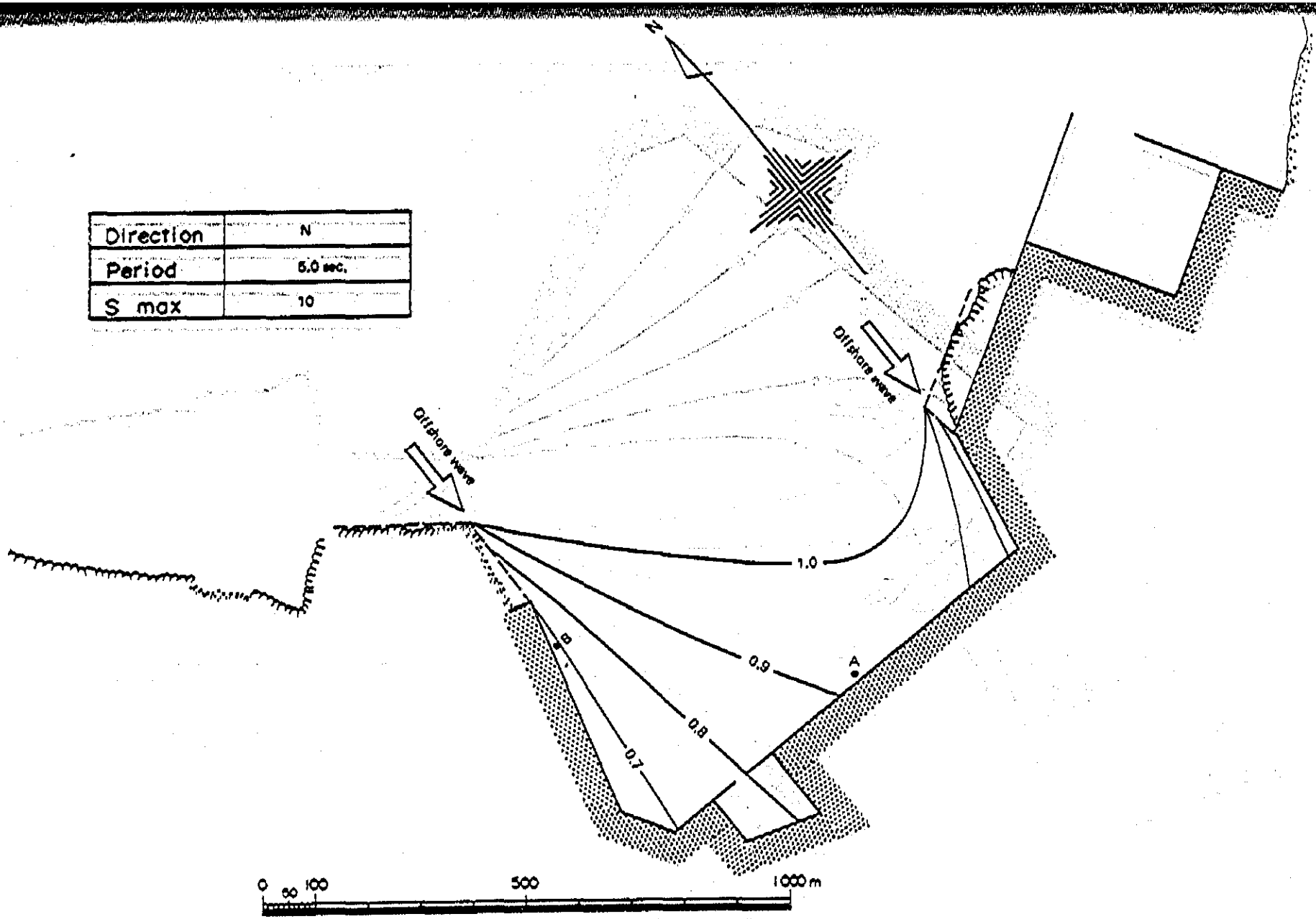


Fig. 6-14 Diffraction Diagram (1)

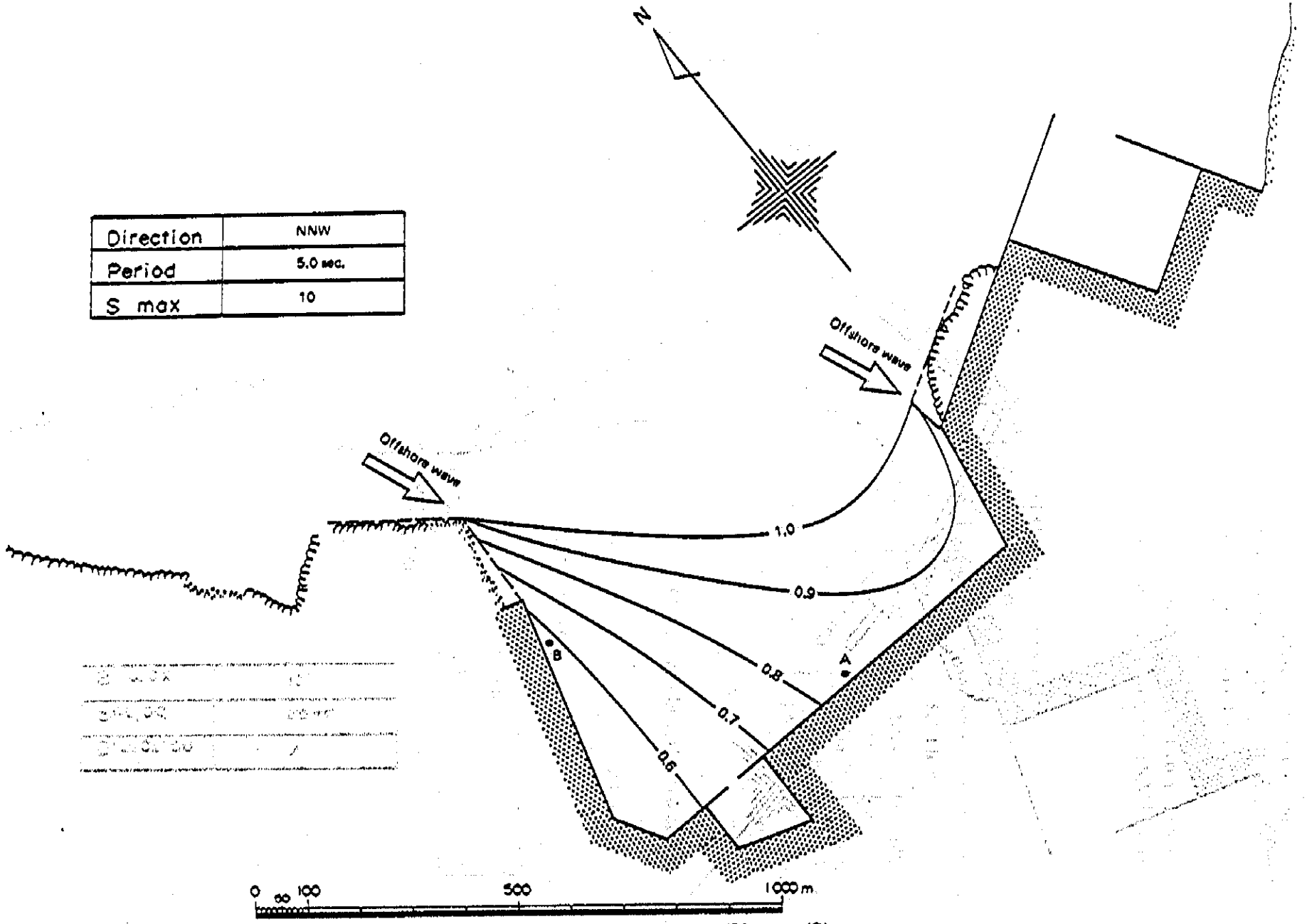


Fig. 6-15 Diffraction Diagram (2)

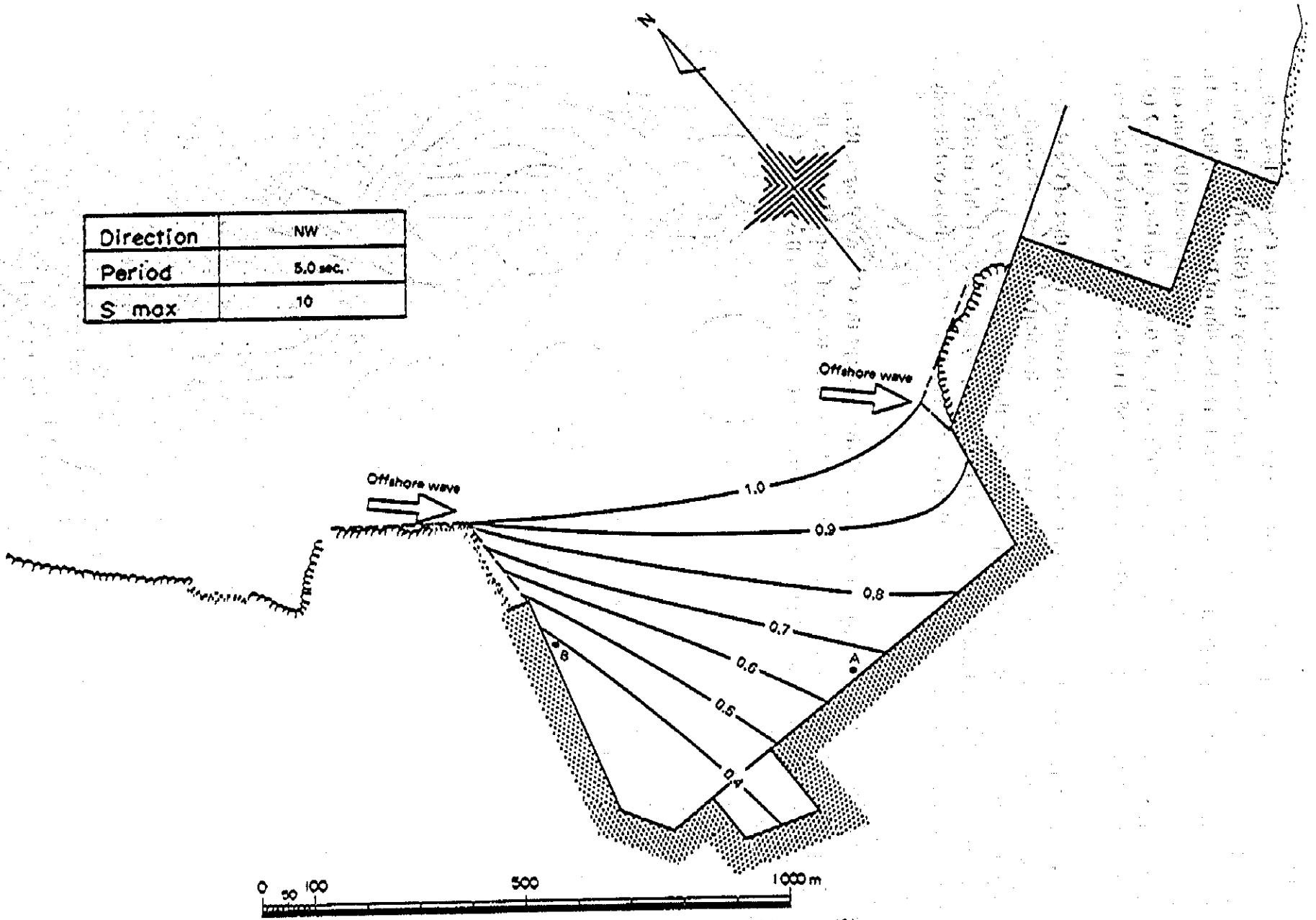


Fig. 6-16 Diffraction Diagram (3)

(4) Littoral Drift

In order to evaluate the soil characteristics of the sea bottom in the Casambalangan Bay, a total of 5 bottom sampling was carried out and the laboratory test (Size and Grain Analysis, Specific gravity and water content) was also conducted. The location of bottom sampling and the result of the tests are shown in Fig. 6-17. The mediam diameter of grain is about 0.09 mm on the spot SS-1, SS-5 (the west coast and east coast of the bay) and 0.07 m on the spot SS-2 (shore side, center of the bay) and about 0.03 mm on the spot SS-4 (offshore side, center of the bay).

This result reveals that the grain size of the offshore side is smaller than that of the shore side. The Casambalangan River, which is the main origin of sedimentation into the Casambalangan Bay, travels down along the coast about 1 Km before flowing into the bay. In dry season this river mouth is trapped and river water flows into the sea only by percolation, while in wet season with an increase of river flow, this river mouth is opened, and river sediment flows out directly to the sea.

In this Casambalangan Bay, there is no critical rivers except this Casambalangan River that affects the siltation on the proposed port area. Therefore in term of port planning, the area required for siltation study is limited to the east half of the Casambalangan Bay.

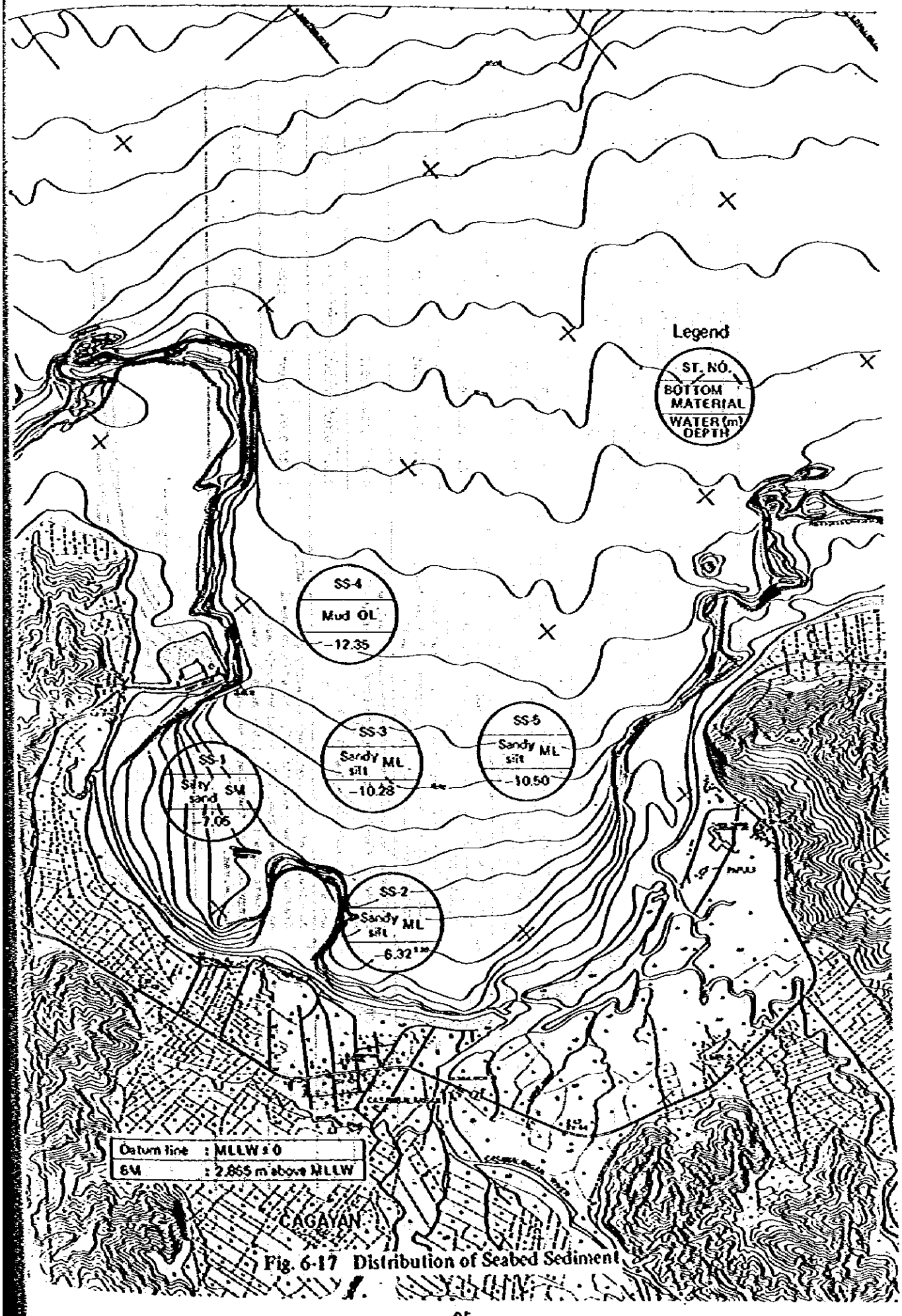


Fig. 6-17 Distribution of Seabed Sediment

Table 6-12 Characteristics of Sediment

Location No.		Sampling Date	Visual inspection: Log	Soil Classification	Description	Mechanical analysis: D25 (mm)	D50 (mm)	D75 (mm)	Coefficient of Grain size So=√D75/D25	Skewness Sk=D25×D25/D50
SS-1	1	Jun 2,1982		Dark gray Fine Sand	Particular of soil are black basaltty particle 40%, Gray sandstone particle 40%, White Calcite 10%, Cream white shell and corals particle less than 10%, Red brown volcanic ash deposit less than 5%, with traces of white brown shell fragments 10-15mm, and dark gray fine gravels 2-3mm ϕ. Smell-less.	0.079	0.093	0.123	1.25	0.10
	2	"				0.064	0.091	0.120	1.37	0.08
SS-2	1	"		Dark gray brown Very fine Sand	Particular of soil are brown volcanic ash depsit 60%, Gray sandstone particle 30%, Black basaltty particle less than 5%, with traces of Brown clayey particle, White brown shell fragments 0.5 to 2mm ϕ, Organic materials, and Fishy smell.	0.043	0.07	0.092	1.52	0.06
	2	"				0.04	0.075	0.106	1.63	0.06
SS-3	1	Jun 3,1982		Brown gray Very fine Sand	Particular of soil are gray sandstone particle 50%, black basaltty particle 20%, brown volcanic ash deposit 20%, White shell particle less than 5%, Organic material less than 5%, with traces of white brown and white shell fragments 0.5 to 2mmϕ, brown clayey particle. Little fishy smell	0.023	0.036	0.055	1.55	0.04
	2	"				0.054	0.066	0.085	1.25	0.07
SS-4	1	"		Dark gray Mud	Particular of soil are Dark gray clayey mud, with traces of shell fragments 1 to 3mmϕ and organic material. Floating fine-grained soil. Bad smell.	0.011	0.024	0.037	1.83	0.02
	2	"				0.015	0.031	0.045	1.73	0.02
SS-5	1	"		Brown gray Fine Sand	Particular of soil are black basaltty particle 40%, Gray sandstone particle 40%, White brown shell particle less than 10%, brown volcanic ash deposit less than 10%, with traces of shell fragments less than 2mm ϕ and organic material smell-less.	0.027	0.05	0.095	1.88	0.05
	2	"				0.028	0.058	0.093	1.82	0.05

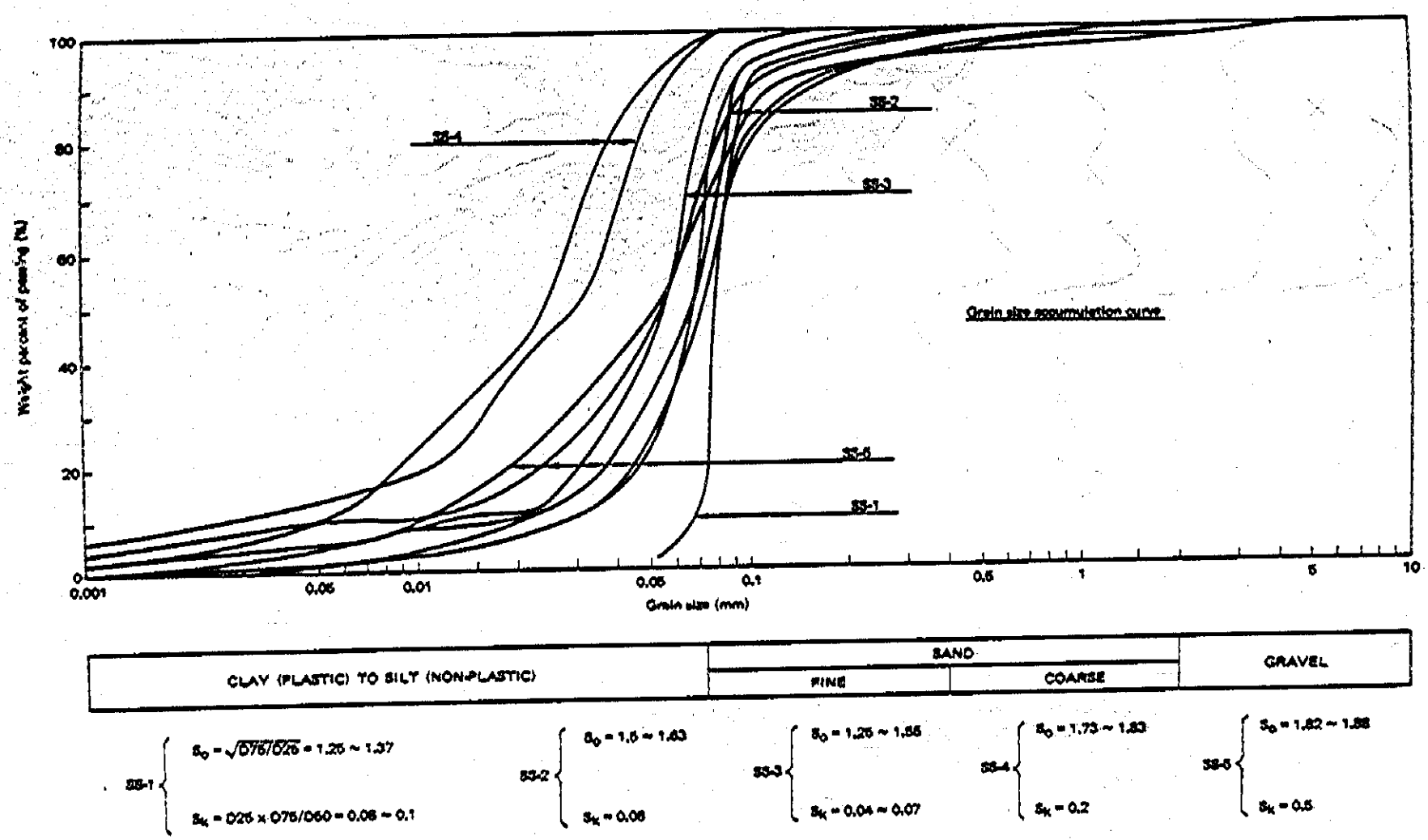


Fig. 6-18 Particle Size Distribution of Sediment

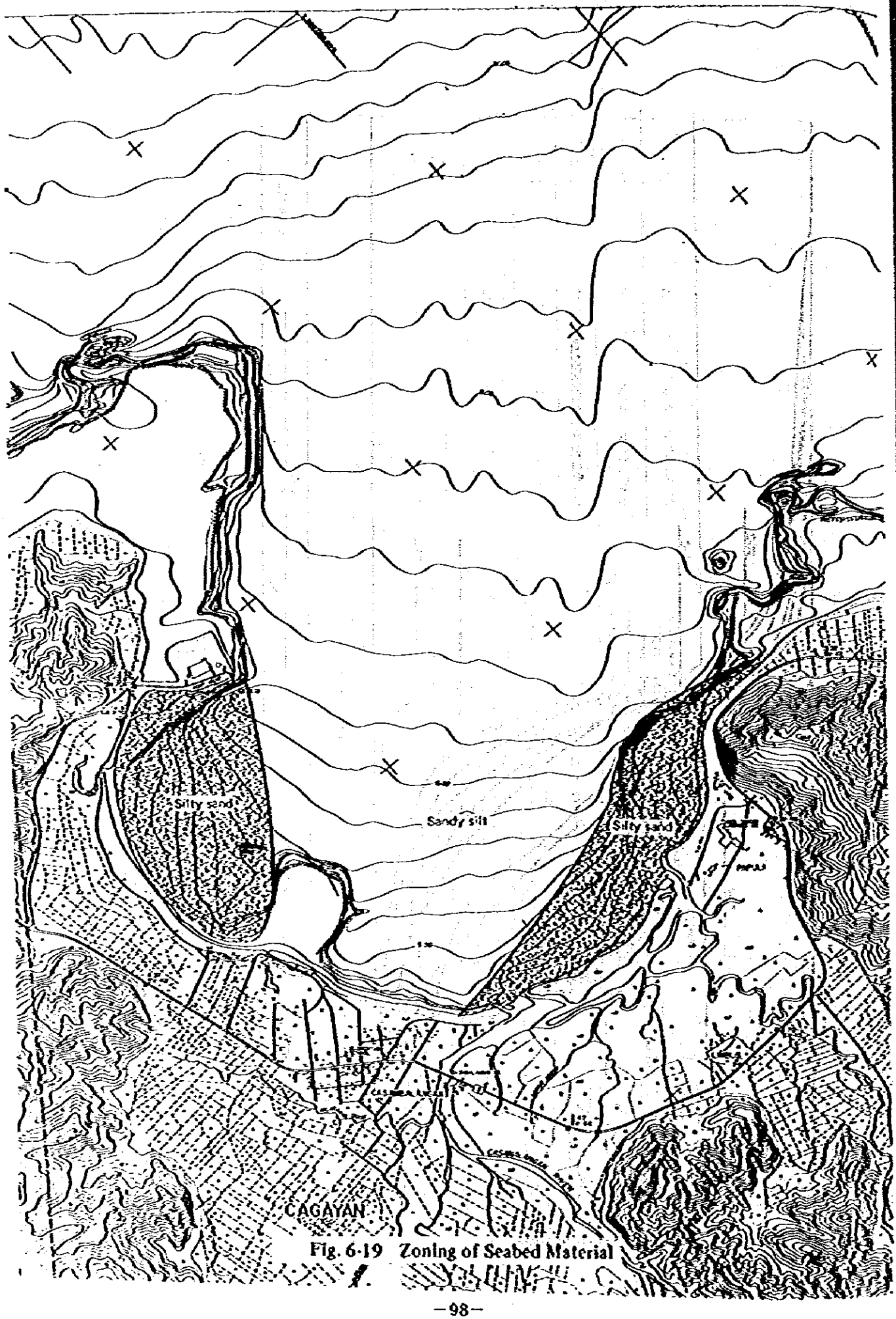


Fig. 6-19 Zoning of Seabed Material