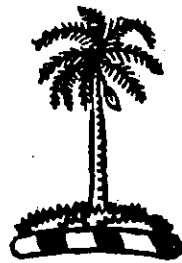# URBAN TRANSPORT STUDY

IN

GREATER METROPOLITAN AREAS

OF

GEORGETOWN, BUTTERWORTH AND BUKIT MERTAJAM

MALAYSIA

PORT AND HARBOUR STUDY

TECHNICAL REPORT - 12

DECEMBER 1979

JAPAN INTERNATIONAL
COOPERATION AGENCY

GOVERNMENT OF
MALAYSIA

PORT AND HARBOUR STUDY

CONTENTS

1.   Outline of the Port

1.1   Site Conditions

(i) Natural Conditions

The Port of Penang is the second largest port in Malaysia, situated on the north end of the west coast of Peninsular Malaysia. Penang is renowned as a safe port, endowed with a natural harbour covering an extensive area of sheltered water between the Island of Penang and Province Wellesley. The channel is 1.75 miles wide at its throat. The port in located partly on the island and partly on Province Wellesley.

The anchorage has a natural depth of 40 feet in excess of the Admiralty Chart Datum (A.C.D). However, the North Channel, which is used as the access for ocean going vessels, with a low water depth of 26 feet A.C.D., is presently too shallow to permit the port to accommodate deep draft vessels.

The South Channel for coasters has a depth of 22 feet.
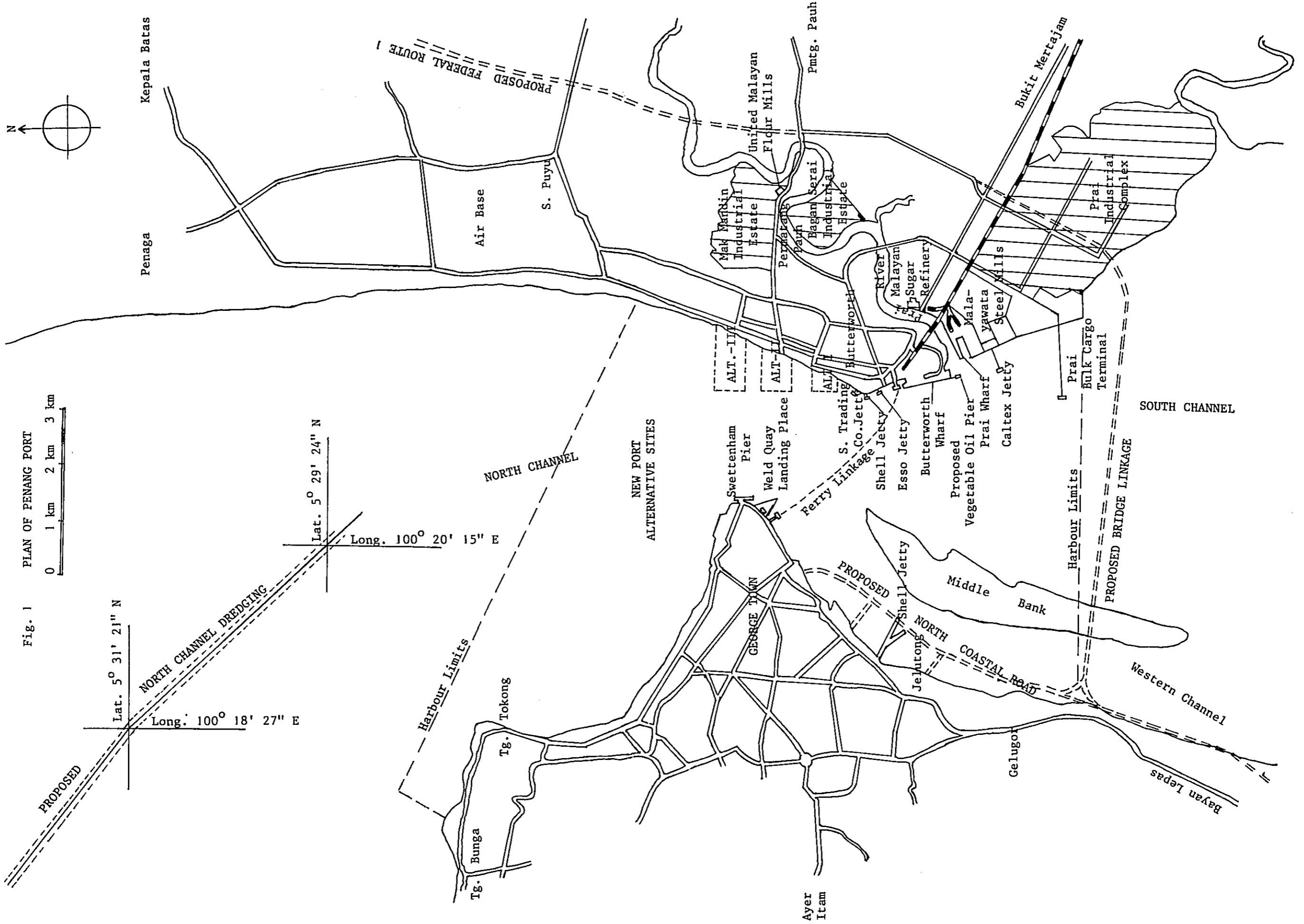
Fig. 1   PLAN OF PENANG PORT

(ii) Port Hinterland

The hinterland of the Port of Penang covers the whole of
North West Peninsular Malaysia, including the states of Perlis,
Kedah, Penang and most of the state of Perak. The southern region
of Thailand in the north is also included.

To the south, the Port of Penang must compete with Port
Klang in the state of Selangor. In the tributary area east of the
Port of Penang, the hinterland is limited by mountain range at
present. However, with the opening of the East-West Highway in
the near future, the hinterland will extend to the northern part
of the Kelantan State.

Within the port hinterland, agriculture is the predominant
form of economic activity in the states of Perlis and Kedah,
manufacturing, in the State of Penang and mining, in the State
of Perak.

The main exports from the hinterland are primary products and
manufactured goods.

The main exports consists of raw materials and semi-processed
products for the new industries that are being established in the
estates in the port hinterland in Province Wellesley.
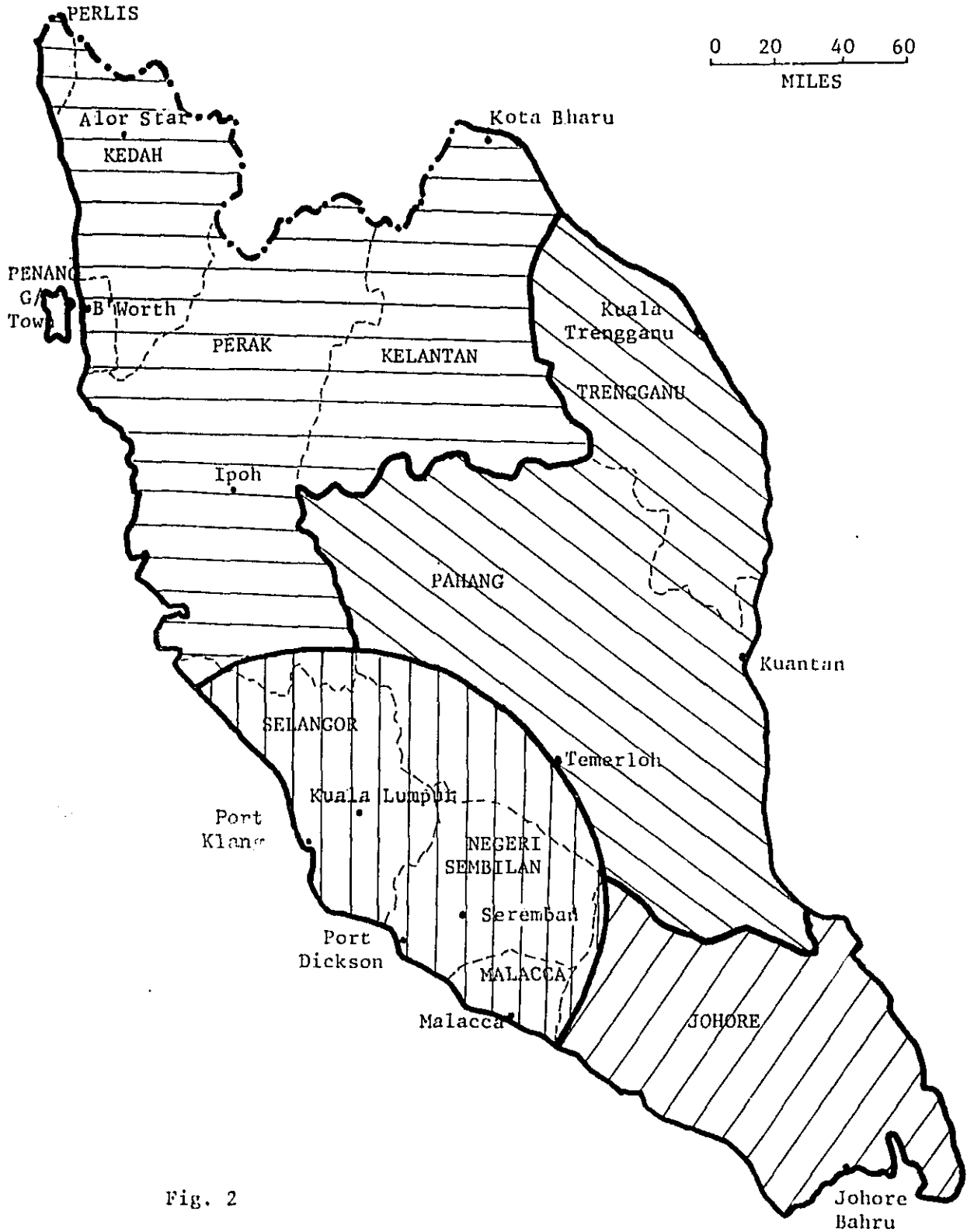
Fig. 2

Hinterlands of West Malaysian Ports.

(iii) Socio-Economic Conditions

a) Population

Population data for Peninsular Malaysia are available from the 1970 housing and population census and the Department of Statistics estimates. The projected population for the port hinterland is as shown in Table 1.

Table 1

Projected Population for the Port Hinterland

('000 persons)

State	1970	1975	1980	Aver. Annual '70 - '75	Growth Rate '75 - '80
Kedah/Perlis	1,076	1,206	1,354	2.3 %	2.3 %
Penang	776	864	968	2.2	2.3
Perak	1,569	1,750	1,955	2.2	2.2
Total	3,421	3,820	4,277	2.2	2.3
Peninsular Malaysia	8,809	10,062	11,554	2.7	2.8

Source: "Population Projections for the States of Peninsular Malaysia 1970 - '80 Department of Statistics.

In the above table, the average annual growth in the port tributary area is estimated at a lower rate as compared to that of the whole of Peninsular Malaysia.

In the population study of the present Urban Transport Study, the future population of the State of Penang from 1981, has been estimated at an annual growth rate of 2.4% based on various data source.

The future population projection for the port hinterland may be summarized as given in Table 2 on the basis of the future population of the remaining three states estimated from data given in the "Third Malaysia Plan".

Table 2

Future Population of the Port Hinterland

('000 persons)

State	1980	1985	1990	2000	Aver. Annual Growth Rate '80 – '90
Kedah/Perlis	1,370*	–	1,657*	–	1.9%
Penang	968	1,090	1,227	1,555	2.4
Perak	2,034	–	2,505*	–	2.1
Total	4,372		5,389 (36%) –		2.1
Peninsular Malaysia	11,822	–	15,100*(100%)–		2.5

* "THE THIRD MALAYSIA PLAN '1976 – '80"

The population of the port of Penang tributar area in 1990 is estimated at 5.39 million, or 36% of the total population of Peninsular Malaysia.

b) Economic Background

1. Macro-Economic Performance

Presently, the Malaysian economy is under The Third Malaysia Plan(1970–80), the second Five-Year Development Pl n designed to implement the objectives of the New Economic Pol cy within a long term (1971–90) development framework of poverty eradication and restructuring of the Malaysian society.

The economy over the period 1976–78 has achieved a real growth rate of 8.7% per annum (17.1% in current prices) growth rate during the period of the Second Malaysia Plan(1970–75).

The real Gross National Product, in 1970 prices, rose from $12,155 million in 1970 to $21,577 million ($34,608 million in current prices), an annual growth rate of 7.4%.

The NEP objectives especially, the annual growth rate during 1976–78 was 8.5% in 1970 prices. The economic development during 1976–80 was largely stimulated by public sector expenditures. G.N.P. by expenditure category indicates that t e public investment and consumption provided a counter-cyclical impact on the economy which was marked by slow growth in private investment in 1976 and by weak export growth in 1977. The better export performance as shown in Table 3 was mainly due to the total amount of rubber and manufactures and the growth rate of crude oil, saw logs and sawn timber.

The volume of imports grew at a rapid rate of 12.4% per annum during the same period.

Table 3

Total Exports of Malaysia in 1975-78

($ million)

Product	1975	1976	1977	1978	Growth rate '76 - '78 %
Rubber	2,026	3,117	3,379	3,539	20.4
Tin	1,206	1,527	1,704	1,920	16.8
Palm oil	1,320	1,196	1,768	1,740	9.6
Crude oil	727	1,550	1,908	2,413	49.2
Sawlogs & Sawn timber	1,061	2,325	2,309	2,309	29.6
Manufactures	1,858	2,359	2,601	3,511	23.6
Others *	1,033	1,368	1,302	1,320	8.5
Total Gross Exports	9,231	13,442	14,971	16,752	22.0

SOURCE: "MID-TERM REVIEW OF THE THIRD MALAYSIA PLAN"

* Includes-partly refined petroleum and petroleum products, canned pineapple, pepper.

2.   Regional Development.

The economic performance of the states in the hinterland of the Port of Penang during the 1970's is shown in Table 4 and 5.

In the MID-TERM REVIEW OF THE THIRD MALAYSIA PLAN, revisions which have been made under the new system of national accounts are taken for 1975 and 1978.

The regional development strategy for the hinterland of the Port of Penang under the N.E.P are to develop under-utilised natural resources and to improve the income position of the poorer states of Kedah and Perlis.

The target G.D.P for 1980 and 1990 in the Outline Perspective Plan (1971-'90) is as shown in Table 6. From the table, it may be noted that for the whole of Malaysia, the target for the share to be occupied by the manufacturing sector in the G.D.P. has been raised from 16% in 1980 to 26% in 1990.

The ratio of shares to be occupied by the manufacturing
sector in the hinterland of the Port of Penang in the year
1980 and 1990 will be 3.96 in Kedah/Perlis, 3.67 in Penang,
and 3.49 in Perak.

Table 4

Past G.D.P By Sector of Origin and State

($ million in 1970 prices)

1970

Sector	Kedah/Perlis	Penang	Perak	Malaysia
Agriculture, foresty, fishing, etc.	426.3	155.0	486.2	3,432
Mining and quarrying	4.0	1.1	301.7	613
Manufacturing	46.5	101.2	142.4	1,307
Construction	37.2	45.9	39.8	481
Services *	229.3	491.5	628.1	4,875
G.D.P	743.3	794.7	1,598.2	10,708
Per Capita G.D.P ($)	665.4	987.2	981.1	993.6
Ratio to Malaysia Aver.	0.67	0.99	0.99	1.00

Total G.D.P of 4 states : 3,136

1975

Sector	Kedah/Perlis	Penang	Perak	Malaysia
Agriculture, forestry, fishing, etc	518.0	171.2	588.7	4,563
Mining and quarrying	8.0	1.0	248.7	612
Manufacturing	87.3	229.0	248.7	2,197
Construction	49.4	69.2	56.6	711
Services *				
G.D.P	1,031.3	1,181.4	1,989.6	15,315
Per Capita G.D.P ($)	828.4	1,323.0	1,101.1	1,250.3
Ratio to Malaysia Aver.	0.66	1.06	0.88	1.00

SOURCE: .   Total G.D.P of 4 states :

"THIRD MALAYSIA PLAN"   *   Includes — Utilities .. ..
                                      Transport, storage and communi-
                                      cations.. .. ..
                                      Wholesale and retail trade .. ..
                                      Ownership of dwelli s, banking,
                                      insurance and real ι ate .. ..
                                      Public administratio nd defence
                                      Other services .. ..

Table 5

Past G.D.P By Sector of Origin and State

($ million in 1970 prices)

1975

Sector	Kedah/Perlis	Penang	Perak	Malaysia
Agriculture, forestry, livestock and fishing	540.3	178.9	614.0	4,804
Mining and quarrying	9.5	4.0	316.4	792
Manufacturing	68.0	348.2	293.7	2,850
Construction	14.8	58.5	51.6	654
Services *	349.6	897.3	947.6	8,265
G.D.P	982.2	1,486.9	2,223.3	17,365
Per Capita G.D.P ($)	784.5	1,657.6	1,225.0	1,412
Ratio to Malaysia Aver.	0.56	1.17	0.87	1.00

Total G.D.P of 4 States : 4,692

1978

Sector	Kedah/Perlis	Penang	Perak	Malaysia
Agriculture, forestry, livestock and fishing	581.0	168.2	658.3	5,531
Mining and quarrying	9.2	4.5	307.7	1,083
Manufacturing	147.5	480.5	506.7	4,258
Construction	19.1	72.2	68.5	896
Services *	440.8	1,091.6	1,183.8	10,516
G.D.P	1,197.6	1,817.0	2,725.0	22,284
Per Capita G.D.P ($)	900.5	1,900.6	1,414.1	1,676
Ratio to Malaysia Aver.	0.54	1.13	0.84	1.00

Table 6

Target G.D.P By Sector of Origin and State
($ million in 1970 prices)

1980

Sector	Kedah/Perlis	Penang	Perak	Malaysia
Agriculture, forestry, fishing, etc.	652.1	212.1	693.9	6,106
Mining and quarrying	9.6	1.2	302.9	806
Manufacturing	208.1	433.3	439.9	3,872
Construction	71.1	103.4	86.3	1,087
Services *	607.2	1,035.8	1,223.3	11,202
G.D.P	1,548.1	1,785.8	2,746.3	23,073
Per Capita G.D.P ($)	1,130.0	1,702.4	1,350.2	1,650.9
Ratio to Malaysia Aver	0.68	1.03	0.82	1.00

Total G.D.P of 4 States : 6,080

1990

Sector	Kedah/Perlis	Penang	Perak	Malaysia
Agriculture, forestry, fishing, etc.	968.9	299.9	1,067.8	9,858
Mining and quarrying	20.4	11.9	423.5	1,280
Manufacturing	824.9	1,593.3	1,533.7	13,144
Construction	150.7	214.3	212.5	2,346
Services *	1,593.6	2,057.4	2,849.3	
G.D.P	3,558.5	4,176.8	6,086.8	50,097
Per Capita G.D.P ($)	2,147.6	3,093.9	2,429.9	2,767
Ratio to Malaysia Aver	0.78	1.12	0.88	1.00

SOURCE:

"THIRD MALAYSIA PLAN"

Total G.D.P of 4 States : 13,822

* Includes - Utilities .. ..

Transport, storage and communications.. .. ..

Wholesale and retail trade .. ..

Ownership of dwellings, banking, insurance and real estate .. ..

Public administration and defence

Other services .. ..

1.2   Port Traffic

(i) Arrival of Vessels

Statistics of all vessels including coasters that called
at the Port of Penang from 1971 to 1978 are given in Table 7.

In 1978, the average tonnage per vessel is 4,596 gross
tons or approximately 7,000 dead weight tons.

Table 7   Arrival of Vessels

PERIOD	NO. OF VESSELS	GROSS REGISTERED TONNAGE
1971	3,529	13.2 million
1972	3,484	13.5 "
1973	3,244	13.1 "
1974	3,481	12.0 "
1975	3,639	13.7 "
1976	3,247	14.5 "
1977	3,166	15.3 "
1978	3,242	14.9 "

Source: "Guide to Port of Penang, June, 1979"

Table 8 gives the number of arrivals of ocean-going vessels
at various ports in Peninsular Malaysia.

The average tonnage of ocean-going vessels that
called at Penang as compared to the average tonnage of vessels
that called at other ports calculated from Table 8 are given in
Table 9.

In 1973, vessels that called at the various ports were of
similar tonnage.

Table 8

Arrivals of Ocean-going Vessels
Engaged in Foreign Trade at Ports
in Peninsular Malaysia.

Tempoh Period	Jumlah Pelabuhan Total ports		Pelabuhan Kelang Port Klang		Pelabuhan Pulau Pinang Port of Penang		Lain-lain Pelabuhan Other Ports	
	Ketibaan Arrivals		Ketibaan Arrivals		Ketibaan Arrivals		Ketibaan Arrivals	
	Bilangan Number	'000 T.B.B. N.R.T.	Bilangan Number	'000 T.B.B. N.R.T.	Bilangan Number	'000 T.B.B. N.R.T.	Bilangan Number	'000 T.B.B. N.R.T.
1973	4,845	20,380	2,440	10,063	1,739	7,376	666	2,941
1974	4,864	21,411	2,495	11,927	1,729	6,634	640	2,850
1975	5,198	23,971	2,749	13,567	1,753	7,072	696	3,332
1976	5,417	26,295	2,794	14,807	1,916	7,601	707	3,887
1977	5,725	29,773	2,851	16,262	1,985	8,097	889	5,414
1978	5,697	32,116	2,978	17,223	1,923	7,988	796	6,904

Source: "Monthly Statistical Bulletin, Peninsular Malaysia Mar. 1979"

Note : Net Registered Tonnage.

Table 9

Trend of the Average Net Tonnage
Per Vessel of Ocean-going Vessels
at Ports in Peninsular Malaysia.

Period	Total Ports	Port Klang	Port of Penang	Other Ports
1973	4,206	4,124	4,241	4,415
1978	5,637	5,783	4,153	8,673

In 1978, in the Port of Klang, the largest port in Malaysia, the average tonnage per vessel that called at the port was approximately 15,000 dead weight tons, corresponding to the average tonnage of vessels that called at ports throughout the country.

However, in the Port of Penang, the average remained at approximately 10,000 D.W.T since 1973.

The draft limitation in the North channel in Penang may be accounted as a major factor for the lack of growth in port traffic.

(ii) Cargo Traffic

(a) Cargo Tonnage

In the volume of cargo handled, the port of Penang ranks second port in Malaysia, following Port Klang, the port for Kuala Lumpur, the capital. The port of Johore and other ports follow in rank.

Table 10

Cargo Loaded and Discharged at Ports in Peninsular Malaysia

Tempoh Period	Jumlah Total '000 Tan tons		Pelabuhan Pulau Pinang Port of Penang		Pelabuhan Kelang Port Klang		Lain-lain Others	
	Muatan diisi Loaded	Dikeluarkan Discharged	Muatan diisi Loaded	Dikeluarkan Discharged	Muatan diisi Loaded	Dikeluarkan Discharged	Muatan diisi Loaded	Dikeluarkan Discharged
1973	5,520	8,319	1,233	2,117	2,916	2,359	1,371	3,843
1974	5,478	9,024	1,203	2,251	2,903	2,726	1,374	4,047
1975	6,326	8,715	1,118	1,945	2,720	2,139	2,488	4,634
1976	7,067	9,945	1,311	2,076	2,895	2,386	2,861	5,483
1977	8,120	11,339	1,466	2,368	2,833	2,603	3,821	6,368
1978	9,417	13,466	2,016	2,926	2,797	3,067	4,544	7,473

Source: "Monthly Statistical Bulletin Peninsular Malaysia, Mar. 1979"

Note : Prior to 1978, data is shown in long tons and with effect from 1.1.'78 tonnages of Cargo are shown in metric tons.

The shares of cargo handled in the Port of Klang and the Port of Penang are 25% and 21% respectively of the cargo handled by all the ports in 1978.

The shares of cargo handled in the two ports may be figured to be 14% and 10% of the total volume of cargo handled by all the ports in the country including East Malaysia in 1977.

Therefore, port activities in the Port of Penang are more closely dependent on the economic development of North-West Peninsular Malaysia. The volume of cargo handled in the Port of Penang has, since the 1970's , maintained a steady growth to cope with the industrial development in the port hinterland based on the import-substitution and export-orientation policy of the government.

Table 11 gives the trend of the total volume of cargo handled in the Port of Penang in the past 9 years and projections made by the Port Commission up to 1987.

In the years 1973 and 1974, the volume of cargo handled recorded was in the range of 4.3 million tons, marking a rapid increase from previous records in the range of 3.7 million tons.

Table 11

Total Tonnage handled and Projections by the Port commission

(mil. metric tons)

	Tonnage handled by the port									Projections		
	1970	1971	1972	1973	1974	1975	1976	1977	1978	1980	1985	1987
Import	2.41			2.64	2.79	2.38	2.52	2.74	2.93	3.66	5.14	5.63
Export	1.29			1.64	1.57	1.46	1.70	1.86	2.00	2.21	2.80	3.09
Total	3.70	3.64	3.74	4.28	4.36	3.84	4.22	4.60	4.93	5.87	7.94	8.72

Source : the Port Commission

Note: Converting figures for 1970 into metric tonnage

		d.w. tons		converting coefficient		m. tons
Import	General cargo	1,096,241	X	1.03	=	1,129,128
	Bulk cargo	901,655	X	1.43	=	1,289,366
						2,418,494
Export	General cargo	773,643	X	1.03	=	796,852
	Bulk cargo	343,689	X	1.43	=	491,475
						1,288,327

However, in 1975, reflecting the adverse economic conditions throughout the world, the port suffered a sharp decline in cargo traffic due to the decrease in the overseas demand for primary products and the decline of domestic demand for capital goods.

In 1976, the volume of cargo handled was restored to the 4 million ton level, and has since increased rapidly at an average annual growth rate of 8% with the stabilization of the economic conditions of the world.

Based on the past trend as given above, projections by the Port Commission are estimated at an average annual growth rate of 6%.

b) Commodities Handled

The port cargo statistics of Malaysia uses the term "imports" and "exports" to designate cargo unloaded and loaded in the port area regardless of origin and destination.

Thus all shipments to East Malaysia are considered exports, while coastal movements of cargo to the Port of Penang are called imports.

The commodity code of the Port of Penang contains 99 items. Classifying the items according to industries, the general trend of commodities handled in the past 5 years and projections up to 1987 made by the Port Commission are as shown in Table 12 and Table 13.

In these tables, commodities listed as other general cargo include a wide range of miscellaneous items. Items imported include raw materials for industries, manufactured goods and consumer goods. Items exported are foodstuffs, fibres and apparel, rubber goods, veneers and plywood and mainly products of light industries.

From Table 14 and Table 15, the general trend of the cargo tonnage of main commodities is as follows:

Table 12

Tonnage of Imported Commodities for the last 5 years and Projections by the Port Commission

(Metric ton)   * Main Import Commodities

Commodity	1974	1975	1976	1977	1978	1980	1985	1987	Remarks
Agricultural Products	(ton)					('000 tons)			
* 1. Rice	111,322	55,101	46,336	75,106	124,890	66.5	51.5	46.5	Information by L. Padi N.
* 2. Wheat & Oats	62,784	41,678	41,116	41,845	47,824	55.0	55.0	55.0	Information by U.N. Flour
* 3. Fruits, Onions, Potatoes & Vegetables	80,757	103,956	120,277	104,720	139,903	135.2	164.0	177.4	
* 4. Animal Feed & Maize	93,704	99,253	52,896	68,711	87,245	75.6	111.0	129.5	General outlook
* 5. Raw Sugar	335,759	293,831	233,001	285,935	260,124	260.0	260.0	260.0	Information by M. Sugar Mfg.
* 6. Salt	26,154	14,900	25,301	35,768	32,561				
7. Rubber & Latex	96,721	70,006	72,109	58,955	56,373	60.0	60.0	60.0	General outlook
8. Palm Oil	36,356	48,302	36,235	15,867	22,424	85.6	109.5	118.5	Trend of Imports
9. Coconut Oil	230	27	-	519	2	-	-		
10. Molasses	69	21	23	12	-	-	-		
Fishery Products									
11. Frozen Fish & Shrimps	20,500	10,726	5,719	10,298	16,659	11.8	15.5	17.4	General Outlook
Forestry Products									
12. Timber	2,313	2,746	2,158	365	903	-	-		
*13. Charcoal	34,547	35,507	25,324	26,061	27,048	30.0	30.0	30.0	
Mining Products									
*14. Coal & Coke	81,046	25,994	21,124	35,171	27,391	40.0	60.0	60.0	Study of Industries
15. Tin Ore	34,344	36,490	12,895	12,545	18,892	17.0	17.0	17.0	ditto
16. Ilmenite Ore	-	-	-	-	-	-	-		
Industrial Metal Products							178.0	237.0	Steel Billets for M.Steel Mill.
*17. Iron & Steel	196,202	89,184	72,888	92,886	115,940	124.2	182.4	212.6	General Outlook
Industrial Chemical Products									
*18. Fuel Oil	933,567	871,351	927,664	1,048,284	1,053,302	1,524.7	2,126.1	2,209.4	Indication by oil companies
*19. Chemicals	32,987	38,716	61,803	53,626	58,768	80.0	80.0	80.0	Study of Industries
*20. Fertilizers	169,884	80,505	97,352	133,336	89,455	176.0	283.5	343.1	ditto
Other Industrial Products									
21. Other general cargo	438,143	460,480	668,887	639,428	743,439	924.0	1,358.5	1,584.6	General Outlook
Total	2,787,389	2,378,774	2,523,108	2,739,438	2,923,143	3,665.6	5,142.0	5,638.0	

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Table 13

Tonnage of Exported Commodities for the last 5 years and Projections by the Port Commission

(Metric ton)   *Main Export Commodities

Commodity	1974	1975	1976	1977	1978	1980	1985	1987	Remarks
Agricultural Products	(tons)					('000 tons)			
1. Rice	34,745	13,704	6,522	2,438	185				
2. Wheat & Oats	186	378	176	398	265				
3. Fruits, Onions, Potatoes & Vegetables	1,606	1,633	2,672	3,987	5,246				
4. Animal Feed & Maize	26,635	42,992	35,108	61,716	38,252	57.8	73.5	80.9	General Outlook
5. Refined Sugar	53,755	55,343	59,025	45,565	54,866	50.9	59.0	62.6	Indication by M. Sugar Mfg.
6. Salt	–	3	–	–	–	–	–	–	
* 7. Rubber & Latex	705,759	593,793	614,993	571,973	571,363	616.3	756.3	829.1	General Outlook
* 8. Palm Oil	78,161	145,576	184,034	308,958	325,507	462.6	679.8	792.8	Information by exporting
* 9. Coconut Oil	18,182	22,372	15,407	28,861	21,324	5.0	5.0	5.0	companies.
*10. Molasses	14,514	26,278	12,029	21,455	35,076	40.0	50.0	50.0	General Outlook
Fishery Products									
*11. Fish & Shrimps Frozen	31,566	25,785	23,082	26,559	29,698	35.7	47.5	53.0	General Outlook
Forestry Products									
*12. Timber	82,757	109,627	158,295	121,854	126,151	143.0	145.0	133.6	General Outlook
13. Charcoal	22,769	20,560	12,616	14,388	15,374	17.3	19.8	20.8	General Outlook
Mining Products									
14. Coal & Coke	–	–	260	196	10	–	–	–	
*15. Tin Slabs	83,915	79,229	81,112	67,420	69,678	69.0	69.0	69.0	Production Trend
*16. Ilmenite Ore	164,292	79,173	122,577	170,762	197,249	170.0	170.0	170.0	ditto
Industrial Metal Products									
17. Iron & Steel	35,518	19,446	24,548	19,969	48,076	23.7	31.4	35.1	Indication by M. Steel Mill
Industrial Chemical Products									
18. Fuel Oil	247	930	–	–	–	–	–	–	
19. Chemicals	6,830	3,394	4,782	2,408	8,922	–	–	–	
20. Fertilizers	9,999	4,981	2,694	4,802	18,168	–	–	–	
Other Industrial Products									
21. Other General Cargo	199,338	215,441	333,813	391,367	440,137	516.2	690.4	786.6	
Total	1,570,774	1,460,638	1,693,745	1,865,076	2,005,547	2,207.5	2,796.7	3,088.5	

Table 14 Main Import Commodities

Commodity	tonnage 1978	share 1978	growth rate '74 – '78
	mil. tons		per annum
Fuel oil	1.05	36%	6.5%
Other general cargo	0.74	25%	14%
Fruits, Onions, Potatoes & Vegetables	0.14	5%	15%

The import of fuel oil, one of the capital goods, has increased to 1,000,000 tons at a stable annual growth rate of 6.5%, occupying a share of 20% of the entire cargo handled in the port.

The total volume of imports excluding fuel oil and the total volume of exports maintain a favourable balance in the range of 2,000,000 tons.

Table 15 Main Export Commodities

Commodity	tonnage 1978	share 1978	growth rate '74 – '78
	mil. tons		per annum
Rubber & Latex	0.57	29%	–
Other general cargo	0.44	22%	22%
palm oil	0.33	16%	42%
Ilmenite Ore	0.19	10%	–
Timber	0.12	6%	11%

The export of rubber and latex, traditional primary products, show a low annual growth rate of 2.3% from the volume exported in 1970 in the range of 5 million tons, due to the low overseas demand for natural rubber.

The export of ilmenite ore is also unstable. On the other hand, exports of palm oil, a newly developed agricultural product, show a remarkable growth rate. Exports of other general cargo consisting mainly of light industrial products also continue to show a rapid increase, indicating the development of manufacturing industries.

The cargo tonnage of the respective commodities imported and exported obtained from Table 14 and Table 15 are given in Table 16.

Capital goods occupy the largest share in imports and primary agricultural products occupy the largest share in exports. Other general cargo follow in order, indicating the present pattern of foreign trade.

The cargo tonnage projection up to the year 1987 by the Port Commission is estimated mainly on the basis of investigation of the hinterland of the port and the development of industries to be located with consideration of the above past trend of port cargo commodities.

Table 16   Cargo Tonnage of Commodities in 1978
('000 tons)

Import			Export		
Capital Goods			Agricutural products		
⎧ Fuel Oil ⎪ Iron & Steel ⎨ ⎪ Chemicals ⎩ Fertilizers	1,315,	45%	⎧ Rubber & Latex ⎪ Palm oil ⎨ ⎪ Coconut oil ⎩ Molasses	952,	47%
Other General Cargo	943,	25%	Other General Cargo	440,	22%
Food Crops			Mining Products		
⎧ Rice ⎪ Wheat & Oats ⎩ Fruits & others	310,	11%	⎧ Tin slabs ⎩ Ilmenite Ore	266,	13%

iii) Container Cargo

The Port Commission has been handling containerised cargo since 1973. At present the Port of Penang is linked with Port Klang in the transportation of containers and is served mainly by feeder and relay services from Port Klang and Singapore.

However, recognition of the importance of Penang and the surrounding states as an industrial region has grown among a number of shipping lines and full container shipping services to the Port of Penang are expected to increase in the very near future especially on the Straits - America route.

The past growth of container traffic through the port and the projections up to 1987 by the Port Commission are as shown in Table 17.

The container cargo tonnage increased at a high annual rate of 44% in the years 1976 - 1978, reflecting activities in the opening years. However, the projections for the container cargo in the years 1980 - 1987 are based on an annual growth rate of 18%.

In 1978, the rate of containerization was merely 10% of the entire volume of general cargo.

$$\text{Import:} \quad \frac{184,830 \text{ tons}}{1,820,600 \text{ tons}} = 10.1\%$$

$$\text{Export:} \quad \frac{177,000 \text{ tons}}{1,498,700 \text{ tons}} = 11.8\%$$

The potential demand for containerization of port cargo in the future may be considered to be quite strong.

According to Table 17 the cargo tonnage per box including empty containers was approximately 15 ton/TEU in 1978.

The proportion of containers is as shown in Table 18.

Table 17　Container handled and Projections by the Port Commission

		Volume handled					Projections		
		1974	1975	1976	1977	1978	1980	1985	1987
Import	Container (TEU's)	1,500	4,525	7,050	9,000	12,015	20,306	57,100	75,500
	Cargo Tonnage (tons)			63,916	123,697	184,830	324,900	914,000	1,208,000
Export	Container (TEU's)	1,494	4,327	7,142	9,037	11,983	18,422	42,100	51,000
	Cargo Tonnage (tons)			110,012	147,975	177,720	299,560	678,000	820,000
Total	Container (TEU's)	2,994	8,852	14,192	18,037	23,998	38,728	99,200	126,500
	increase (per annum)	-	(196%)	(60%)	(27%)	(30%)			
	Cargo Tonnage (tons)			173,928	271,672	362,550	624,460	1,592,000	2,028,000

SOURCE : "Guide to Port of Penang"

"Review of Port of Penang Cargo Projections, 1978"

Note : Empty containers included.

TEU : Twenty Equivalent Unit.

Table 18   Proportion of Containers in 1978

	F.C.L.	L.C.L.	Empty	Total
Import	5,247	4,257	2,511	12,015
(ETU's)	(44%)	(35%)	(21%)	(100%)
Export	3,192	6,403	2,388	11,983
(ETU's)	(27%)	(53%)	(20%)	(100%)

SOURCE : "Review of Port of Penang Cargo Projections,
         the Port Commission, 1978"

Note   : F.C.L. : door to door service

          L.C.L. : not door to door service

From the above two tables, the cargo tonnage of occupied
containers may be calculated as approximately 19 ton/TEU per box.

iv)   Port Administration

The Port of Penang is under the administration of a port
authority, the Penang Port Commission which is a statutory body
incorporated by ordinance in 1956.

The Commission owns, operates and administers various facilities
for port service and has the duty to provide for the promotion of
improvements and development of the port.

With constant improvement of port facilities the Port
Commission has handled the greater percentage of the port traffic.
In 1978 the Commission handled 42% of the port traffic and by
1978 the commission was handling 2.87 mil. tons or 58% of the over-
all port traffic as shown in Table 19.

Table 19 Tonnage handled at the port and
the Port Commission in 1978.
(Metric Tons)

	TOTAL JAN/DEC 1977			TOTAL JAN/DEC 1978		
	PORT	P.P.C.	% P.P.C.	Port	P.P.C.	% P.P.C.
Imports						
General Cargo	1,640,000	986,500	60	1,820,600	1,189,100	65
Bulk Cargo	1,099,400	117,800	11	1,102,600	118,000	11
Total	2,739,400	1,104,300	40	2,923,200	1,307,100	45
Exports						
General Cargo	1,406,300	1,013,700	72	1,498,700	1,068,100	71
Bulk Cargo	458,800	458,400	100	506,900	497,300	98
Total	1,865,100	1,472,100	79	2,005,600	1,565,400	78
Total Imports & Exports						
General Cargo	3,046,300	2,000,200	66	3,319,300	2,257,200	68
Bulk Cargo	1,558,200	576,200	37	1,609,400	615,300	37
Total	4,604,500	2,576,400	56	4,928,700	2,872,500	58

SOURCE : "General Information Jan. 1979"
Port Commission

The Port of Penang is open almost all the year round except
on three port holidays, and the wharves of the Port Commission
operate round the clock.

Table 20 Port working Hours.

1st shift - 0730 hours - 1530 hours (meal break - 1130 - 1230)	
2nd shift - 1530 hours - 2330 hours (meal break - 1930 - 2030)	
3rd shift - 2330 hours - 0730 hours (meal break - 0330 - 0430)	

SOURCE : "Guide to Port of Penang, Jan. 1979"

1.3   Port Facilities

(i)   Berthing facilities

The Port of Penang is located in the channel between the
island of Penang and Province Wellesley and includes the Port
Commission facilities at Butterworth, George Town (Swettenham Pier)
and Prai, the public facility at Weld Quay in George Town and the
private facilities on both sides.

The flow of cargo within the port follows several paths.
Ships can be worked at either the Butterworth and Swettenham
Wharves or they can be worked in the stream or roadstead.

Lifting cargo from ocean-going ships at berth can be done
both onto the wharf and over the side to lighters. Cargo can be
landed at any of these locations and any other public or private
landing point within the port.

The cargo flows are greatly complicated as a result of the
seperation of Island, Mainland and the road cargo handling activities
coupled with intra-port movements.

The Penang Port Commission owns, operates and administers
several facilities for the use of the general public. The existing
situation of the facilities are as follows:
Swettenham Pier

Swettenham Pier is located within the core of George Town on
the island and accommodates ocean going vessels, coasters and lighters.

Tin ore is unloaded from lighters onto lorries of the tin
smelter, whose plant is located in center of downtown George Town.

Vegetable oil installations are located close to the wharf with
pipelines connecting the installations to the berths.

However, due to the unfavourable location, recently, the demand
for the use of the facilities is declining sharply, with more cargo
handled at vegetable oil installations on the Butterworth side. At
Swettenham Pier, fuel oil is unloaded for the Gelugor Power Station
through a pipe line.

Butterworth Wharves

The wharves are deep water facilities mainly for general cargo located at Butterworth in Province Wellesley. The wharves handle an increasing percentage of the total cargo tonnage moving through the port.

The conventional berths 4 and 5 were improved in 1976 so that it could also be used for the container cargo handling. In response to the increasing demand for modern container handling facilities in the port, the sixth berth was opened to traffic in April 1978. Berth 1 and 2 are used as common berths for both general cargo and vegetable oil.

Prai Wharf

This wharf is located at the estuary of the Prai River and due to heavy silting, it is used by coasters and lighters.

The movement of cargo through the wharf has declined since the opening of the Butterworth Wharves in 1968. Presently the wharf remain largely as a handling place for heavy bulk cargo such as ilmenite ore, iron ore, coal and coke.

In addition to the Penang Port Commission wharves, there are the public free landing place at Weld Quay on the island and a number of private jetties in Province Wellesley. All cargo are moved by lighters. The most important of these private jetties are those of the Permatang Pauh, Malayan Sugar Manufacture and Straits Trading Company, all in the Prai River.

Furthermore, there are private facilities in the harbour used exclusively for petroleum product imports. These consist of jetties for Shell, Esso and Caltex.

(ii) Cargo Tonnage Handled

The tonnages handled at the wharves in 1978 are given in Table 21.

The amount of cargo handled at Swettenham Pier is only 7% of all cargo excluding fuel oil. Approximately 57% of all cargo excluding fuel oil, was moved across the Butterworth Wharf over 1978. Almost all the rice, palm oil and timber move through Butterworth. The principal commodity handled at Prai is ilmenite ore.

Excluding fuel oil, the shares of the cargo handled on Province Wellesley and Penang Island are 86% and 14% respectively with a far greater share handled in Province Wellesley.

Table 21

Tonnage of Commodities handled at Individual Port Areas in 1978
('000 tons)

* Dry Bulk Cargo
** Wet Bulk Cargo

Wharf / Commodity	Penang Area — Swettenham Pier import	export	Utara Weld Quay import	export	Butterworth Area — B'worth Wharf import	export	S.Trading Co. Jetty import	export	Prai River Area — M.Sugar Mfg. Jetty import	export	Permatang Pauh Jetties import	export	Prai Marginal Area — Prai Wharf import	export	Other minor landing places import	export	Total import	export
1. Rice	-	-	-	-	125	-	-	-	-	-	-	-	-	-	-	~	125	-
2. Wheat & Oats	-	-	-	-	* 4	-	-	-	-	-	* 44	-	-	-	-	-	* 48	-
3. Food Products	31	-	4	4	103	1	-	-	-	-	1	-	-	-	-	-	139	5
4. Animal Feeds	-	-	32	-	9	27	-	-	-	-	46	11	-	-	-	-	87	38
5. Sugar (Raw & Refined)	12	-	-	-	* 17	2	-	-	* 23	52	-	1	-	-	-	-	*248 12	55
6. Salt	-	-	-	-	* 1	-	* 2	-	-	-	* 29	-	-	-	-	-	* 32	-
7. Rubber & Latex Bulk	-	3	39	66	-	309	-	3	-	-	-	162	-	** 10 1	** 14	** 14	** 14 39	** 14 - 517
8. Palm Oil (Bulk/Drums)	-	** 1	-	-	** 12 1	**297 19	-	-	-	-	-	-	-	-	** 10	** 10	** 22 1	**308 19
9. Coconut Oil (Bulk/Drums)	-	** 1 2	-	-	-	** 1 17	-	-	-	-	-	-	-	-	-	-	-	** 2 19
10. Molasses	-	-	-	-	-	** 35	-	-	-	-	-	-	-	-	-	-	-	** 35
11. Fish Products	6	5			1	17									9	8	16	30
12. Timber	-	-	-	1	1	125	-	-	-	-	-	-	-	-	-	-	1	126
13. Charcoal	-	-	8	-	-	-	-	-	-	-	-	-	1	-	17	15	26	15
14. Coal & Coke	* 9	-	* 2	-	* 8	-	* 5	-	-	-	* 1	-	* 3	-	-	-	* 28	-
15. Tin (Ore/Slabs)	* 15	29	-	-	-	40	* 3	-	-	-	-	-	-	-	-	-	* 18	69
16. Ilmenite Ore	-	-	-	-	-	-	-	-	-	-	-	-	-	*197	-	-	-	*197
17. Iron Ore or Steel Billets	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18. Iron & Steel	6	1	5	-	84	18	-	-	-	-	20	29	2	-	-	7	117	49
19. Chemicals	1	-	1	-	** 39	9	-	-	-	-	-	-	** 7	-	10	-	** 46 12	9
20. Fertilizers	-	-	-	-	* 55	8	-	-	-	-	* 11	-	* 23	10	-	-	* 89	18
21. Other General Cargo	131	26	63	23	498	341	1	7	-	-	37	28	16	13	3	6	749	444
Total	211	68	154	94	958	1,266	11	10	231	52	189	230	52	231	63	54	1,869	2,005
Total (combined)		279		248		2,224		21		283		419		283		117		3,874
Fuel Oil	** 86	-	-		-		-		-		-		-		**967*		**1,053	
Total		365		248		2,224		21		283		419		283		1,170		4,927

* Private Oil Terminals

REVIEW OF THE PORT DEVELOPMENT PLANS

During the Third Malaysia Plan period, the Port Commission has undertaken several major development projects, including the sixth berth of the Container Terminal opened in 1978, the Bulk Cargo Terminal just completed in 1979, and the Vegetable Oil Pier scheduled to be constructed soon.

Furthermore, among the long term projects undertaken are the feasibility study on 'Deepening of the North Channel' and Phase III Port Expansion Project.

These projects are in accordance with the Port Master Plan Study drawn up in 1975.

2.1   Short Term Projects

(i) Prai Bulk Cargo Terminal

The terminal is located south of the Prai Power Station and the Malayawata Steel Mill at the Prai Industrial Estate and has just commenced operation in mid - 1979.

In the Port of Penang, there were no facilities where ships could discharge and load bulk cargo efficiently. Dry and Wet bulk cargo such as fertilizers, coal/coke and chemicals have been handled dispersedly at the various handling points in the port.

The proposed project will provide efficient and modern handling facilities for bulk cargo, including bulk cargo appropriated to industries adjacent to the terminal.

Though the final stage of the terminal project has not been planned, the first stage of the project has been planned as given in Table 22.

Table 22   Plan of Bulk Cargo Terminal

Item		Description	
Site Acreage	:	75 acres	
Wharf Structure	:	site supporting type approach bridge 3,850 ft	
		Berth Length 460 ft	
Accomodation for ship	:	35 or 40 feet draught x 1 berth	
Commodities to be Handled in 1987 ('000 tons)	:	Chemical(Bulk)	80.0
		Fuel Oil	520.0
		Fertilizers	235.6
		Steel Billets	237.0
		Coal & Coke	39.0

Source : Port Commission

With the connection of the railway with the terminal, the export of ilmenite ore which is handled at the Prai Wharf at present will be handled at the new terminal.

Depending on the demand of cargo traffic in the future, provisions have been made for the expansion of land by reclamation and the construction of 2 additional berths at the terminal.

(ii)   Butterworth Vegetable Oil Pier

In the Port of Penang, vegetable oil such as palm oil is presently shipped using the general cargo berths at Butterworth wharf and Swettenham Pier.

In response to the rapid increase in the volume of vegetable oil to be handled in the port, the project will provide a   specialised pier for the oils,expanding· from the southern end of Butterworth Wharf into the Prai River estuary.

Table 23   Plan of Vegetable Oil Pier

Item		Description
Opening Target Year	:	1980
Pier Structure	:	Open dolphin type
Accommodation for ship	:	Outer berth x 1 No. 30,000 D.W.T.
		inner berth x 1 No. Coastal
Commodities to be Handled	:	Palm oil & Coconut oil
Designed Throughout	:	1.3 million tons per annum

Source :   Port Commission

2.2   Long Term Development Studies

(i)   The North Channel Deepening Study

The North Channel, which is the primary sea approach to the port water limits, has a depth of only 26 feet ACD.

Therefore, vessels with 32 feet draft presently have to wait for favourable tidal conditions.

The importance of the South Channel is diminishing because of the limited depth as well as the expected construction of a linkage bridge between Penang Island and Province Wellesley.

The growing trend in the use of bigger vessels in world shipping, as well as in the Port of Penang, introduces an urgent need for deeper draft access for bulk carriers, container vessels and other specialized vessels to the Port of Penang. With this view, the feasibility study on the deepening of the North Channel was carried out.

All facilities such as the Prai Bulk Cargo Terminal, Butterworth Vegetable Oil Pier and a new port at North Butterworth require access by vessels with drafts exceeding current channel depth.

The proposed initial dredging plan is as shown in Table 24.

Table 24   Proposed Initial Dredging Plan
of the North Channel.

Item	Description	
1. Opening Year of Channel	1984	
2. Channel Alignment	Lat.	Long.
Southern End	5° 29' 24" N	100° 20' 15" E
Off Erskine Bay	5° 31' 21" N	100° 18' 27" E
Northern End	5° 35' 21" N	100° 13' 10" E
3. Channel Dimension	depth - 39 ft ACD x width 600 ft	
4. Capital Dredging Requirement	$11 - 33$ million m^3	
5. Spoil Area		
Sandy soil	To be used in potential reclamation projects	
Silty soil	Dumping at sea	

'Engineering Study into the Feasibility of Deepening the
North Channel to the Port of Penang, Jan. 1979'

(ii) Phase III Port Development Study

Since 1973 the cargo traffic in the Port of Penang has increased
rapidly and the existing capacity and the available capacity from
the short term projects are anticipated to be insufficient to
meet the demand in the near future, especially in the case of
container and conventional general cargo.

The phase III Port Development Study is to locate and plan
for a new port to accomodate the growth in traffic over the next
50 years.

Presently, Part I of the study, which include traffic, economic
and engineering studies of various alternatives, is in progress and
is expected to be completed in January 1980.

This study is complementary to the North Channel Deepening
Study and the project limits is the water area along the shore line
at North Butterworth.

In the study, the wharf of the New Port will be planned as a container terminal provided with facilities for all container handling functions in the port. With the opening of the New Port, the present Butterworth container berths will be turned into conventional berths.

The summary of the New Port is as shown in Table 25.

As site alternatives, Alt. - I with the present Pantai Road as the access, Alt - II with the present Jetty Road as the access, and Alt - III with an access from the north end of the Mengkuang Road are under study.

At present, Alt - I at the south end is considered to be the most favourable site because it is located near the North Channel, the land around the end of the wharf is owned by the State Government, and the width of Pantai Road may be expanded.

Table 25   Summary of the New Port in
the Port Development Study

Item	Description		
1. Tonnage of Container Cargo handled by Port ('000 tons)			
	1985	1990	2000
High level growth	817	1,354	3,014
Low level growth	483	874	1,731
2. Berth Requirement for the New Port (- 39 feet depth)			
	opening year & berth req.	1990	2000
High level growth	1984 2 Nos (520 m)	3 Nos (780 m)	4 Nos (1,040 m)
Low level growth	1988 2 Nos	2 Nos	3 Nos
3. Development Acreage of the New Port (Initial phase : 2 berths)			
Site Alternative - I			
Port Area	approx. 56 acres		
Commercial Area	approx. 74 acres		
Total	130 acres		

Source : Port Commission, Sept. 1979

TRAFFIC RELATED TO THE PORT

Inland Movement of Port Cargo

(i) Origin and Destination

In analyzing the inland movement of cargo handled in the
Port of Penang, the cargo handled in the port will be defined as
follows.

Cargo handled in the port will include cargo delivered directly
to the initial destination from the wharf in the case of imports,
and cargo delivered directly to the wharf from the final origin in
the case of exports.

Other cargo movement will be taken up separately as general
transport activities.

The initial destination and final origin indicate factories
and storages where the cargo remains for a considerable length of
time regardless of the location.

Therefore, fuel oil and a portion of the fertilizers which are
stored largely within the port area will be excluded from the analysis.

a) Principal Commodities

The descriptions in this section are based on the following
information sources, supplemented by information obtained from the
industries located in the area.

- "Penang Port Study 1975" E.G. Frankel Inc.
- "Notes on Review of Penang Port Cargo
  Projections 1979 - 1987" Penang Port Commission.
- "Investment guide to Penang, 7th edition"
  Penang Development Corporation

Main food crops and most industrial raw material and semi-
processed goods are imported for storage, processing and manufacture
at the industrial estates by a limited number of importers.

It is relatively easy to identify their initial destination
within the port hinterland.

The inland origin of principal primary products for export may
be identified by the producing region.

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Rice

For a part of the supply of rice, the staple food, Malaysia depends on imports from Thailand. From the Port of Penang, the rice is re-exported to East Malaysia where the rate of self-sufficiency is low.

Wheat & Oats

Malayan Flour Mills located at Mak Mandin Industrial Estate is the principal importer of wheat in Peninsular Malaysia.

Food Products

In the hinterland of Penang, the supply of fruits, potatoes, vegetables and onions depends on imports from various overseas countries.

Animal Feed

Maize, crushed palm kernel, and coconut cake are imported from nearby countries as animal feed. Processed in the industrial estates adjacent to the port area, the products are distributed to the entire port hinterland.

Industry	Location of factory	Acreage
Sin Heng chan	Mak Mandin	4.95
Gold Coin Malaysia	- ditto -	4.17
Chee Kheng Stock Feeds Mfg.	Prai	2.15
Soon Soon Feedmills	- ditto -	5.00

Sugar

In Malaysia, the demand for sugar is supplied mainly by the import of raw sugar.

In the Port of Penang, sugar is delivered to the Malayan Sugar Mill at Prai. The refined sugar is supplied to the markets throughout the country including East Malaysia.

Rubber & Latex

Nearly one half of the rubber exports of the Southeast Asia region comes from Malaysia. Rubber is produced mainly in the entire state of Perak and southern Kedah. Most of the rubber is processed into rubber bales and brought directly into the port area, with only a small portion brought in through the industrial estates adjoining the port area.

Rubber is also produced at the South-West District on the Island of Penang. Rubber and Latex is imported from southern Thailand and Sumatra for processing and re-exporting.

The importers are as follows,

Industry	Location of factory
Lee Rubber	Penanti
Uniroyal	Prai

Palm Oil

While Malaysia is the largest exporter of palm oil in the world, the port of Penang plays only a small role in the exports. Oil palm cultivation in the hinterland of the port is centered in lower Perak. The share of production in Penang and Kedah is far smaller because of inadequate rainfall.

Palm oil is transported directly to the port area from the place of origin, with a portion going to the two industrial estates for oil extraction.

Industry	Location of factory	Acreage
Palmco Oil Mill	Prai	5.00
Khong Guan Vegetable Oil Refinery	Mak Mandin	1.91

A portion of palm oil exported via Penang is brought to the port area by water transport from Teluk Anson in the state of Perak.

Timber

Recently, the ratio of the export of timber is sharply declining.

Sawn timber exported through Butterworth wharf comes mainly from Kedah and Perak by road although increasing quantities are being transported from Kelantan and Pahang by rail.

Coal & Coke

The major importers are as follows:

Industry	Location of factory
Malayawata Steel Mill	Prai
Southern Iron Works	Nibong Tebal
Perak Carbite Co.	Perak

Tin Ore & Slabs

Malaysia is the largest tin producer accounting for a share of about 40% of the world's tin and the producing region is the state of Perak.

All tin smelting facilties in Peninsular Malaysia are
located in the Penang area and tin ore is brought mostly by
rail.

Industry	Location of factory
Strait Trading Co.	Butterworth
Dato Keramat.Smelting	George Town

The tin ore is further moved to George Town from the
Butterworth wharf by lighters.

Some tin ore and tin-in-concentrate are imported from
Sumatra and Southern Thailand for smelting and re-exporting.

Ilmenite Ore

A by-product of alluvial tin mining, ilmenite is used
primarily as a raw material for the paint industry.

Ilmenite treatment plants are located in the Ipoh area
of the State of Perak from where ilmenite is brought to the
Prai wharf by road and rail.

Iron & Steel

The production of Malayawata Steel Mill, which is Malaysia's
only steel mill, covers only a part of the nation's steel demand.
The principal importers are as follows.

Industry	Location of factory
Malayawata Steel Mill	Prai
Steel Pipe Industries	Butterworth
Southern Iron Works	Nibong Tebal
Boon & Chia	Perak state

M.Y.S is also the major exporter of iron & steel products
to East Malaysia.

Chemicals

The major importers of chemicals are all located in the
Prai Industrial Estate. e.g. Malayan Electro Chemical
Industries, Penfibre, Federal Fertilisers, Berden Chemical and
Sumit Gas.

Fertilizers

Malaysia depends on imports and components for almost one
half of the demand for fertilizers in the nation.

A large portion of the fertilizer imports is stored in the
godowns of the Butterworth Wharf and distributed to the hinter-
land. Federal Fertilizers in Prai imports, mixes and packs
fertilizers.

Industry	Location of factory & storage facility	Import tonnage for 1979 (tons)
Federal Fertilizers	Prai	50,000
Guthrie Kima		50,000
Setia Jaya	Wharf godowns	40,000
Other firms		20,000

At present, the demand for fertilizers is limited to the oil palm and rubber estates and large irrigation land.

b) Other General Cargo

The inland destination and origin of commodities grouped as other general cargo may be identified by classifying the various commodities in the group into raw materials and manufactured goods of industries and general consumer goods, and allocating the shares to regions according to a parameter.

1.   Table 26 and Table 27 give the results of classifying the various commodities listed in the "Imports, Exports and Trans-shipment Statistics by Landing Points, the Port Commission", into manufactured goods and raw materials for industries and general consumer goods. Trans-shipment within the wharves are negligible.

The classification does not clarify the entreports for exports, but reflects information on products of manufacturing industries located in the area.

The results of the classification indicate that, on the Penang Island side, the ratio of consumer goods is high, whereas, in Province Wellesley , -   the ratio of goods of manufacturing industries is high, giving a range close to the actual situation on the whole.

Assuming that the ratio of goods of non-manufacturing industries and other commodities correspond to the ratio of goods of manufacturing industries and general consumer goods from Table 26 and Table 27, the commodity components of other general cargo will be as given in . Table 28.

Table 28   Commodity Components of Other
General Cargo in 1978.

		Penang Island	Province Wellesley
Import	Raw Materials for Manufacturing Industries	75,342 tons (40%)	374,108 tons (70%)
	General Consumer Goods	117,786 (60%)	174,157 (30%)
Export	Manufactured Goods	34,972 (70%)	372,385 (90%)
	General Consumer Goods	14,341 (30%)	43,564 (10%)

Table 26   Other General Cargo Imports in 1978

(tons)

	Penang Island	Province Wellesley
Raw Materials for Manufacturing Industries		
Machinery & Comp. parts	1,041	14,609
Acids	142	39,993
Asbestos goods	167	11,192
Fibres	3,511	54,622
Textiles	4,049	7,202
Thread	1,043	10,040
Glue, Gum, Starch	758	3,593
Palm kernels	11	17,121
Plastic materials	3,950	27,259
Paper (Newsprint)	9,932	4,321
Paper (others)	16,308	25,404
Miscellaneous	296	6,516
Total	41,208 (21%)	221,872 (40%)
General Consumer Goods		
Beer, Wine, Spirits	2,692	331
Flour	1,543	8,760
Milk powder	1,759	2,165
Beans, peas, seeds	9,228	9,434
Cotton goods	3,010	9,440
Canned fish	1,448	2,899
Medicines & Medical products	3,525	835
Motorcycles & parts	10,719	28,708
Provisions	19,512	29,286
Soap & Detergent	2,989	298
Wearing apparel	3,859	5,773
Miscellaneous	4,138	5,358
Total	64,422 (33%)	103,287 (19%)
Consumer Goods of Non-Manufacturing Industries	11,489 (6%)	28,287 (5%)
Other Commodities	76,010 (40%)	194,820 (36%)
Other General Cargo Total	193,129 (100%)	548,266 (100%)

Table 27   Other General Cargo Export in 1978

(tons)

	Penang Island	Province Wellesley
Products and Semi-Products of Manufacturing Products		
Copra	1,524	17,191
Coconut shell flour	-	1,549
Asbestos goods	12	10,139
Cotton goods	1,849	11,634
Fibers	154	61,438
Textiles	714	6,994
Thread	23	11,124
Wearing apparel	1,053	48,074
Electrical App. & eqp.	532	11,820
Canned fish	389	7,973
Ghee	-	35,076
Tapioca (flour, sago, chips)	-	12,003
Passengers baggage	760	6,943
Petroleum products	-	1,988
Rubber goods	303	11,129
Veneer & Plywood	52	22,708
Biscuits & Confectionery	1,825	745
Miscellaneous	1,037	1,225
Total	10,227 (21%)	279,753 (67%)
General Consumer Goods in Stock		
Flour	8	1,785
Beans, Peas, Seeds	841	19,460
Motorcycle & parts	353	1,145
Provisions	2,575	9,861
Miscellaneous	417	477
Total	4,194 (8%)	32,728 (8%)
Goods of Non-Manufacturing Industries in Stock	12,684 (26%)	17,206 (4%)
Other Commodities	22,209 (45%)	86,263 (21%)
Other General Cargo Total	49,314 (100%)	415,950 (100%)

2. The inland destination and origin of raw materials and manu-
factured goods are generally obtained with the output value of
manufacturing industries as the parameter.

Table 29 gives the output values of the manufacturing indus-
tries in the hinterland of the Port of Penang classified according
to the traffic zones.

In the states in the hinterland, it will be necessary to con-
sider the distance for economic transport by highways for cargo to
be handled in the Port of Penang.

It will be close to the actual situation to define the direct
port tributary area to extend to the Kota Star district where Alor
Star is located for the State of Kedah, and the Kinta district
where Ipoh is located for the State of Perak.

3. The initial destination and last origin of general consumer
goods may be allocated in proportion to the output values of
wholesales.

In Table 29, the output value of wholesales in the hinterland
of the Port of Penang has been classified according to traffic
zones in accordance with Table 30.

George Town occupies a very high ratio of 78% of the output
value of wholesales in the State of Penang.

The high ratio may be considered to imply that George Town
is a consumer area as the center of tourism, administration and
education. Therefore, it may be easily assumed that part of the
general cargo handled in the port area of Province Wellesley is
transferred to the Island of Penang through ferry linkage.

The volume of cargo transferred in 1978 may be obtained as
follows.

Total volume of general cargo imported:
118 + 174 = 292,000 tons

Volume collected in the State of Penang:
292 x 62% = 181,000 tons

Volume collected in the Island of Penang:
181 x 78% = 141,000 tons

Volume transferred from Province Wellesley
to Penang Island.:
141 - 118 = 23,000 tons

Table 29 Gross Value of the Output of

the Manufacturing Industries in 1974

($ '000)

(For Penang State)

Traffic Zone		Town adjacent to port	back town of port
Province Wellesley	North District	Butterworth 342,803 (38%)	S. Puyu, S. Dua, Penaga, Kepala Batas, Tasek Gelugor 57,764 (6%)
	Central District	Prai 277,649 (31%)	Pmtg. Pauh, Simpang Ampat Bkt. Mertajam 147,670 (17%)
	South District	−	Nibong Tebal 65,159 (8%)
	Total	891,045 (100%)	
Penang Island	East District	George Town 194,308 (42%)	−
	S − W District	−	S. Ara, Bayan Lepas 273,385 (58%)
	Total	467,693 (100%)	
State Total		1,368,910 added other towns	

(For Province Wellesley)

State	Direct Port Tributary Area	State Total
Kedah	Kota Star & 4 districts 270,208 (13%)	added 2 districts and others 315,276
Perak	Kinta & 4 districts 904,490 (44%)	added 2 districts and others 1,034,213
Penang	Prov. Wellesley 891,045 (43%)	added Pg. Island and others 1,368,910
Total	2,065,743 (100%)	2,718,399

SOURCE : "Survey of Manufacturing Industries, Peninsular Malaysia

1974, Vol. I" Department of Statistics Malaysia.

Table 30 Value of the Output of
Wholesales in 1974.

(For Penang State)   ($ '000)

Traffic Zone		Town adjacent to port	back town of port
Province Wellesley	North District	Butterworth 405,295 (70%)	–
	Central District	–	Bukit Mertajam 175,884 (30%)
	Total	(78%) 581,179	(100%)
Penang Island	East District	George Town 2,039,704 (99%)	TG. Tokong, TG. Bungah A. Itam, Glugor 4,265 (1%)
	South-West District	–	–
	Total	(22%) 2,043,969	(100%)
Total		(100%) 2,625,148	

(For Province Wellesley)

State	Direct Port Tributary Town	
Kedah	Kulim S. Patani Alor Star	334,771 (8%)
Perak	Taiping Ipoh Pokok Assam Pusing & G. Hijau Kuala Kangsar Batu Gajah S. Siput	1,250,021 (30%)
Penang		2,625,148 (62%)
Total		4,209,940 (100%)

SOURCE : "Sample Survey of Wholesale and Retail Trades
         in Peninsular Malaysia in 1974, Vol. I"
         Department of Statistics Malaysia

Total volume of general cargo exported:

$$14 + 44 = 58,000 \text{ tons}$$

Volume generated in the Island of Penang:

$$58 \times 78\% = 45,000 \text{ tons}$$

Volume transferred from the Island
of Penang to Province Wellesley.

$$45 - 14 = 31,000 \text{ tons}$$

The transfer of cargo may also apply to the import of food products listed among principal commodities in paragraph a).

(ii) Cargo Flow

    a) Railway Transport

In Province Wellesley, the flow of port cargo is dependent on railway transport as follows.

The Port of Penang is served by the southbound and north-bound freight trains of the Malayan Railway via the stations at the Prai and Butterworth Wharves.

The stations of Prai Halt, Prai goods and Butterworth in the Penang Port area are grouped in to zone 8 "Penang Port"

The origins and destinations of various commodities carried by rail to and from "Penang Port" in 1973 are given in Table 31. In the table, the cargo tonnage handled in the port in the same year is also listed.

From the table, it may be seen that in the State of Kedah, the port cargo does not depend on railway transport at all. The table also indicates the following facts.

Inland from "Penang Port"

1. The sugar carried by rail is the refined sugar from the Malayan Sugar Manufacturing.

As the destinations are beyond the State of Selangor where Port Klang is located, the iron and steel may be considered to be cargo forwarded from the plant of the Malayawata Steel Mill.

Table 31   Cargo Carried by Rail from/to Penang Port in 1973
(tons)

Code	Commodity	Destination or Origin State									Total	Reference (port cargo in 1973)
		Perlis	Kedah	Perak	Selangor	Malacca	Johore	Pahang	Trengganu	Others		
Inland												('000 tons)
609	Diesel (Fuel) oil	-	-	29,891	-	-	-	-	-	23	29,914	Fuel Oil Imp. 837
805	Fertilizers/Manure	2,392	-	-	-	-	-	-	-	617	3,009	Fertilizers Imp. 113
605	Rice	-	-	17,863	-	-	3,840	-	-	1,221	22,924	Rice Import 56
526	Iron & Steel	-	-	-	35,969	-	4,997	-	-	8,553	49,519	Iron/Steel Imp. 114
216	Sugar	-	-	-	46,699	3,956	13,733	-	7,079	9,482	80,949	Sugar Import 242
507	Gas (Bulk/Cylinder)	-	-	-	-	-	-	-	-	-	-	
610	Kerosene/Paraffin	-	-	-	-	-	-	-	-	-	-	
411	Petrol	-	-	-	-	-	-	-	-	-	-	
	Others	3,876	-	-	-	-	-	-	5,609	6,375	15,860	Other Import 351
	Total	6,268	-	47,754	82,668	3,956	22,570	-	12,688	26,271	202,175	Total Imports 2,148
To Penang												
701	Cement & Clinker	175	-	95	-	-	-	-	-	-	270	
707	Logs	-	-	-	-	-	-	-	-	1,969	1,969	Timber Export 130
991	Iron Ore	-	-	37,158	-	-	-	35,844	-	599	73,601	Iron Ore Exp. 0
371	Rubber & Latex	10,491	-	38,353	-	-	-	-	-	170	49,014	Rubber Exp. 558
201	Beer & Stout	-	-	-	4,993	-	-	-	-	401	5,394	
790	Ilmenite Ore	-	-	79,744	-	-	-	-	-	-	79,744	Ilmenite Exp. 142
560	Tin Ore	-	-	-	18,529	-	-	-	-	1,805	20,334	Tin Slab Exp. 81
215	Milk & Milkpowder	-	-	-	4,027	-	-	-	-	254	4,281	
524	Animal Feed	4,560	-	-	-	-	-	-	-	-	4,560	Animal F. Exp. 13
602	Palm Oil	-	-	-	-	-	-	-	-	-	-	Palm Oil Exp. 54
791	Gypsum	-	-	-	-	-	-	-	-	-	-	
502	Asphalt & Bitumen	-	-	-	-	-	-	-	-	-	-	
	Others	8,579	-	-	6,918	-	-	-	-	8,983	24,480	Other Export 100
	Total	23,805	-	155,350	34,467	3,956	-	35,844	-	14,181	267,603	Total Exports 1,232
	Total Both Ways	30,073 (6%)	-	203,104 (43%)	117,135 (25%)	3,956 (1%)	22,570 (5%)	35,844 (8%)	12,688 (3%)	40,452 (9%)	469,778 (100%)	

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SOURCE : "Penang Port Study 1975"

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2.   The rice carried by rail may be cargo forwarded from the
L P N stock located in Prai, considering the rate of storage in
the distribution system of rice.

3.   The volume of diesel oil and fertilizers carried by rail,
even if the entire volume may be carried directly from the wharf,
will be merely of a ratio of about 3% of the import volume.

To "Penang Port"

1.   The iron ore and tin ore are raw material cargo for the plants
of the Malayawata Steel Mill and the tin smelters respectively.

2.   Milk and milkpowder and beer and stout are general consumer
goods cargo for the urban area of Penang.

3.   Rubber and latex, ilmenite ore and animal feed carried by rail-
way are export cargo delivered directly to the wharf. The rate of
dependence on railway may be obtained as given in Table 32.

Table 32   Export Cargo Carried by Railway in 1973
('000 tons)

| Commodity | Export tonnage | Tonnage carried by railway | Origin | |
			Perlis	Perak
Rubber & Latex	558	49 (9%)	11 (22%)	38 (78%)
Ilmenite Ore	142	79 (56%)	–	79
Animal Feed	13	4 (30%)	4	–
Total	713	132 (18%)	15	117

Of the timber collected in the Port of Penang as cargo, the
railway transport of sawn timber from the States of Pahang and
Kelantan is increasing in recent years.

The railway transport of commodities listed as others and
the total both ways may be considered as cargo mostly to and from
the industrial zones adjoining the port area.

The dependence on railway transport of cargo from the Port of
Penang may be evaluated as follows.

1.   The direct transport by rail from the wharf for inland move-
ment of cargo is actually negligible.

2.   The volume of cargo collected directly to the wharf by rail
was in the range of 132,000 tons or about 10% of the total volume
of exports as of the year 1973.

b)   Cargo Flow Pattern

The existing cargo flow pattern of port cargo may be obtained
as shown in Table 33 and Table 34.

Import flow

The urban area of the State of Penang is the initial destination
of 70% of the total volume of import cargo, and the direct movement
of cargo to other states is very small.

Export flow

Of the export cargo, primary products from the States of Perlis/
Kedah and Perak are delivered directly to the port in great volume,
occupying 65% of the total volume of exports.

3.2   Traffic Through the Wharves

a)   Average Load of Lorries

The survey of traffic volume from/to each wharf and the load
tonnage of the lorries has not been conducted so far.

The average load of the lorries on the ferries between Penang
Island and Province Wellesley will be available for the study.

Table 34 Export Final Origin to Port Area in 1978
('000 tons)   * including cargo handled at other minor landing places

Penang Island			Commodity	Penang Island	Province Wellesley						Other State	
South-West District	George Town & Vicinity	Port Area	Penang / Province Wellesley		Port Area	B'worth including Mak Mandin Ind'l Estate	Prai Industrial Estate	North District	Central District	South District	Perlis & Kedah	Perak
–	–	–	Animal Feed – 38	–	–	–	4 (10%)	–	–	–	by rail 4 (10%)	30 (80%)
–	–	–	Refined Sugar – 55	–	Sugar Mill 55 (100%)	–	–	–	–	–	–	–
30 (40%)	39 (60%)	–	Rubber & Latex 69 499*	–	–	24 (5%)	25 (5%)	–	Bkt. Mertajam 50 (10%)	–	by rail 10 (2%) 140 (28%)	by rail 50 (10%) 200 (40%)
–	1 (100%)	–	Palm Oil 1 326*	–	Trans-shipment 23 (7%)	Mak Mandin 10 (3%)	16 (5%)	–	–	–	17 (5%)	260 (80%)
–	3 (100%)	–	Coconut Oil 3 18	–	–	.Mak Mandin 3 (15%)	2 (10%)	–	Bt. Tengah 4 (20%)	–	–	9 (50%)
–	–	–	Molasses – 35	–	–	–	–	–	–	–	35 (100%)	–
–	5 (100%)	–	Fish Products 5 25*	–	–	5 (20%)	5 (20%)	–	–	–	–	15 (60%)
1 (100%)	–	–	Timber 1 125	–	–	6 (5%)	–	–	Bkt. Mertajam 12 (10%)	–	32 (25%)	by rail 25 (20%) 50 (40%)
–	–	–	Charcoal – 15*	–	Trans-shipment 15 (100%)	–	–	–	–	–	–	–
–	Dato Keramat 29 (100%)	–	Tin Slabs 29 40	–	Bagan Luar 40 (100%)	–	–	–	–	–	–	–
–	–	–	Ilmenite Ore – 197	–	–	–	–	–	–	–	–	by rail 117 (60%) 80 (40%)
–	1 (100%).	–	Iron & Steel 1 48*	–	–	–	48 (100%)	–	–	–	–	–
20	29	–	Other general 49 395*	31	–	66	47	9	30	12	46	154
51 (32%)	107 (68%)	–	Total 158 1,816	31 (2%)	133 (7%)	114 (6%)	147 (8%)	9 (0.5%)	96 (5%)	12 (0.5%)	284 (16%)	990 (55%)

Table 35 has been prepared from records of ferry tickets giving the total weight including load weight and own weight of lorries.

The average load of lorries is approximately 3.3 ton/vehicle according to the table.

Average load of lorries

$$= \frac{5883 \text{ c.w.t}}{20 \text{ c.w.t/ton}} \times \frac{1}{90 \text{ vehicles}} = 3.26 \text{ ton/vehicle}$$

Table 35 Load Distribution of Lorries
on the Ferries on July 27th, 1979

Own weight range of lorries	Number of lorries	Total load weight of each range
11 - 30 c.w.t.	37 vehicles	654 c.w.t.
31 - 50	13	359
51 - 70	16	1,660
71 - 90	15	2,091
91 - 110	9	1,119
Total	90	5,883

Total number of lorries : 450
sampling ratio   : 20%

b) Monthly Fluctuation of Port Cargo

The monthly fluctuation of traffic volume generated from the port area may be considered to correspond to the cargo tonnage handled in the port.

Table 36 <u>MONTHLY FLUCTUATION OF CARGO THROUGH WHARVES</u>
('000 tons)

Location	Import / Export	JAN.	FEB.	MAR.	APR.	MAY	JUN.	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTAL
Penang Area	1978	33.8	27.4	34.8	25.1	31.1	27.9	29.0	28.4	25.2	28.8	30.4	41.8	364.2
02 Swettenham Pier		11.5	14.4	12.5	13.9	13.0	12.8	17.4	13.5	14.9	12.4	12.6	12.0	161.5
05 Utara Weld Quay	1977	29.4	24.1	31.7	29.8	30.1	25.0	32.3	26.2	31.4	34.7	32.1	40.2	367.5
		13.7	15.4	14.6	14.8	15.3	15.9	17.8	13.4	15.9	12.6	13.1	12.4	175.3
Butterworth Area	1978	62.5	76.1	94.3	72.1	65.2	69.6	90.2	89.3	64.9	74.8	90.2	103.4	953.0
01 B'worth wharf		86.7	83.5	112.5	109.6	91.1	108.5	108.0	117.7	109.3	109.9	105.2	118.6	1261.0
	1977	48.5	40.4	72.1	53.3	53.7	47.9	65.7	91.1	65.7	68.5	55.3	65.7	728.4
		75.9	72.1	101.1	130.9	91.0	92.8	99.5	103.6	97.1	97.5	94.2	102.4	1159.2
Prai River Area	1978	27.3	34.0	31.8	15.3	41.9	61.3	28.7	27.8	35.6	44.0	41.2	41.2	431.2
M. Sugar Mfg.		21.3	21.9	27.5	20.7	24.9	21.4	17.8	31.0	29.3	21.9	20.1	33.6	292.0
06 ‍ Trading Co.	1977	4?.7	37.8	18.8	31.9	46.0	20.2	43.7	48.1	27.5	58.0	19.8	55.5	466.6
07 Permatang Pauh		?.8	24.7	28.3	16.0	17.4	21.6	20.4	23.8	30.8	15.1	25.7	28.2	275.2
Prai Marginal Area	1978	1.1	0.2	1.8	1.0	13.1	0.2	5.9	1.9	1.6	6.7	16.7	1.1	51.9
		12.9	1.0	18.8	34.4	16.7	17.1	12.2	37.1	14.6	23.7	10.7	31.2	231.0
03 Prai wharf	1977	2.6	10.9	8.5	2.6	1.9	4.3	2.3	7.4	22.0	4.2	1.7	2.9	71.9
		43.1	25.8	24.3	3.2	22.6	1.4	6.0	7.7	12.7	13.4	25.7	16.6	203.0

* Excluded trans-shipment; the cargo flow handled at other landing places
* Prepared from imports, exports and trans-shipments by landing points (1977 - 1978)

Table 37 Monthly Fluctuation Ratio
of Cargo for 1977-78

Port Area	Average Monthly Cargo ('000 tons)	Maximum Monthly Cargo ('000 tons)	Monthly Fluctuation Ratio
Penang Area Import	30.4	Dec. 41.0	1.34
Export	14.0	Jul. 17.6	1.25
Butterworth Area Import	70.0	Aug. 90.2	1.29
Export	100.8	Apr. 120.2	1.19
Prai River Area Import	37.4	Dec. 48.3	1.29
Export	23.6	Dec. 30.9	1.30
Prai Marginal Area Import	5.1	Sep. 11.8	2.88
Export	18.0	Jan. 28.0	1.54

Table 38 Monthly Fluctuation of
Container Units in 1978

	JAN.	FEB.	MAR.	APR.	MAY	JUN.
Twenty Feet Equivalent Units	2,001	1,477	2,240	2,017	1,777	1,777
	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	2,058	2,064	1,635	2,205	2,197	2,550

Source : Port Commission   Total   23,998 TEUs

Monthly
fluctuation ratio = $\dfrac{2,550}{23,998 \times 12}$ = 1,27

Monthly Fluctuation Ratio

$$= \frac{\text{Maximum Monthly Cargo handled}}{\text{Average Monthly Cargo handled}}$$

Table 36 gives the monthly cargo tonnage handled in the port
area. The average monthly fluctuation ratio for the years 1977
and 1978 obtained from the table is given in Table 37.

The monthly fluctuation ratio on the whole is about 1.25.
At Prai Wharf the fluctuation ratio shows large figures as the
cargo tonnage handled is small.

The monthly fluctuation of the container units at Butterworth
Wharf is as shown in Table 38.

C) Hourly Fluctuation of Traffic Volume

The results of the traffic counting survey carried out at the
entrance of Butterworth Wharf separately as part of the present
URBAN TRANSPORT STUDY will be useful to study the hourly fluctua-
tion of the traffic volume generated from the wharf and the ratio
of other vehicles for lorries.

Table 39 Present Traffic Volume
from/to Butterworth Wharf.

(Vehicles)

	Peak Traffic Volume per hour	Motor Cars Taxis Vans & Pick-ups	Medium Size Lorries	Lorries with 3 Axles & Trailers	Motor Cycles Scooters & Others	Total
inward	540 (7-8 a.m.)	696	489	242	1,819	3,247
outward	401 (4-5 p.m.)	716	467	285	1,901	3,368

Source : Technical Report - 07   Note: Survey Station   : Custom Examination
        "Traffic Generation"   gate

                                Survey Date   : 9th, July, 1979(Mon)
                                Survey Time Zone   : 6 a.m. - 10 p.m.

1. The peak hours of the traffic volume at Butterworth
Wharf are 7-9 A.M. for inward traffic and 3-5 P.M. for outward
traffic.

A scattering may be observed in the latter.
Hourly fluctuation ratio:

$$(\text{inward}) \quad = \frac{540}{3247} = 0.17 \text{ hour/day}$$

$$(\text{outward}) \quad = \frac{401}{3368} = 0.12 \text{ hour/day}$$

2. Assuming that the conversion ratio to motor-vehicles for
motor-cycles, scooters and others to be 0.5 in accordance with
the general value applied in traffic planning,

Ratio of other vehicles:

$$(\text{inward}) \quad = \frac{696 + 1,819 \times 0.5}{489 + 242} = 2.19$$

$$(\text{outward}) \quad = \frac{716 + 1,901 \times 0.5}{467 + 285} = 2.21$$

4.   Long Term Cargo Projections

4.1   Cargo Tonnage Projection

(i) Estimation of Total Cargo Tonnage.

The volume of cargo to be handled in the Port of Penang may
be estimated by the trend method which applies the regression
analysis using the trend of cargo tonnage in the past, as the
share occupied by the Port of Penang in the total cargo tonnage
of Peninsular Malaysia and activities in the sphere of the port
area on land will continue to show favorable trends in the future.

a) Index Projection

A reliable projection of the volume of cargo to be handled in
the port may be obtained from the correlation of the port cargo
traffic and the socio-economic conditions of the hinterland as the
two factors are closely related to each other.

In the present study, the cargo tonnage will be estimated by
using the statistics of the Gross Regional Products of the port
hinterland from which the future target values may be obtained.

b) Time Series Projection

Assuming that the social structure will remain unchanged, the time series estimation is often applied in estimating the cargo tonnage, based on the period of time (yearly) involved.

Period	Cargo Tonnage (mil. tons)
1971	3.64
1972	3.74
1977	4.60
1978	4.93

In the case of the Port of Penang, from the trend of cargo tonnage in the past, it may be assumed that the annual cargo tonnage will increase at a fixed rate.

The correlation equation will be as follows

$$y = 3.61 \, e^{0.043t}$$

(the correlation coefficient in the equivalent
   linear equation : 0.99)

where,　　y　:　cargo tonnage

　　　　　t　:　yearly period

　　　　　e　:　exponential constant

The future cargo tonnage obtained by the time series projection is shown in Table 41.

Table 41. Cargo Tonnage Projection
by the Time Series

Year	Yearly Period t	Cargo Tonnage y
1980	9	5.31 mil. tons
1985	14	6.59
1990	19	8.17
2000	29	12.56

period	GDP ($'000 mil.)	Cargo Tonnage (mil. tons)
1970	3,136	3.70
1975	4,202	4·14 **
1978	5,139*	4·93

* The G.D.P for 1978 according to the new account system has been revised according to the 1970 base.

$$4,202 \times \frac{5,739}{4,692} = 5,139$$

** As the cargo tonnage for 1975 may be assumed to show an exceptional variation, the figure has been revised by taking the average of the three figures for the cargo tonnages from 1974 to 1976.

$$\frac{4.36 + 3.84 + 4.22}{3} = 4.14$$

The correlation equation will be as follows.

$$Y = 0.61x + 1.72$$

(correlation coefficient : 0.98)

where, Y : Cargo Tonnage

X : GDP

The future cargo tonnage estimated by the index, the target values of the G.D.P, will be as given in Table 40.

Table 40. Cargo Tonnage Projection
by the Target GDP Index

Year	Target G.D.P. X	Cargo Tonnage Y
	$'000 mil	mil tons
1980	6.080	5.42
1990	13.822	10.15

c) Results of Projections

The results of estimation of the total cargo tonnage dis-
cussed in the previous two paragraphs are shown in Fig. 3.
Cargo tonnage values estimated by the Port Commission up to the
year 1987 are also plotted in the figure. The results of
estimation of cargo tonnage up to the year 1990 based on the
target G.D.P and the time series proposed in the present study
show almost the same growth rate of an annual average of 6.5% as
the estimation of the Port Commission.

The annual growth rate of the total target G.D.P of the 4
hinterland states for the years 1980-1990 is 8.5, , while the
rate for the whole of Malaysia is 8.0%.

In view of the long term economic development of Malaysia,
the target values are not impossible figures. A growth rate of
7.5% for total Malaysia, and 8.0% for the total of the 4 states
may be considered as a possible growth level.

In the 1980's, rubber, timber, tin and palm oil will continue
to be vital industrial products.

From records of recent years, the export of crude oil will
be the top earner of foreign exchange, playing an important role
in the economic development of Malaysia.

Revenue from oil exports will make a substantial impact on
the trade and balance of payments position of the country.

The resulting increase in public sector investments will
serve to increase the domestic demand in spite of the anticipated
low growth in world economy.

An economic structure with a stronger foundation of manu-
facturing industries as the core will be established.

However, the worldwide pattern of exploring various energy
resources expected to reach the peak in 1990 due to the depletion
of oil reserves presents a difficult problem in making even a

Fig. 3 Projection of Total Cargo Tonnage
(Million Tons)

- Past tonnage handled.
+ Projections by Port
  Commission.
⊙ Projections proposed
  in the Present Study.
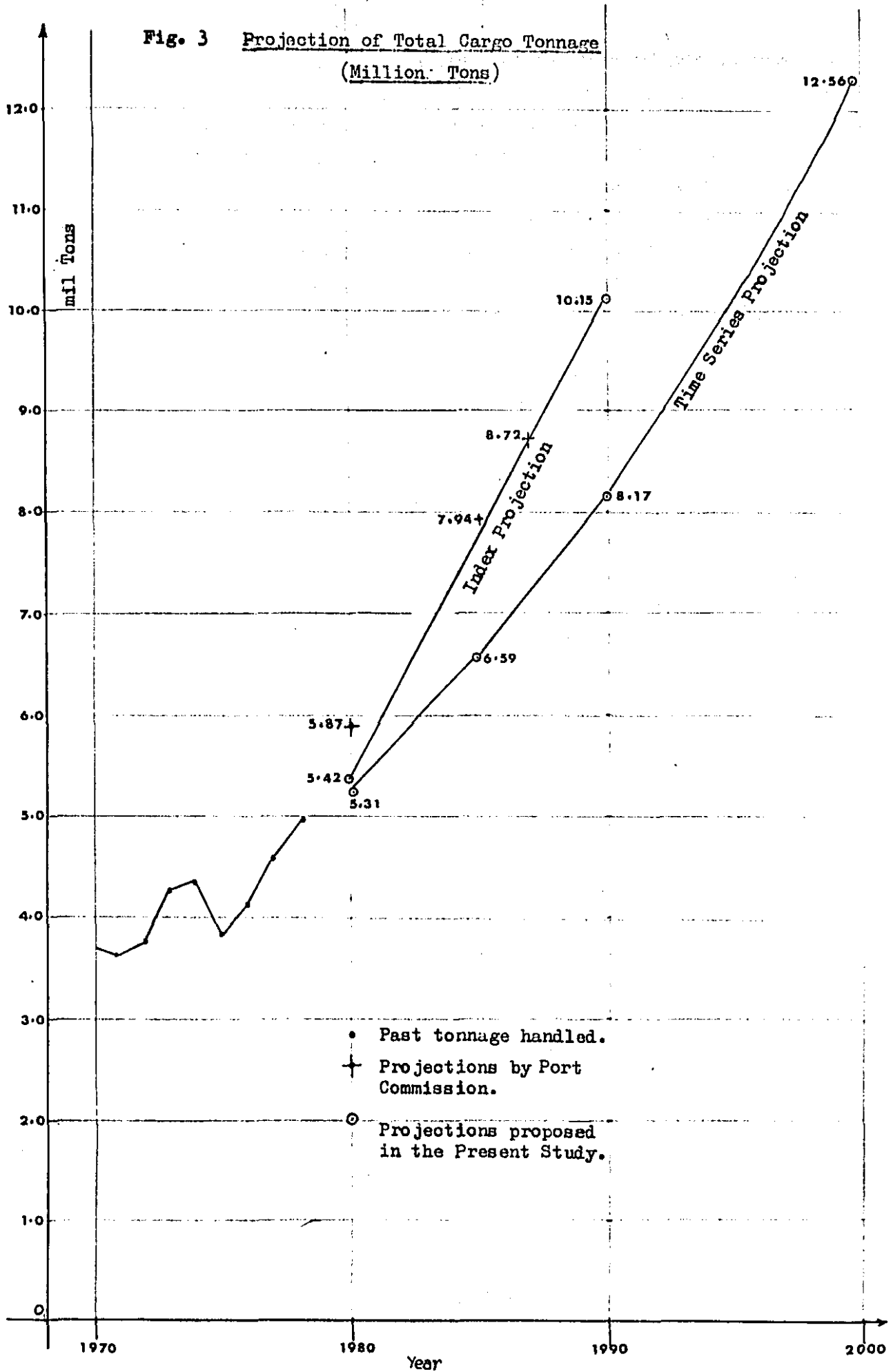
macroscopic forecast for the future.

According to the time series projection up to the year
2000 given in Fig. 3, the yearly growth rate is 4.4%, showing
one trend of future growth obtained from the past trend.

As it may be considered to indicate the lowest limit of the
cargo to be handled in the Port of Penang, it will serve as one
projection value for the uncertain year 2000.

From the above discussion, in the present study, the future
cargo tonnage will be estimated as follows.

1985	7.94 million tons (the Port Commission)
2000	12.50 million tons

(ii) Estimation of Cargo Commodities

Cargo commodities listed the projections made by the Port
Commission mentioned in Section 1 - 2, (ii) b) will be taken
as terms to be contained in the total cargo tonnage of 7.94 million
tons to be handled in the year 1985.

Various uncertain factors will be involved in estimating
cargo commodities to be handled in the year 2000.

In the present study, the volume of the respective commo-
dities will be estimated by the trend method as shown in Fig. 4

Fig. 4   Estimation of Cargo Commodities
for the year 2000
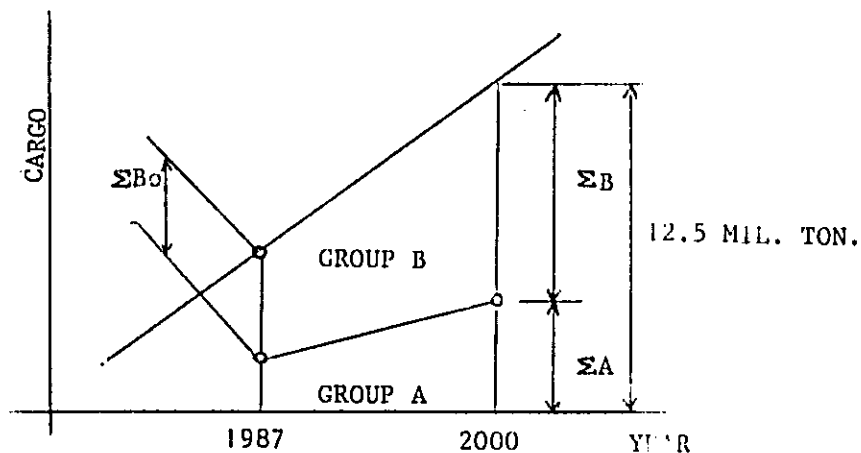
The entire cargo commodities will be divided into two large group, commodities to be handled in volume with certain accuracy (to be called group A), and commodities of uncertain volume (to be called group B).

The volume of each commodity in the former group to be handled in the year 2000 will be estimated, and the total cargo handling volume of group A will be obtained $(\sum A)$.
$-\sum A$ will be subtracted from the total 12.5 million tons to be handled in the year 2000 to obtain the total cargo handling volume $\sum B$ of group B.

- The cargo handling volume of each commodity in group B for the year 2000 will be obtained by allocating the total cargo handling volume $\sum B$ according to the shares occupied by the respective commodities in the cargo handling volume for 1987 estimated by the Port Commission.

a) Long-Term Forecast of Essential Commodities

Commodities in group A may be reasonably estimated in approximate figures in a long-term forecast for the year 2000 to be made at the present point on the basis of predicatable factors such as the availability of natural resources and the growth of population.

1. Exports of Forestry and Mining Products.
Timber

The overseas demand for the export of timber is expected to be basically strong in the future. However, in regard to the forest resources of Malaysia, the Malaysian Timber Industry Board predicts that Peninsular Malaysia will exhaust itself of commercial wood species within 12 years given the present rate of felling - 922,000 acres of forest land a year.

In Peninsular Malaysia, forest resources are mostly located in the states on the east coast.

Timber produced in the hinterland to be handled in the Port of Penang cannot be expected to be of a large volume in the future.

In the present study, the long term projection for the export of timber will be of the same cargo tonnage as the projection for 1987.

<div align="right">Export   130,000 tons</div>

Charcoal

Past statistics indicate that the production of charcoal and firewood is in proportion to the production of round timber, and the volume to be produced in the hinterland will not be increased in the future. The volume of import of charcoal from nearby countries to provide for domestic consumption and re-export will also remain uncertain.

Therefore, in the future, the equilibrium between the supply and demand of general fuel will be maintained by depending on other types of fuel in the urban areas.

In the present study, the long term projection for the export and import of charcoal will be estimated to be of the same cargo tonnage as the projection for 1987.

<div align="center">Import 30,000 tons,   Export 20,000 tons</div>

Tin Ore and Slabs

The world tin market is dominated by the International Tin Council which maintains a tin buffer stock price range, and tin mining operations in Malaysia have been carried on with rising production costs and poorer grade deposits as in other producing countries.

Regarding prospects on tin resources, without the introduction of greater incentives on an international scale, the same pattern of supplementing the decrease of ores from an old mine by ores produced in a new mine will be repeated.

Importers point out that there are no prospects of importing tin-in-concentrates and tin ores from nearby countries.

In the present study, the long term projection for the export of tin ore and slabs will be the same as the projection for 1987.

<div align="right">Export   70,000 tons</div>

Ilmenite ore

Malaysia is a minor source of the world production of ilmenite ore, without potential of future increase in production.

Therefore, in the future, prior to exporting the ore, ilmenite will be processed into titanium oxide with the possibility of serving the domestic demand which will be aroused with the development of the painting industry. In the present study, the long term projection for the export of ilmenite ore will be estimated at the level of 1975, the lowest volume of exports in recent years.

<div align="right">

Export   80,000 tons
</div>

2. Import of Agricultural Products
Rice

According to past statistics of the production of rice in Peninsular Malaysia, with the introduction of double cropping and a high yielding variety of rice, the production has increased at an yearly growth rate of 5% (1968 - 1975), supplying 90% of the domestic demand.

Though the problem of the rice price will be involved for a complete self-supporting condition, if the self-supporting policy is to be maintained in the future, with the traditional rice bowl of Malaysia in the hinterland, in the Port of Penang, the estimated import of 46,500 tons of rice in 1987 will cease to exist by the year 2000.

The re-export of rice to East Malaysia with a lower self-supporting rate through the Port of Penang at present will be tranported through a different route.

Wheat & Oats/Food Products

As a long term trend, the increase of urban population and the improvemant of the daily diet due to economic growth will undoubtedly increase the demand for wheat and oats, fruits, onions, potatoes and vegetables in the future.

Considering the growth of population and the consumption per

head, yearly growth rate of 4% will be quite an accurate figure for the long term projection of the import of the above products.

Wheat & Oats				
	(1987)		(4%)	(2000)
import	55,000	x	1,800 =	100,000 tons
Food Product	(1987)		(4%)	(2000)
import	177,400	x	1,665 =	300,000 tons

Raw Sugar and Refined Sugar

From the early 1970's, sugar cane projects have been developed by the government.

However, during the period, the import of raw sugar in the Port of Penang occupying a share of 2/3 of the entire volume imported throughout the country remained at the level of 230,000-300,000 tons/year.

The increase in production was merely sufficient to provide for the increase of consumption.

The long term demand for sugar in Malaysia may be estimated to increase at a rate of about 4%. Prospects for the self-sufficiency of sugar in Malaysia including East Malaysia is not clear.

In the present study, the long term projection for the import of raw sugar and the export of refined sugar will be estimated to be of the same volume as the projection for 1987.

Raw sugar import	260,000 tons
Ref sugar export	60,000 tons

Salt

The consumption of salt per head does not normally fluctuate. The long term projection for the import of salt may be estimated to correspond with the population growth of the hinterland.

	(1978)		(2.1%)	(2000)
import	32,561	x	1,614	= 50,000

The total cargo tonnage of essential cargo commodities to be handled in the year 2000 will be $A = 1,100,000$ tons.

b) Long-Term Forecast of Variable Commodities

Cargo commodities belonging to group B include agricultural and fishery products the export of which is largely dependant on variable overseas demand, basic commodities imported in large quantities involving inaccurate factors, and other general cargo the volume of which will be affected by the international economic situation.

The general trend of the cargo tonnage is expected to increase in the future, but at the present time, it is difficult to estimate the volume for each commodity in view of the long period of time involved.

1. Export of Agricultural Products

Agricultural products such as rubber, palm oil, animal feed, coconut oil, molasses and fishery products posses potentials for increased production through investments in plantations and facilities.

Prices of primary agricultural products will be stabilized through further international cooperation in the future, giving a favourable outlook for prospects in long-term exports.

2. Import of Basic Commodities

Coal and coke, steel billets, iron and steel, fuel oil, chemicals, fertilizers, and animal feed are basic commodities for manufacturing and agricultural industries. Including certain commodities which are exclusive materials for specified plants, following certain process in various fields, the commodities play active roles in the economy of the region.

Imports from the domestic and overseas market will be necessary to meet the demand in the region in the future as well.

3. Imports and Exports of other general cargo.

The development of manufacturing industries will be promoted to solve the employment problem, and high growth may be

expected in light industries of the labour intensive type using
local resources.

International circumstances will promote the sharing of in-
dustries in the economic structure based on the recognition of
mutual dependence in world economy.

The total cargo tonnage of commodities belonging to group B in
the year 2000 will be as follows.

$$B = \text{total cargo tonnage for the year 2000}$$
$$-A$$
$$= 12.5 - 1.1 = 11.4 \text{ million tons}$$

Therefore, the cargo tonnage of the commodities in group B
will be estimated by allocating the total 11.4 million tons, as
given in Table 42, in accordance with the shares occupied by the
respective commodities in the total cargo tonnage of the year
1987 mentioned in Section 2.

c) Summary of Cargo Commodities

Table 43 is a summary of projections for various cargo commodities to be handled in the Port of Penang in 1985 and 2000.

Table 42. Allocation of the Cargo Tonnage
of the commodities in group B for the year 2000

Commodities	import export	1987 Tonnage	% of total	2000 Tonnage
Agricultural & fishery Products		(000 tons)		(000 tons)
Rubber	import	60.0		90
	export	829.1		1,230
Palm oil	import	118.5		170
	export	792.8		1,170
Animal Feed*	export	80.9		120
Coconut oil	export	5.0		10
Molasses	export	50.0		70
Fish Products**	import	17.4		30
	export	53.0		80
Sub Total Basic commodities		2,006.7	26%	2,970
Coal & Coke	import	60.0		90
Iron & Steel	import	212.6		320
	export	35.1		50
Steel Billets	import	237.0		350
Fuel Oil	import	2,209.4		3,270
Chemicals	import	80.0		120
Fertilizers	import	343.1		510
Animal Feed	import	129.5		190
Sub Total Other general		3,306.7	43%	4,900
Other general Cargo	import	1,584.6		2,380
	export	769.5		1,150
Sub Total		2,354.1	31%	3,530
Total		7,667.5	100%	11,400

* Palm kernel expeller
** Fish caught/Frozen shrimps.

Table 43. Cargo Projections ('000 tonnes)

Commodity	Import		Export	
	1985	2000	1985	2000
Agricultural Products				
1. Rice	51.5	-	-	-
2. Wheat & Oats	55.0	100.0	-	-
3. Fruits, Onions Potatoes & Vegetables	164.0	300.0	-	-
4. Animal Feed·	111.0	190.0	73.5	120.0
5. Raw & Refined Sugar	260.0	260.0	59.0	60.0
6. Salt	38.0	50.0	-	-
7. Rubber & Latex	60.0	90.0	756.3	1,230.0
8. Palm Oil	109.5	170.0	679.8	1,170.0
9. Coconut Oil	-	-	5.0	10.0
10. Molasses	-	-	50.0	70.0
Fishery Products				
11. Fish & Shrimps Frozen	15.5	30.0	47.5	80.0
Forest Products				
12. Timber	-	-	145.0	130.0
13. Charcoal	30.0	30.0	19.8	20.0
Mining Products				
14. Coal & Coke	60.0	90.0	-	-
15. Tin Ore or Slabs	17.0	-	69.0	70.0
16. Ilmenite Ore	-	-	170.0	80.0
Metal Industrial Products				
17. Steel Billets	208.0	350.0	-	-
18. Iron & Steel	182.4	320.0	31.4	50.0
Chemical Industrial Products				
19. Fuel Oil	2,126.1	3,270.0	-	-
20. Chemicals	80.0	120.0	-	-
21. Fertilizers	283.5	510.0	-	-
Other Industrial Products				
22. Other General Cargo	1,290.5	2,380.0	690.4	1,150.0
Total	5,142.0	8,260.0	2,796.7	4,240.0

4.2   Cargo Handling Program

(i) Present Cargo Handling Capacity

At present, in the Fort of Penang, general cargo, dry bulk cargo and wet bulk cargo are handled at the same wharves.

The cargo handling capacity must be evaluated by the general cargo conversion method based on experience.

The handling capacities of general cargo berths have generally been evaluated macroscopically as given in Table 44.

Table 44   Yearly Standard General Cargo Handling Capacity
Per Unit Facility (2 shifts)

Ocean berth (-9m ~ -10m depth)		Coastal berth	Lighters wharf
Wide Apron	Narrow Apron	800-400 ton/m	400-200 ton/m
200,000ton/berth	100,000ton/berth	Avr. 600ton/m	Avr. 300ton/m

By the general cargo conversion method, the volume of specified cargo may be converted into the volume of general cargo by the following ratio.

dry bulk cargo   = 1/2
containerized cargo   = 1/3
wet bulk cargo   = 1/6 (by coasters) -
                        1/15 (ocean-going vessels).

Table 45 Comparison of the Cargo Handling Capacity and the Volume
of Cargo Handled in 1978.

(Penang Island)

Wharf	Berth size depth x length	Standard General Cargo Handling Capacity ('000 tons)	Converted General Cargo Volume Handled ('000 tons)	Vo/Ca (1)
Swettenham Pier			(Actual Volume Handled = 365,000 tons)	
Outer Ocean berth 2 Nos.	-32ft x 1,200ft	(-32') 100 x 2Nos = 200	General Cargo 253 = 253	
Inner Coastal berth 2 Nos.	-15ft x 12ft	(-15') 70*x 1No = 70 (-12') 30*x 1No = 30	Dry Bulk Cargo 24x1/2 = 12	
Lighters wharf	-4ft x 1,000ft	(-4') 200 t/m x 300m = 60	Wet Bulk Cargo 88x1/6 = 15	
		total Ca = 360	total Vo = 280	0.78
Utara Weld Quay Landing place			(Actual Volume Handled = 248,000 tons)	
Lighters wharf	-4ft x 1,200ft	(-4') 200 t/m x 360m = 72	General Cargo 246 = 246 Dry Bulk Cargo 2x1/2 = 1	
		total Ca = 72	total Vo = 247	3.53

* Reduction rates of capacities for small berths from large berth (-9m).

-- 7.5m -- 4.0m = 2/3

-- 3.9m -- 2.0m = 1/3

(2)

Table 46 Comparison of the Cargo Handling Capacity and the Volume of Cargo Handled in 1978.

(Province Wellesley)

Wharf	Berth size depth x length	Standard General Cargo Handling Capacity ('000 tons)	Converted General Cargo Volume Handled ('000 tons)	Vo/Ca
Butterworth wharf			(Actual Volume Handled = 2,224,000 tons)	
Ocean general berth 3 Nos.	-32ft x 2,928ft	(-32') 200 x 6 Nos = 1,200	General Cargo* 1,392 = 1,392	
Ocean general-Container berth 2 Nos.			Container Cargo* 363 x 1/3 = 121	1.35
Ocean Container berth 1 No.	-32ft x 524ft		Dry Bulk Cargo 85 x 1/2 = 43	
			Wet Bulk Cargo 384 x 1/6 = 64	
		total Ca = 1,200	total Vo = 1,620	
Prai Wharf			(Actual Volume Handled = 283,000 tons)	
Coastal berths	-10ft—-14ft x 1,200ft	(-10'--14') 400 t/m x 360m = 144	General Cargo 43 = 43	
Lighters wharf	-8ft x 1,400ft	(-8') 300 t/m x 420m = 126	Dry Bulk Cargo 223 x 1/2 = 112	0.59
			Wet Bulk Cargo 17 x 1/6 = 3	
		total Ca = 270	total Vo= 158	

* Containerized Cargo = 363,000 tons

Uncontainerised Cargo = 1,755,000 tons - 363,000 tons = 1,392,000 tons

The comparison between the standard handling capacity of
the respective wharves in the Port of Penang calculated by the
above method and the present cargo handling volume are given in
Table 45 and Table 46. In the lists, at wharves where the ratio
of the volume and capacity is over 1.0, cargo handling is covered
by night shifts.

As may be seen from Tables 45 and 46, there is a wide diff-
erence between the volumes of cargo handled at the respective
wharves.

On Penang Island

At the Utara Weld Quay, cargo handling by lighters is carried
out to an extraordinary volume, showing a large imbalance in the
stevedoring at the Swettenham Pier. Due to the overwhelmingly
great volume of cargo handled on Province Wellesley, the Butter-
worth Wharf and the roadstead are in greater use for the berth-
ing of ocean-going vessels in the port.

On Province Wellesley.

Cargo handling at the Butterworth Wharf is of a normal
volume. On the other hand, lacking advantage of direct steve-
doring of cargo from vessels, the Prai Wharf remains idle to a
greater degree as cargo assembles at Butterworth Wharf.

As discussed in Section 2.1 (ii), with the expected opening
of the vegetable oil pier in 1980, the volume of general cargo
to be handled at Butterworth Wharf will be increased.

According to the Port Commission, the present container
handling capacity of the Butterworth Wharf is 60,000 TEUs/year.

The handling capacity of the wharf as an exclusive wharf
for general cargo will be 2.22 million tons/year as follows.

Capacity of cargo converted to general cargo :
    1,200,000 ton x 1.35 = 1.620 million tons
Container cargo capacity :
    60,000 box x 15 ton= 0.900 million tons
Conventional cargo capacity :
    Capacity converted to general cargo   1.62
    Container cargo volume converted to
        general cargo   -0.9 x 1/3
    ───
    Conventional cargo   1.32 million tons

Actual Handling Capacity :

Container cargo	0.90	
Conventional cargo	1.32	
total	2.22 million tons	

(ii) Cargo Handling Policy for Existing Wharves

The Port Commission estimates the volume of cargo to be handled at the existing wharves in 1985 as given in Table 47.

Swettenham Pier

The estimated volume of cargo to be handled will be 365 thousand tons, of the same level as the actual volume handled in 1978, with no problem in the cargo handling capacity.

Butterworth Wharf

Vegetable oil will be handled at the exclusive pier to be opened in 1980.

The container cargo handling volume is pending depending on the time of opening of the container terminal in the New Port.

Prai Wharf

By shifting bulk cargo to the Prai B.C.T., the volume of cargo to be handled at Prai Wharf will be decreased from the actual volume of 283 thousand tons handled in 1978 to 206 thousand tons.

Prai B.C.T.

650 thousand tons of fuel oil to be delivered to the Prai Power Station is included in the volume of cargo to be handled.

Other Handling Points

The proposed volume of cargo to be handled is 1,258,000 tons excluding fuel oil, which is an increase of 16% compared to the 1,088,000 tons actually handled in 1978.

(iii) Allocation of Cargo Handling in Port Areas

a) Cargo Handling in the year 1985

The total volume of cargo forecast for the year 1985 will be 7.94 million tons. Assuming that the cargo will be al   ited to the respective wharves according to the policy discussec   the previous Paragraph (ii), the general cargo load at Butter th Wharf will be 2.696 million tons.

Table 47   Cargo Handling Program of Wharves for 1985
('000 tons)

Wharf and Commodity	Import	Export	Total
Swettenham Pier			
Fuel Oil	85.0	–	85.0
Vegetable Oil	–	2.0	2.0
Dry Bulk/General Cargo	236.0	50.0	286.0
Total	321.0	52.0	373.0
Butterworth Wharf			
Vegetable Oil/Mollasses	109.5	732.8	842.3
Non Containarised Cargo	486.1	618.8	1,104.9
Container Cargo	Pending	Pending	Pending
Prai Wharf			
Latex Bulk	–	10.0	10.0
Dry Bulk/General Cargo	20.0	176.0	196.0
Total	20.0	186.0	206.0
Prai Bulk Cargo Terminal			
Fuel Oil	650.0	–	650.0
Chemical (Bulk)	80.0	–	80.0
Dry Bulk/General Cargo	442.0	–	442.0
Total	1,172.0	–	1,172.0
Total at Commission's Wharves	3,022.6	2,267.6	5,290.0
Other Handling Points			
Fuel Oil	1,391.1	–	1,391.1
Latex Bulk	15.0	15.0	30.0
Dry Bulk/General Cargo	713.5	514.1	1,227.6
Total	2,119.6	529.1	2,648.7

SOURCE : "Cargo Projections – Tonnage handled at Commission's
Wharf (1979 – 1987)" Port Commission

	Swettenham	B'worth	Prai	Prai BCT	Others	Total
Fuel Oil	85	–	–	650	1,391	2,126
Vegetable Oil/ Molasses	2	843	–	–	–	845
Latex/Chemicals	–	–	10	80	30	120
Dry bulk/ General Cargo	286	2,696	196	442	1,229	4,849
Total	373	3,539	206	1,172	2,650	7,940

However, the Butterworth Wharf will not be able to handle the load as the present general cargo handling capacity is as follow.

Conventional cargo   1.62 million tons

or

Conventional/Containerized cargo   2.22 million tons

According to the policy of the Port Commission, with the opening of the New Port, the present Butterworth container berths will be used as conventional berths.

Therefore, the conventional general cargo to be handled at Butterworth Wharf will be 1.62 million tons.

Total cargo volume to be handled at Butterworth Wharf,

Conventional general cargo   1.62 million tons
Vegetable Oil   0.843 million tons

Total   2.463 million tons

Cargo handling volume in New Port,

Allocated load volume   2.696

Conventional general cargo
at Butterworth   -1.620

New Port   1.076 million tons

However, the above allocation applies to the case of the highest limit of growth when the total volume of port cargo, as discussed in Section 4.1 (i) c), reaches 7.94 million tons in 1985.

With the lowest limit of growth, the total volume will reach 7.94 million tons in 1990. The opening of the New Port will be in demand between the years 1985 – 1990.

Table 48 gives the details of the allocation of car handling in port areas.

In the Table, cargo handling at the other handling points is allocated according to the following considerations.

Utara Weld Quay Landing Place

In view of the present volume of cargo handled to the capacity, even in case the facilities are expanded, it will be desirable to estimate the volume of cargo to be handled at Weld Quay for the long term program at the 248 thousand ton level which is the actual cargo handling volume in 1978.

Private Jetties

Involving the problem of commercial rights, further development of private jetties in the Port of Penang will be difficult even in the long future.

In the present study, the long term cargo handling capacity of the private jetties excluding the oil jetties will be estimated as given in Table 49, taking the maximum handling capacity in the past.

Table 48
Allocation of Cargo Handling in Port Areas for 1985
(000 tons)

Commodity \ Wharf	Penang Area				Butterworth Area				Prai River				Prai Marginal Area				New Development Area		Minor landing places		Total	
	Swettenham Pier		Utara Weld Quay		B'worth Wharf		S.Trading Co. Jetty		M.Sugar Mfg. Jetty		Permatang Pauh Jetties		Prai Wharf		Bulk Cargo Terminal							
	import	export	import	export	import	export	import	export	import	export	import	export	import	export	import	export	import	export	import	export	import	export
1. Rice	—	—	—	—	52	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	52	—
2. Wheat & Oats	—	—	—	—	—	—	—	—	—	—	55	—	—	—	—	—	—	—	—	—	55	—
3. Food Products	40	—	4	—	120	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	164	—
4. Animal Feeds	—	—	32	—	30	54	—	—	—	—	49	20	—	—	—	—	—	—	—	—	111	74
5. Sugar (Raw & Fef.)	—	—	—	—	—	—	—	—	260	59	—	—	—	—	—	—	—	—	—	—	260	59
6. Salt	—	—	—	—	—	—	—	—	—	—	38	—	—	—	—	—	—	—	—	—	38	—
7. Rubber & Latex Bulk	—	10	45	45	—	450	—	36	—	—	—	120	—	10	—	—	—	—	15	85	60	756
8. Palm Oil (Bulk & Drums)	—	2	—	—	110	678	—	—	—	—	—	—	—	—	—	—	—	—	—	—	110	680
9. Coconut Oil (Bulk & Drums)	—	—	—	—	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5
10. Molasses	—	—	—	—	—	50	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	50
11. Fish Products	6	6	—	—	—	32	—	—	—	—	—	—	—	—	—	—	—	—	10	10	16	48
12. Timber	—	—	—	—	—	145	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	45
13. Charcoal	—	—	9	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	21	20	30	20
14. Coal & Coke	6	—	5	—	—	—	5	—	—	—	5	—	—	—	39	—	—	—	—	—	60	—
15. Tin (Ore & Slabs)	15	29	—	—	—	40	2	—	—	—	—	—	—	—	—	—	—	—	—	—	17	69
16. Ilmenite Ore	—	—	—	—	—	—	—	—	—	—	—	—	—	170	—	—	—	—	—	—	—	170
17. Iron Ore or Steel Billets	—	—	—	—	—	—	—	—	—	—	—	—	—	—	208	—	—	—	—	—	208	—
18. Iron & Steel	10	—	10	—	132	11	—	—	—	—	30	20	—	—	—	—	—	—	—	—	182	31
19. Chemicals	—	—	—	—	—	—	—	—	—	—	—	—	—	—	80	—	—	—	—	—	80	—
20. Fertilizers	—	—	—	—	70	—	—	—	—	—	19	—	—	—	195	—	—	—	—	—	284	—
21. Other General Cargo	139	25	65	35	436	48	3	4	—	—	34	30	20	6	—	—	559	517	44	15	1,290	690
Total	216	72	170	80	950	1,513	10	40	260	59	230	190	20	186	522	—	559	517	90	130	3,017	2,797
	288		250		2,463		50		319		420		206		522		1,076		220		5,814	
Fuel Oil	85		—		—		—		—		—		—		650		—		1,391		2,126	
Total	373		250		2,463		50		319		420		206		1,172		1,076		1,611		7,940	

Table 49. Cargo Handling Capacity
of Private Jetties ('000 tons)

Jetty	berth dimensions	actual volume handled 1973	actual volume handled 1978	Capacity
M. Sugar Mfg.	-8^{tt} x 1 No.	280*	325	330
Permatang Pauh	-8^{tt} x 11 Nos.	366*	419	420
S. Trading Co.,	-27^{tt} x 1 No.	47*	30	50

* "Penang Port Study 1975"

b) Cargo Handling in the year 2000

It will be the basic policy to handle the general cargo which will be increasing from the year 1985 by expanding the New Port.

Therefore, in the allocation of cargo handling in the Port of Penang in the year 2000, the main problem will be the handling of fuel oil which will reach 3.27 mil. tons during the period.

The present private oil jetties possess a handling capacity of 2 mil. tons/year, judging from the berth dimensions.

In the present study, port areas will be used according to the following plan to handle the remaining volume fuel oil.

1. Palm oil will be entirely handled at the Butterworth vegetable oil pier. The present palm oil storage facilities at Swettenham Pier will be used for fuel oil.

2. By providing rail siding at the Prai B.C.T., the ilmenite ore which is loaded by barges at the Prai Wharf at present, will be loaded by direct stevedoring through the B.C.T.

3. Due to the conditions of the water area, even in the future, vessels will not be able to berth directly at Prai Wharf. The space of Prai Wharf will be converted into fuel oil distribution base, and fuel oil will be handled by the jetty system.
Table 50 gives the allocation of the handling of fuel oil.

Table 50. Allocation of Handling of Fuel Oil

('000 tons)

District	Handling		Volume
Shell, Esso, Caltex Swettenham Pier	4 terminals		2,000
for Gelugor Power Station Wharf tank capacity	by pipe line 5,232 ton	85 65	150
Prai B.C.T for Prai Power Station	by pipe line		650
Prai Wharf Wharf tank yard	80,000 m^2		470
Total			3,270

Based on the above discussion, the volume of cargo to be handled in the existing port area in the year 2000 will be 9 mil. tons.

	Swettenham	B'worth	Prai	Prai BCT	Others	Total
Fuel Oil	150	–	470	650	2,000	3,270
Vegetable Oil/ Mallosses	–	1,420	–	–	–	1,420
Latex, chemicals Dry Bulk, & general cargo	300	1,620	–	1,130	1,260	4,310
	450	3,040	470	1,780	3,260	9,000

Volume of cargo to be handled in the New Port,

Total volume in 2000	12.50
Volume to be handled in existing port area	– 9.00
New Port	3.50 mil. tons

Table 51 gives the details of the allocation of cargo handling in port areas.

iv) New Port Container Terminal

According to the Port Development Study undertaken by the Port Commission at present, the New Port will be planned as the container terminal of North Butterworth.

Table 51

Allocation of Cargo Handling in Port Areas for 2000

(000 tons)

Wharf / Commodity	Penang Area — Swettenham Pier import	export	Utara Weld Quay import	export	Butterworth Area — B'worth Wharf import	export	S.Trading Co. Jetty import	export	Prai River Area — M.Sugar.Mfg. Jetty import	export	Permatang Pauh Jetties import	export	Prai Marginal Area — Prai Wharf import	export	Bulk Cargo Terminal import	export	New Development Area import	export	Minor landing places import	export	Total import	export
1. Rice	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2. Wheat & Oats	-	-	-	-	-	-	-	-	-	-	100	-	-	-	-	-	-	-	-	-	100	-
3. Food Products	40	-	10	-	250	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	300	-
4. Animal Feeds	-	-	30	-	100	100	-	-	-	-	60	20	-	-	-	-	-	-	-	-	190	120
5. Sugar (Raw & Ref.)	-	-	-	-	-	-	260	-	-	-	50	-	-	-	-	-	-	-	-	-	260	60
6. Salt	-	-	-	-	-	-	-	-	50	-	-	-	-	-	-	-	-	-	-	-	50	-
7. Rubber & Latex Bulk	-	10	40	40	-	350	-	150	-	-	-	120	-	-	-	-	-	600	50	60	90	1,230
8. Palm Oil (Bulk & Drums)	-	-	-	-	170	1,170	-	-	-	-	-	-	-	-	-	-	-	-	-	-	170	1,170
9. Coconut Oil (Bulk & Drum)	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10
10. Molasses	-	-	-	-	-	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	70
11. Fish Products	20	20	-	-	-	50	-	-	-	-	-	-	-	-	-	-	-	-	10	10	30	80
12. Timber	-	-	-	-	-	130	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	130
13. Charcoal	-	-	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	20	30	20
14. Coal & Coke	-	-	10	-	-	-	-	-	-	-	10	-	-	-	70	-	-	-	-	-	90	-
15. Tin (Ore & Slobs)	-	30	-	-	-	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	70
16. Ilmenite Ore	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80	-	-	-	-	-	80
17. Iron Ore or Steel Billets	-	-	-	-	-	-	-	-	-	-	-	-	-	-	350	-	-	-	-	-	350	-
18. Iron & Steel	10	-	10	0	260	30	-	-	-	-	40	20	-	-	-	-	-	-	-	-	320	50
19. Chemicals	-	-	-	-	-	-	-	-	-	-	-	-	-	-	120	-	-	-	-	-	120	-
20. Fertilizers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	510	-	-	-	-	-	510	-
21. Other General Cargo	150	20	60	40	260	50	-	-	-	-	-	-	-	-	-	-	1,870	1,030	40	10	2,380	1,150
Total	220	80	170	80	1,040	2,000	-	50	260	60	260	160	-	-	1,050	80	1,870	1,630	120	100	4,990	4,240
Total (combined)	300		250		3,040		50		320		420		-		1,130		3,500		220		9,230	

	Penang Area		Butterworth Area		Prai River Area		Prai Marginal Area (Prai)	Prai Marginal Area (Bulk Cargo)	New Development Area	Minor landing places	Total
Fuel Oil	150	-	-	-	-	-	470	650	-	2,000	3,270
Total	450	250	3,040	50	320	420	470	1,780	3,500	2,220	12,500

Study Case	1985	2000
	('000 tons)	
Volume to be handled in New Port (Port Development Study)	817	3,014
(Present Study)	1,076	3,500
Estimated volume of Container Cargo in the Port of Penang (Port Commission, 1978)	1,592	—

The volume of container cargo handled in the Port of Penang in 1978 was 362,550 tons.

The feasibility of planning the New Port as a container terminal may be approved in view of the increasing volume of container cargo as follows.

Table 52 gives the details of container cargo handled in 1978. Main commodities included in other general cargo are electrical appliances and equipment, plastic material, fibres, textiles, cotton goods and rubber goods.

As may be seen from the Table, other general cargo, rubber and latex and tin ore occupy 90% of the commodities of container cargo.

Of the above commodities, future prospects are dim for the import of tin ore.

D : Average no. of operating days of wharves per month

ν : Daily fluctuation ratio

$$\beta = \frac{\text{Cargo volume of peak day}}{\text{Average cargo volume per day}}$$

τ : Hourly fluctuation ratio

$$\gamma = \frac{\text{Traffic volume of peak hour}}{\text{Daily traffic volume}}$$

δ : Ratio of other vehicles

$$\delta = \frac{\text{No. of related vehicles}}{\text{Total no. of lorries}}$$

The particular values of the main factors in the above calculation for the Port of Penang have been analyzed in Section 3.2.

Table 52

Container Cargo Commodities

Jan. - June in 1978 (tons)

Import			Export		
Fertilizer	40		Coconut Oil Drums	1,302	
Tin Ore	8,271	(9%)	Latex Drums	4,133	
Animal Feeds	3,299		Rubber Bales	7,496	(25%)
Chemicals	2,674		Rubber Pellets	11,546	
Fresh Fruits	2,023		·Tin Slabs	4,908	
Fresh Vegetables	900		Chemicals	1,147	
Wheat & Oats	1,005		Frozen Shrimps	1,506	
Other General	73,723	(80%)	Other General	58,827	(65%)
Total	91,935	(100%)	Total	90,875	(100%)

In the present study, container cargo to be handled in the New Port will be rubber and latex and other general cargo. The shares to be accupied by the above commodities in the entire cargo volume handled in the Port of Penang will be, excluding fuel oil, very large as can be seen from Table 53.

The volumes to be handled at New Port will be 39% in 1985 and 73% in 2000, and also will be 18% in 1985 and 38% in 2000 respectively of the total cargo volume to be handled in the Port of Penang.

It will be quite reasonable to assume that the figures indicate the rate of containerization of cargo in the Port of Penang in the future, judging from the rate of container cargo handled in the Port of Kelang at present as shown in Table 54.

As a general principle, it will be necessary to develop the inland distribution system of cargo and to attract the frequent call of container vessels to increase the rate of container traffic.

Table 55 and Fig. 5 show the proposed plans for the New Port Container Terminal.

Table 55   New Port Container Terminal

Item	Description	
	1985	2000
1. Cargo Handling		
yearly cargo handling volume	1,076,000 ton	3,500,000 ton
Vessels to call	25,000 ton full container ship	
Cargo handling capacity	800,000 ton / berth /year	
2. Berthing Facilities		
No. of berths	2 berths	5 berths
Extension of berths	500 m	1,250 m
Depth of berths	-39'	-39'
3. Area of Space		
Space for wharf 300 m wide	150,000 m2	375,000 m2
Other space 375 X 50%	185,000 m2	185,000 m2
Total	83 acres	138 acres

Table 53

Cargo Handling Shares of New Port

('000 tons)

1985

	Import	Export	Total	
Penang Port				
a. Entire Cargo *	3,017	2,797	5,814	
Rubber & Latex	–	756	756 ⎫ b/a = 47%	
b. Other General	1,290	690	1,980 ⎭	
New Port				
Rubber & Latex	–	–	– ⎫ c/b = 39%	
b. Other General	559	517	1,076 ⎭ c/a = 18%	

2000

	Import	Export	Total	
Penang Port				
a. Entire Cargo *	4,990	4,240	9,230	
Rubber & Latex	–	1,230	1,230 ⎫ b/a = 51%	
b. Other General	2,380	1,150	3,530 ⎭	
New Port				
Rubber & Latex	–	600	600 ⎫ c/b = 73%	
c. Other General	1,870	1,030	2,900 ⎭ c/a = 38%	

* Excluding Fuel Oil

Table 54

Dry Cargo Tonnage of Klang Port in 1977

(tons)

	Import	Export	Total	
Conventional	1,626,965	1,756,183	3,383,148	(83%)
Container Proper	391,046	329,296	720,342	(17%)
Total	2,018,011	2,085,479	4,103,490	(100%)

SOURCE: "PROGRESS REPORT 1977" KLANG PORT AUTHORITY

Fig. 5 LOCATION AND PLAN OF NEW PORT
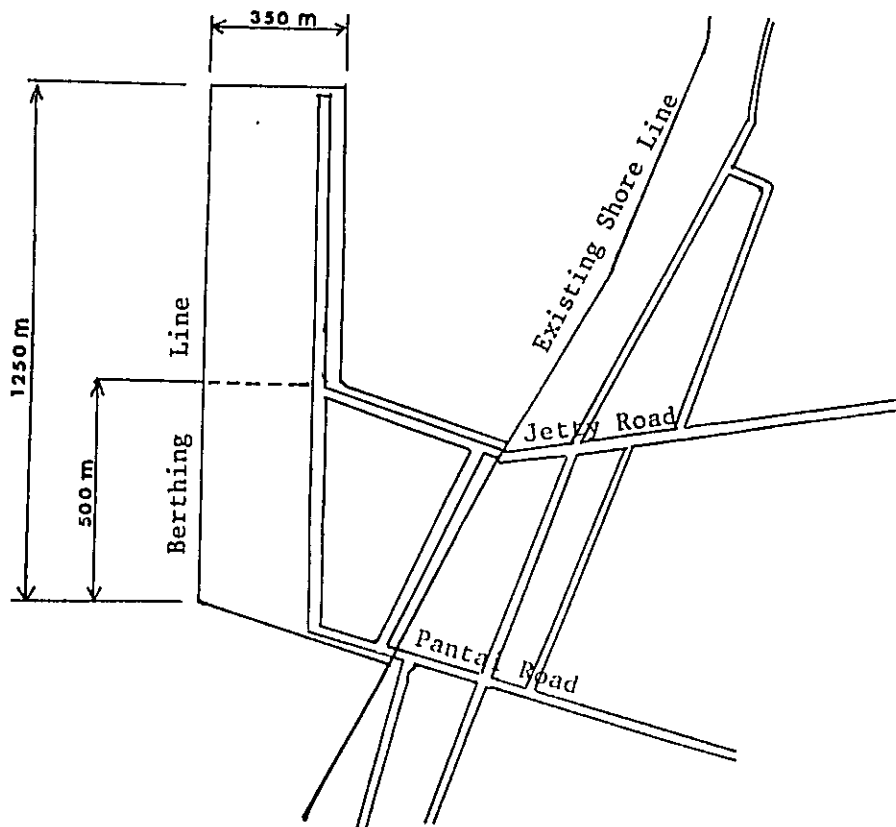
5.   Future Traffic Generation

5.1   Estimate Approach

(i) Origin and Destination

(a) Development of the State of Penang.

To estimate the future demand of traffic in the Port of Penang, in regard to the regional distribution of traffic, it will be necessary to consider the trend of the development of the State of Penang.

Table 56 gives the present situation of the development of industrial estates in the State of Penang.

Table 56

Industrial Estates in the State of Penang in 1977

Estate	Gross Area(1)	Factory Area Occupied (2)*	% of land Occupied **
Province Wellesley	acres	acres	
Mak Mandin	285	159	70
Bagan Serai	200	60	40
Prai Complex	2,117	496	30
Penang Island			
Bayan Lepas I.E	124	6	6
Bayan Lepas F.T.Z	352	117	42
Pulau Jerejak	406	130	40

* Factories in operation, including factories under construction and factories with sites approved.

** (1) / (2) X 0.8

Industries on Province Wellesley depend largely on marine transport for cargo of the factories. In the Prai Complex, there is ample space for future location of factories.

The industrial estates on the Island side, mostly of labour intensive type of industries such as electronics, are all located in the southern region. The cargo traffic depends largely on air transport through the Bayan Lepas Air Port, and the pattern of traffic is not likely to make a great change in the future.

The distribution of the future population in the State of Penang has been estimated as given in Table 57 in the population study of the present Urban Transport Study.

Table 57
Population Distribution
of Penang State, 1979-2000 ('000 persons)

	1979 (1)	1985	2000 (2)	(2)/(1)
Penang Island	513	580	750	1.46
Province Wellesley	433	538	800	1.85
Total	946	1,188	2,550	1.63

Though there is difference in the growth rates of population between the Island of Penang and Province Wellesley, the present flow of port cargo following the accumulation of population will not be greatly changed.

b) Principal Commodities

The destination and origin of greater part of raw materials for industries imported and a part of the primary products exported through the Port of Penang are the three industrial estates on Province Wellesley.

As compared to the present cargo flow patern discussed in section 3.1 (ii) b), the future flow of cargo of the commodities on Province Wellesley of the State of Penang may be estimated by assuming that the location of industries will be concentrated in the Prai Industrial Estate.

Rice, Tin Ore and Sugar Imports

Exclusive cargo for specified factories is not expected to increase in the future, and the destination of the cargo will not be the changed.

Steel Billets, Iron & Steel, Chemicals

Animal Feeds and Salt Imports

The commodities are imported to meet the demand of industries located in the various regions at present. The future increase of cargo flow may be considered as demand generated in Prai.

Wheat & Oats, Coal & Coke Imports

The commodities are imported to meet the demand of industries located in the various regions. The industrial research predicts an increase in the cargo volume for 1985.

Therefore, the allocation of destinations for 1985 will be made according to the ratio of 1978, but the increase of cargo up to the year 2000 will be considered as the demand generated in Prai.

Rubber & Latex, Palm Oil, Fish Products, and Timber Exports

At present, the Mak Mandin Industrial Estate is the last origin of a part of these products. The future cargo volume from Mak Mandin is estimated to be of the present level. The cargo flow from the remaining regions will be allocated among the regions according to the present ratio.

Other Principal Commodity Exports

The future cargo volume generated will be allocated according to the present ratio.

c) Other General Cargo

The productive charactristics of Province Wellesley and the consuming characteristics of the Island will be considered in the allocation of the shares of other general cargo.

The cargo flow will be allocated on the basis of the analysis of the present cargo flow pattern discussed in Section 3.1 (i) b). The commodities will be classified into general consumer goods and goods of manufacturing industries according to the present ratio.

Allocation of Manufacturing Goods to the States

The cargo handling volumes on Penang Island and Province Wellesley will be considered to be the total volume to be allocated to the hinterland.

The cargo volumes will be allocated to the state of Province Wellesley according to the ratios obtained from the present output values of manufacturing industries and the G.D.P growth rate of the manufacturing sector.

Allocation of Manufacturing Goods within Province Wellesley

On Province Wellesley, the allocation of shares to regions excluding Prai will be of the present level, and the future increase of shares will be allocated to Prai.

Allocation of General Consumer Goods to the States

The total cargo handling volume on the Island and Province Wellesley will be allocated according to the present ratio of the output value of wholesales of the states.

Allocation of General Consumer Goods within Province Wellesley

The shares of goods will be allocated according to the present ratio of the output value of wholesales of the states. The difference between the volume allocated to Province Wellesley and the cargo handling volume in the port may be ;sumed to be cargo transferred from the Island.

(ii) Calculation of Traffic Generation

The traffic volume generated from and concentrated to the port area is generally obtained from the following equation.

Hourly traffic volume (vehicles/hour) : V

$$V = \frac{C}{W \times E} \times \frac{B}{12 \text{ months}} \times \frac{r}{D} \times \rho \times \delta$$

Where,

C : yearly cargo volume handled (ton)

W : average load of occupied lorries (ton)

E : ratio of occupied lorries

$$E = \frac{\text{No. of occupied lorries}}{\text{Total No. of lorries}}$$

B : Monthly fluctuation ratio

$$B = \frac{\text{Cargo volume of peak month}}{\text{Average cargo volume per month}}$$

D : Average no. of operating days of wharves per month

ρ : Daily fluctuation ratio

$$\rho = \frac{\text{Cargo volume of peak day}}{\text{Average cargo volume per day}}$$

δ : Ratio of other vehicles

$$\delta = \frac{\text{No. of related vehicles}}{\text{Total no. of lorries}}$$

The particular values of the main factors in the above calculation for the Port of Penang have been analyzed in Section 3.2. For the calculation of the traffic volume for the present study, the above factors may be supplemented as follows.

-The average load of occupied lorries

In the case of the Port of Penang, the load weight of general cargo is taken to be about 3.3 tons.

However, for the load weight of bulk cargo, the generally accepted value of 8 tons will be used.

In load weight of containers is taken to be 19 ton/T.E.U..s for the Port of Penang. However, as 20 ft. length containers will be used for the inland transport of containers in the future, a reasonable load weight of the track trailers of container cargo will be 15 tons.

- Ratio of occupied lorries

The generally accepted value of the ratio of occupied lorries is about 0.5.

-Average no. of operating days per month of wharves.

As discussed in Section 1.2 (iv), as the wharf of the Port
Commission operates almost all the year round, the number of
operating days may be taken as 30 days/month.

-Daily fluctuation ratio

When the monthly fluctuation ratio is 1.2, the daily fluc-
tuation ratio is generally in the range of 1.4 - 1.8.

-Ratio of other vehicles.

The ratio of vehicles·related to port activities at
Butterworth Wharf at present is about 2.0.
The ratio is far smaller when the origin and destination of cargo
are at a distance from the port area.

A reasonable ratio at the container terminal of the New
Port will be about 1.5.

Table 58. Factors for the Calculation of Traffic Volume

Factors Cargo Type	Container Cargo	Conven'l Cargo	bulk Cargo
Average load weight	15.0 ton	3.3 ton	8.0 ton
Occupied lorry ratio E	0.5	0.5	
Monthly fluctuation ratio B	1.27	1.25	
Operating days of wharves D	30 days/M	30 days/Month	
Daily fluctuation ratio	1.6	1.6	
Hourly fluctuation ratio	0.15	0.15	
Ratio of other vehicles Origin & Destination			
District adjoining port	1.5	2.0	
Short distance district	1.25	1.5	
Long distance district	1.0	1.0	

Table 59. Geometrical Coefficient of Traffic Volume

Traffic Zone			F - Value		
	Penang Island	Province Wellesley	Container Cargo	Conven'l Cargo	bulk Cargo
Penang State	George Town & Vicinity	Butterworth & Prai Ind'l Estate	0.17×10^{-3}	1.0×10^{-3}	0.4×10^{-3}
	South - West District	North District Central District South District	0.14×10^{-3}	0.75×10^{-3}	0.3×10^{-3}
Other States		Perlis Kedah Perak	0.11×10^{-3}	0.5×10^{-3}	0.2×10^{-3}

Table 58 is a summary of the above factors. From the table, the geometrical coefficients in the equation for the calculation of the aforementioned traffic volume may be obtained as given in Table 59.

$$\bar{V} = C \times F$$

Traffic Volume in Port Areas

The allocation of cargo handling volumes to port areas in the Port of Penang for the year 1985 and 2000 has been estimated for the respective commodities in Section 4.2 (ii).

The future regional allocation of traffic between the port and inland districts may be obtained by collecting the regional allocation of port cargo commodities obtained by the method discussed in the previous paragraph   (i) for the respective regions.

The conversion of vehicles for the highway transport of cargo will be calculated according to the ratio given in the previous paragraph (ii).

As the future trend of inland transport facilities, the railway transport volume and the rate of F.C.L. containers will not change greatly from the present state.

The regional allocation of the future hourly traffic volume classified according to the port areas in the Port of Penang are given in Table 60 and 61 in a series.

Fig 6 and 7 show the desired lines obtained from the above tables.

Province Wellesley
Import - Outward

Reflecting the nature of cargo for factories, the ratio of southbound traffic to the Prai Industrial Estate and the State of Perak is high.

In the year 2000, due to the industrial development, a heavy concentration of traffic will occur in the Prai Industrial Estate.

The traffic generation from the New Port in the year 1985 will not be heavy.

Inward - Export

As the cargo flow consists of a large volume of primary products from the port activity zone, the traffic will assemble from the states of Perlis/Kedah and Perak.

In the year 2000, the traffic generation from the Prai Industrial Estate will also be quite heavy.

The concentration of traffic volume to the New Port in the year 2000 will be quite intensive.

Table 60 Traffic Volume for 1935 (1)
Cargo Tonnage : '000 tons/year
Traffic Volume : Vehicles/hour
* : Bulk Cargo

Via Linkage: Existing Ferries or Proposed Bridge			Penang Island	
			G'Town /Vicinity	S-West District
Outward	Food Products	36	36	—
	Other General	80	80	—
	Cargo Tonnage		116	—
	Traffic Volume		73	—
Inward	Other General	40	40	—
	Cargo Tonnage		40	—
	Traffic Volume		23	—

Penang Area: Swettenham Pier Utara Weld Quay			Penang Island		
			Port Area	G'Town /Vicinity	S-West District
Out-Ward	Food Products	44	—	44	—
	Animal Feeds	32	—	—	32
	Rubber & Latex	45	—	45	—
	Fish Products	6	—	6	—
	Charcoal	9	—	9	—
	Coal & Coke	11	—	* 11	—
	Tin Ore	15	—	* 15	—
	Iron & Steel	20	—	20	—
	Other General	204	—	154	50
	Cargo Tonnage		—	304	82
	Traffic Volume			288	62
In-Ward	Rubber & Latex	55	—	33	22
	Palm Oil	2	—	* 2	—
	Fish Products	6	—	6	—
	Tin Slabs	29	—	29	—
	Other General	60	—	33	27
	Cargo Tonnage		—	103	49
	Traffic Volume				37

Butterworth Area: Butterworth Wharf S. Trading Co.,

	Penang Island	Province Wellesley						Perlis & Kedah	Perak
		Port Area	B'worth M. Mandin	Prai Ind. Estate	North Dist.	Central Dist.	South Dist.		
Out-ward									
Rice 52	—	—	—	52	—	—	—	—	—
Food Products 120	36	—	15	—	—	7	—	13	49
Animal Feeds 30	—	—	—	30	—	—	—	—	—
Palm Oil 110	—	*110	—	—	—	—	—	—	—
Coal & Coke 5	—	—	—	—	—	—	—	—	* 5
Tin Ore 2	—	* 2	—	—	—	—	—	—	—
Iron & Steel 132	—	21	—	100	—	—	—	—	11
Fertilizers 70	—	* 62	—	* 8	—	—	—	—	—
Other general 439	34	—	45	69	—	33	13	58	187
Cargo Tonnage	70	195	60	259	—	40	13	71	252
Traffic Volume	53		60	254		30	10	36	125
In-ward									
Animal Feeds 54	—	—	—	—	—	—	—	rail 7	47
Rubber & latex 486	—	—	—	—	—	—	—	rail 12 / 174	rail 62 / 238
Palm Oil 678	—	* 48	* 10	* 34	—	—	—	* 34	* 552
Coconut Oil 5	—	—	* 3	—	—	—	—	—	* 2
Molasses 50	—	—	—	—	—	—	—	* 50	—
Fish Products 32	—	—	5	7	—	—	—	—	20

									rail
Timber	145	–	6	–	–	15	–	37	29 58
Tin Slabs	40	40	–	–	–	–	–	–	–
Iron & Steel	11	–	–	11	–	–	–	–	–
Other General	52	–	10	–	13	26	13	–	–
Cargo Tonnage	3	88	34	52	–	41	13	295	917
Traffic Volume	2		26	32		31	10	123	293

for 1985 (3)

Prai River Area: Malayan Sugar Mfg. Permatang Pauh		Penang Island	Province Wellesley						Perlis & Kedah	Perak
			Port Area	B'worth M. Mandin	Prai Ind. Estate	North Dist.	Central Dist.	South Dist.		
Outward										
Wheat & Oats	55	-	-	* 55	-	-	-	-	-	-
Animal Feeds	49	-	-	33	16	-	-	-	-	-
Sugar	260	-	*260	-	-	-	-	-	-	-
Salt	38	-	-	* 32	6	-	-	-	-	-
Coal & Coke	5	-	-	-	-	-	-	* 5	-	-
Iron & Steel	30	-	-	-	9	-	-	21	-	-
Fertilizers	19	-	-	-	*19	-	-	-	-	-
Other General	34	-	-	34	-	-	-	-	-	-
Cargo Tonnage		-	260	154	50	-	-	26	-	-
Traffic Volume		-	/	101	38	-	-	17	-	-
Inward										
Animal Feeds	20	-	-	-	7	-	-	-	-	13
Sugar	59	-	59	-	-	-	-	-	-	-
Rubber & Latex	120	-	-	24	21	-	62	-	-	13
Iron & Steel	20	-	-	-	20	-	-	-	-	-
Other General	30	-	-	30	-	-	-	-	-	-
Cargo Tonnage		-	59	54	48	-	62	-	-	26
Traffic Volume		-	/	54	48	-	46	-	-	13

for 1985 (4)

Prai Marginal Area : Prai Wharf Prai B.C. Terminal	Penang Island	Province Wellesley						Perlis & Kedah	Perak
		Port Area	B'worth M.Mardin	Prai Ind. Estate	North Dist.	Central Dist.	South Dist.		
Outward									
Coal & Coke 39	–	–	–	* 29	–	–	* 7	–	* 3
Steel Billets 208	–	–	–	* 208	–	–	–	–	1,
Chemicals 80	–	–	–	pipe 80	–	–	–	–	1,
Fertilizers 195	–	–	–	* 195	–	–	–	–	–
Other general 20	–	–	–	20	–	–	–	–	–
Cargo Tonnage	–	–	–	452	–	–	7	–	3
Traffic Volume	–	–	–	193	–	–	2	–	1
Inward									
Rubber & Latex 10	–	–	–	10	–	–	–	–	rail 102
Ilmenite Ore 170	–	–	–	–	–	–	–	–	* 68
Other General 6	–	–	–	6	–	–	–	–	–
Cargo Tonnage	–	–	–	16	–	–	–	–	68
Traffic Volume	–	–	–	16	–	–	–	–	14

New Port		Penang Island	Province Wellesley						Perlis & Kedah	Perak
			Port Area	B'worth M.Mandin	Prai Ind. Estate	North Dist.	Central Dist.	South Dist.		
Outward	Other General 559	46	–	23	157	10	10	–	73	240
	Cargo Conventional	21	–	10	71	4	4	–	33	108
	Tonnage FCL Container	25	–	13	86	6	6	–	40	132
	Traffic Normal Lorry	16	–	10	71	3	3	–	17	54
	Volume Track–Trailer	4	–	2	15	1	1	–	4	15
	Total	20	–	12	86	4	4	–	21	69
Inward	Other General 517	37	–	34	142	10	5	–	71	218
	Cargo Conventional	25	–	23	95	7	3	–	48	146
	Tonnage FCL Container	12	–	11	47	3	2	–	23	72
	Traffic Normal Lorry	19	–	23	95	5	2	–	24	73
	Volume Track–Trailer	2	–	2	8	–	–	–	3	8
	Total	21	–	25	103	5	2	–	27	81

Table 6. Traffic Volume for 2000 (1)

(Cargo Tonnage: '000 tons/year)

(Traffic Volume: Vehicles/hour)

* : bulk cargo

Via Linkage Existing Ferries or Proposed Bridge		Penang G'town/Vicinity	Island S-West Dist.
Out-ward	Food Products	95	–
	Other General	244	–
	Cargo Tonnage	339	–
	Traffic Volume	183	–
In-ward	Other General	80	–
	Cargo Tonnage	80	–
	Traffic Volume	45	–

Penang Area: Swettenham Pier Utara Weld Quay		Port Area	Penang Island G'town /Vicinity	S-West Dist.
Out-ward	Food Products	50	–	50	–
	Animal Feeds	30	–	–	30
	Rubber & Latex	40	–	40	–
	Fish Products	20	–	20	–
	Charcoal	10	–	10	–
	Coal & Coke	10	–	* 10	–
	Tin Ore	–	–	–	–
	Iron & Steel	20	–	20	–
	Other General	210	–	158	52
	Cargo Tonnage		–	308	82
	Traffic Volume		–	302	62
In-ward	Rubber & Latex	50	–	30	20
	Fish Products	20	–	20	–
	Tin Slabs	30	–	30	–
	Other General	60	–	33	27
	Cargo Tonnage		–	113	47
	Traffic Volume		–	113	35

Butterworth Area: Butterworth Wharf S. Trading Co.,		Penang Island	Province Wellesley						Perlis & Kedah	Perak
			Port Area	B'worth M. Mandin	Prai Ind. Estate	North Dist.	Central Dist.	South Dist.		
Out-ward	Food Products 250	95	–	29	–	–	12	–	24	90
	Animal Feeds 100	–	–	–	100	–	–	–	–	–
	Palm Oil 170	–	*170	–	–	–	–	–	–	–
	Iron & Steel 260	–	21	–	228	–	–	–	–	11
	Other General 260	30	–	17	41	–	30	13	35	94
	Cargo Tonnage	125	191	46	369	–	42	13	59	195
	Traffic Volume	94		46	369		32	10	30	98
In-ward	Animal Feeds 100	–	–	–	–	–	–	–	rail 12	88
	Rubber & Latex 400	–	–	–	–	–	–	–	rail 23 / 108	rail 115 / 154
	Palm Oil 1,170	–	*, 84	*10	*60	–	–	–	*60	*956
	Coconut Oil 10	–	–	*3	*1	–	*2	–	–	*4
	Mollasses 70	–	–	–	–	–	–	–	*70	–
	Fish Products 50	–	–	5	11	–	–	–	–	rail 34 / 26
	Timber 130	–	–	6	–	–	13	–	33	rail 52
	Tin Slabs 40	–	40	–	–	–	–	–	–	–
	Iron & Steel 30	–	–	–	30	–	–	–	–	–
	Other General 50	4	–	7	–	–	26	13	–	–
	Cargo Tonnage	4	124	31	102	–	41	13	271	1,288
	Traffic Volume	3	30	23	65	10	30	10	97	355

for 2000 (3)

Prai River Area: Malayan Sugar Mfg. Permatang Pauh		Penang Island	Province Wellesley						Perlis & Kedah	Perak
			Port Area	B'worth M. Mandin	Prai Ind. Estate	North Dist.	Central Dist.	South Dist.		
Outward										
Wheat & Oats	100	-	-	* 55	* 45	-	-	-	-	-
Animal Feeds	60	-	-	33	27	-	-	-	-	-
Sugar	260	-	* 260	-	-	-	-	-	-	-
Salt	50	-	-	* 32	* 18	-	-	-	-	-
Coal & Coke	10	-	-	-	-	-	-	* 2	-	* 8
Iron & Steel	40	-	-	-	19	-	-	21	-	-
Cargo Tonnage		-	260	120	109	-	-	23	-	8
Traffic Volume		-		68	59	-	-	16	-	2
Inward										
Animal Feeds	20	-	-	-	12	-	-	-	-	8
Sugar	60	-	60	-	-	-	-	-	-	-
Rubber & Later	120	-	-	24	21	-	62	-	-	13
Iron & Steel	20	-	-	-	20	-	-	-	-	-
Cargo Tonnage		-	60	24	53	-	62	-	-	21
Traffic Volume		-		24	53	-	47	-	-	11

Prai Marginal Area: Prai Wharf, Prai B.C. Terminal

	Penang Island	Province Wellesley						Perlis & Kedah	Perak
		Port Area	B'worth M. Mandin	Prai Ind. Estate	North Dist.	Central Dist.	South Dist.		
Out-ward									
Coal & Coke 70	–	–	–	* 60	–	–	* 10	–	–
Steel Billets 350	–	–	–	* 350	–	–	–	–	–
Chemicals 12 120	–	–	–	pipe 120	–	–	⌐	–	–
Fertilizers 510	–	–	–	* 510	–	–	–	–	–
Cargo Tonnage	–	–	–	920	–	–	10	–	–
Traffic Volume	–	–	–	368	–	–	3	–	–
In-ward									
Ilminite Ore 80	–	–	–	–	–	–	–	–	rail 48 / * 32
Cargo Tonnage	–	–	–	–	–	–	–	–	32
Traffic Volume	–	–	–	–	–	–	–	–	6

For 2000 (5)

New Port	Penang Island	Province Wellesley						Perlis & Kedah	Perak
		Port Area	B'worth K. Mandin	Prai Ind. Estate	North Dist.	Central Dist.	South Dist.		
Outward Other General 1,870	214	–	117	565	10	27	–	251	686
Cargo Tonnage conventional	96	–	53	254	4	12	–	113	309
FCL container	118	–	64	311	6	15	–	138	377
Traffic Volume Normal Lorry	72	–	53	254	3	9	–	57	154
Track-Trailer	17	–	11	53	1	2	–	15	41
Total	89	–	64	307	4	11	–	72	195
Inward Rubber & Later 600	–	–	–	37	–	53	–	215	295
Other General 1,030	76	–	74	355	10	9	–	146	360
Cargo Tonnage conventional	51	–	50	263	7	42	–	242	439
FCL container	25	–	24	129	3	20	–	119	216
Traffic Volume Normal Lorry	38	–	50	263	5	32	–	121	220
Track-Trailer	4	–	4	22	–	3	–	13	24
Total	42	–	54	285	5	35	–	134	244

Fig: 6 DESIRED LINES FOR 1985

Import — Outward

(Vehicles/hour)

Penang Port Area

New Port Area

Existing Ferry Linkage

George Town and Vicinity

Butterworth Port Area

Prai Marginal Area

South-West District of Penang Island

Proposed Bridge Linkage

Perlis & Kedah State and North District of Province Wellesley

Prai River Area

Butterworth Mak Mandin industrial estate

Central and South District of Province Wellesley & Perak State

Prai Industrial Estate

350   288   20   53   62   216   25   36   12   60   86   568   254   193   196   165   73   38   101   156   17   3

Inward – Export
(Vehicles/hour)

Perlis & Kedah State
and North District of
Province Wellesley

Prai River Area

Butterworth &
Mak Mandin
Industrial
Estate

Central and South District
of Province Wellesley
& Perak State

Prai Industrial
Estate

Prai Marginal
Area

Butterworth Port
Area

Penang Port Area

New Port Area

Existing Ferry
Linkage

George Town
Vicinity

South-West
District of
Penang Island

Proposed Bridge Linkage

FIG. 7 DESIRED LINES FOR 2000
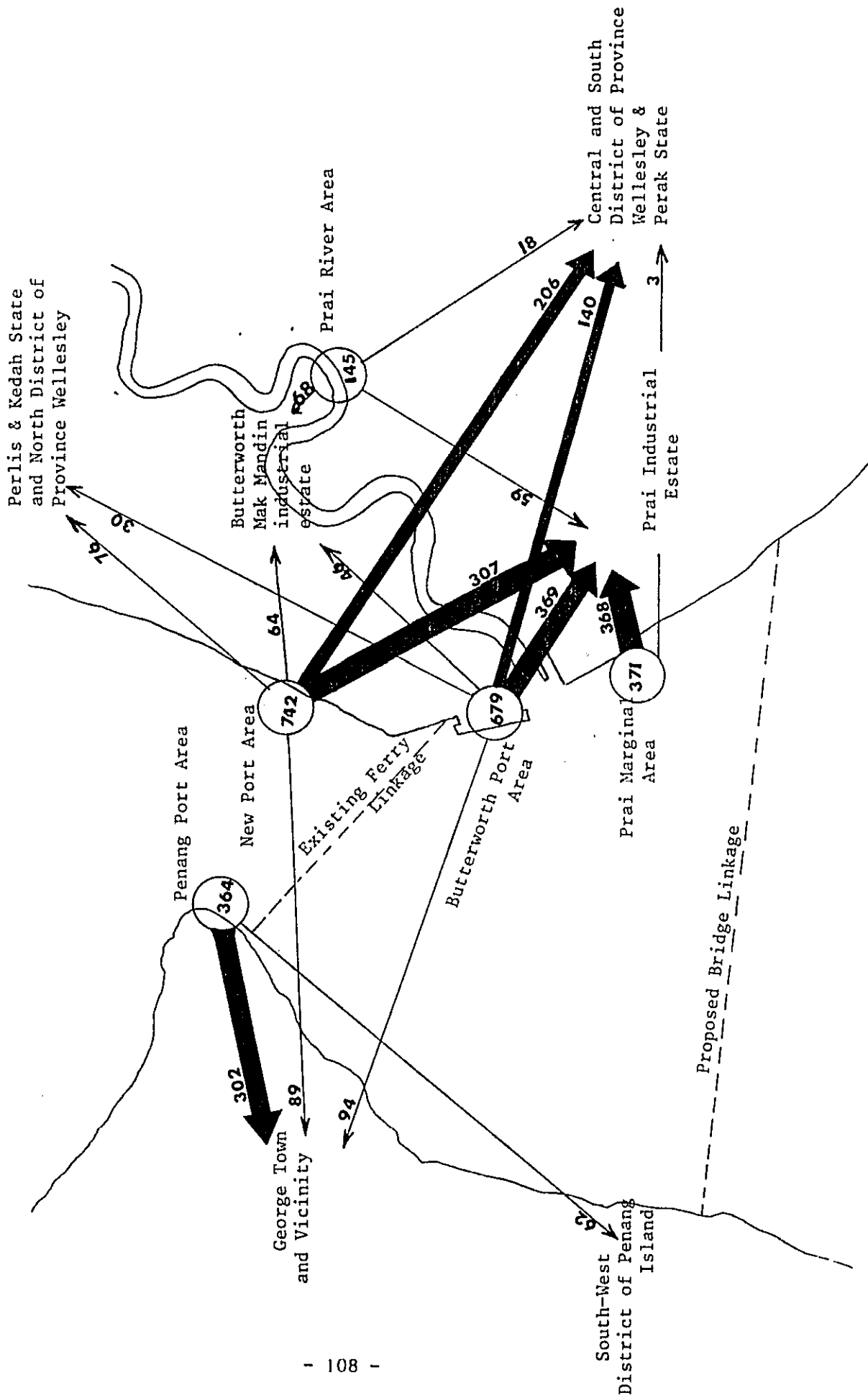
Import – Outward
(Vehicles/hour)

Inward — Export
(Vehicles/hour)

Perlis & Kedah State
and North District of
Province Wellesley

Central and South
District of Province
Wellesley & Perak
State.

Prai River Area

Butterworth &
Mak Mandin
Industrial
Estate

Prai Industrial
Estate

Prai Marginal
Area

Penang Port Area

New Port Area

Butterworth Port
Area

Existing Ferry
Linkage

Proposed Bridge Linkage

George Town
Vicinity

South-West
District of
Penang Island

135

6

799

584

6

148

279

396

58

285

65

53

97

139

54

23

24

113

42

3

52
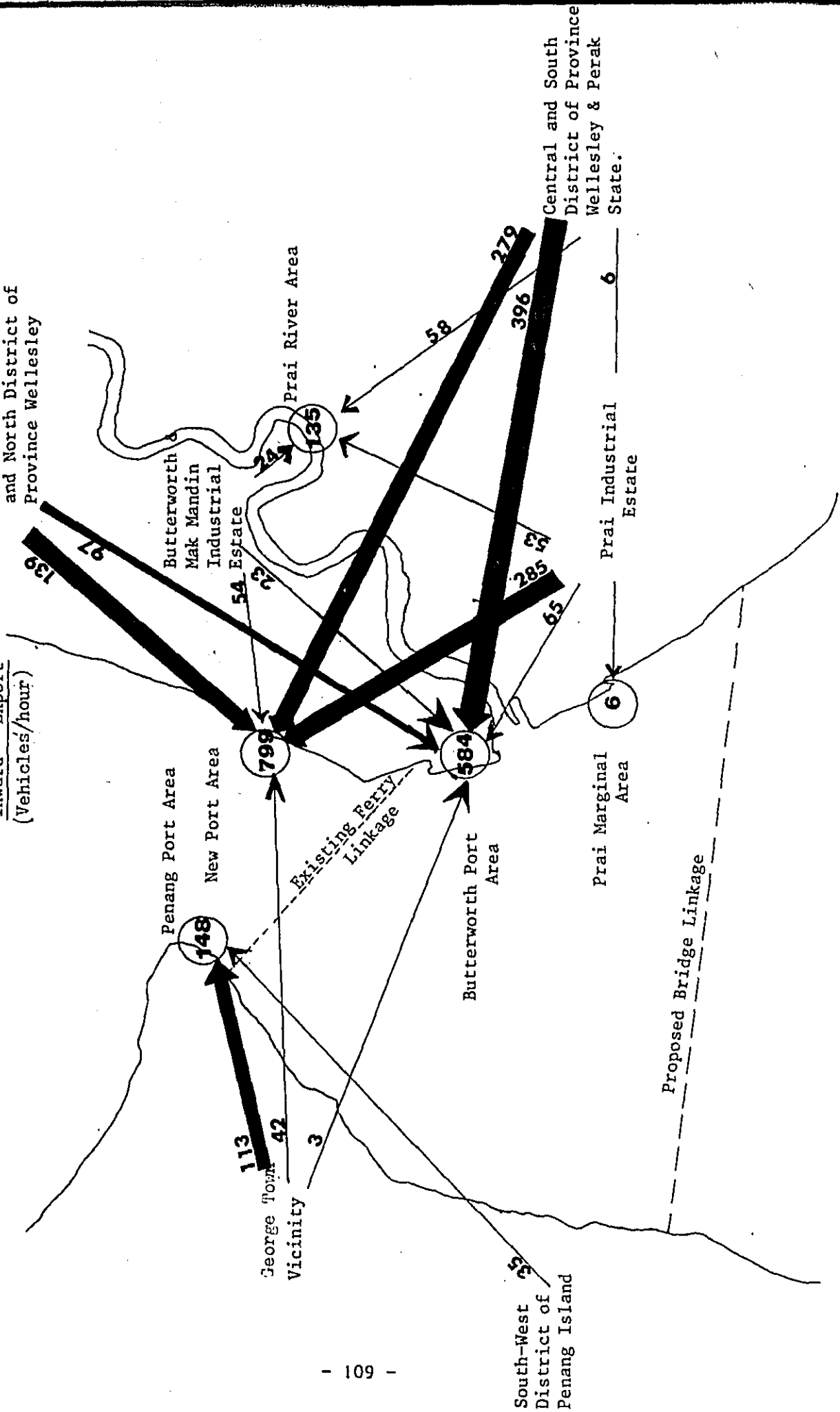
Penang Island

Port development will not be carried out on the Island, and the industrial development at Bayan Lepas in the south will depend largely on air cargo. The traffic volume in the port area will remain unchanged in the future.

However, with the increase of population on the Island, the transfer of general consumer goods with Province Wellesley will gradually increase.

The daily total traffic volume is given in Table 61.

Table 61.   Daily Traffic Volume of Port Areas.

Port Area	1985		2000	
	Import –Outward	Inward –Export	Import –Outward	Inward –Export
Penang Area	2,333	926	2,426	986
Prai Marginal Area	1,306	200	2,473	40
Prai River Area	1,040	1,073	·966	900
Butterworth Area	3,786	3,446	4,526	3,893
New Port	1,440	1,760	4,946	5,326

Daily traffic volume = hourly traffic volume x 1/hourly fluctuation ratio 0.15

In the present study, the future demand of traffic in the Port of Penang has been estimated as above with regard to the following points.

- The cargo flow has been restricted to the direct transport between the initial destination and the last origin and the port areas.

- The regional allocation of the shares of port cargo has been made on the basis of study of available data. To obtain more accurate allocation, a proper research on the distribution system of commodities will be required.