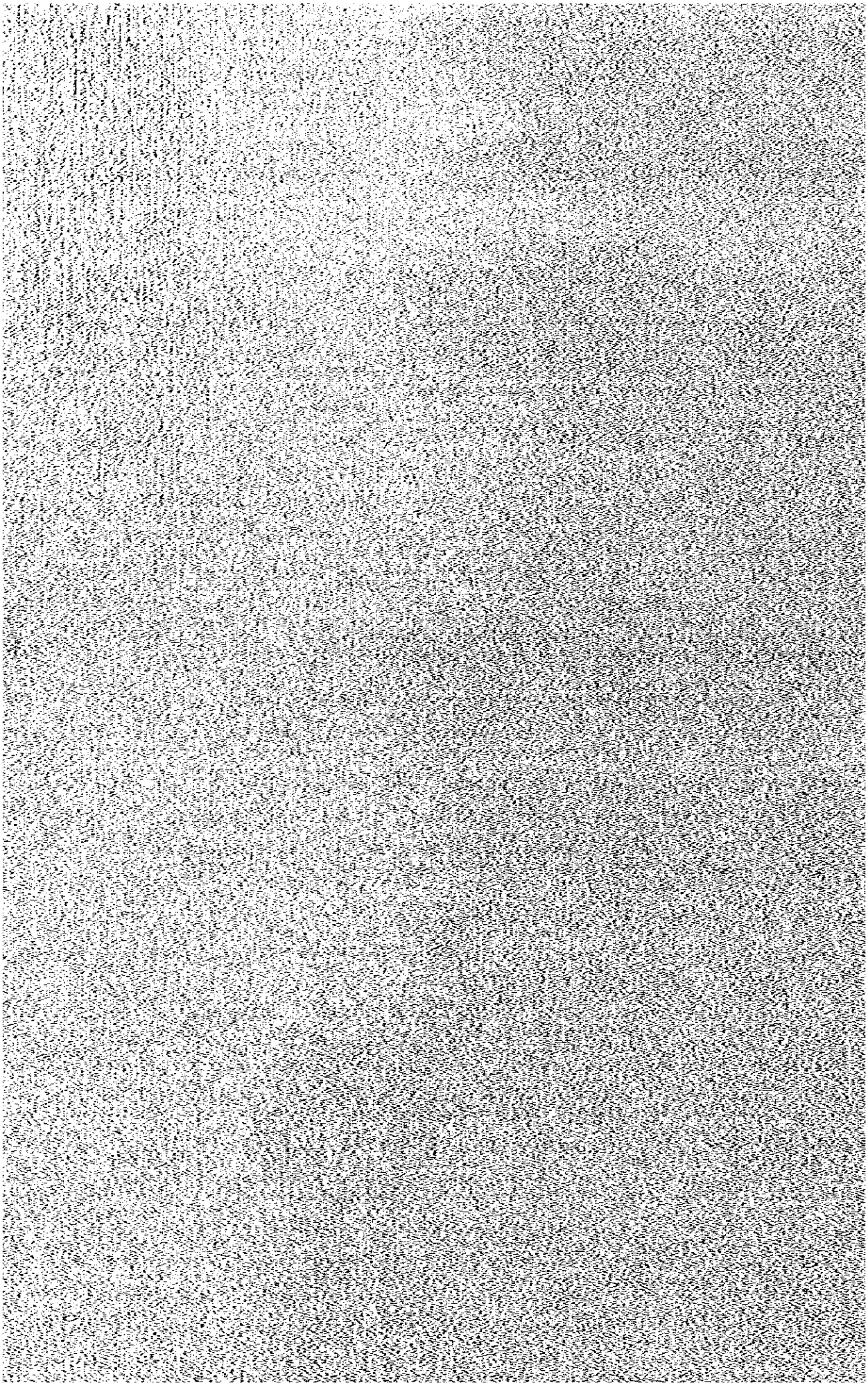
# REPORT FOR RAILWAY DEVELOPMENT PLAN IN MALAYSIA

OCTOBER 1983

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)



# *REPORT FOR RAILWAY DEVELOPMENT PLAN IN MALAYSIA*



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# PREFACE

In response to the request of the Government of Malaysia, the Government of Japan decided to conduct a study on the Railway Development Plan in Malaysia and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA sent to Malaysia a 24-man study team headed by Dr. Masayuki Nishida, Vice President of the Japan Railway Technical Service, in September 1982, under the guidance of the Supervisory Committee chaired by Dr. Shigeru Morichi, Associate Professor of Tokyo Institute of Technology.

The team had discussions with the officials concerned of the Government of Malaysia on the Plan and conducted a field survey in Malaysia. After the team returned to Japan, further studies were made and the present report has been prepared.

I hope that this report will serve for the development of the Plan and contribute to the promotion of friendly relations between our two countries.

I wish to express my deep appreciation to the officials concerned of the Government of Malaysia for their close cooperation extended to the team.

October 1983

Keisuke Arita
President
Japan International Cooperation Agency

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# *SUMMARY AND CONCLUSION*

# SUMMARY AND CONCLUSION

## (1) Basic approach for study

The following four (4) alternative scenarios have been selected for the study of the Railway Development Plan.

| | West Coast Line | New East-West Line |
|---|---|---|
| Case A-A | Standard Gauge<br>Electrification<br>Double track | Standard Gauge<br>Electrification<br>Double track |
| Case B-B | Meter Gauge<br>(Conventional Line)<br>Standard Gauge<br>(New Line)<br>Electrification<br>Single or double track | Standard Gauge<br>Electrification<br>Single or double track |
| Case C-B | Meter Gauge<br>Electrification<br>Single or double track | Standard Gauge<br>Electrification<br>Single or double track |
| Case D-C | Meter Gauge<br>Electrification<br>Single or double track | Meter Gauge<br>Electrification<br>Single or double track |

The alternatives considered for the West Coast Line are as follows.

Case A: Conversion of the existing West Coast Line into the new electrified double track line with the standard gauge.

Case B: Construction of the new electrified railway of standard gauge alongside the existing West Coast Line. This existing West Coast Line is assumed to continue its operations.

Case C: Improvement of the existing West Coast Line into electrified double track line, depending on the development of demand forecast in the future. This case includes the possibilities for future conversion into the standard gauge track.

Case D: Improvement of the existing West Coast Line into electrified double track depending on the development in the future traffic demand. This case D, however, does not include any future conversion into the standard gauge track.

The alternative cases considered for the New East-West Line include the followings.

Case A: Construction of the new electrified railway of standard gauge double track.

Case B: Construction of the new line of standard gauge track. Whether to be electrified or not and whether to be single tracked or double tracked will be decided depending on the future demand projections.

Case C: Construction of the new line of meter gauge track. Whether to be electrified or not and whether to be single tracked or double tracked will be decided depending on the future demand projections.

The combination of all these cases explained above produces twelve (12) different plans. Through the discussion with the MRA authorities, the following four (4) cases have been selected for the further comparison and study. These four (4) cases compare the difference in the qualities of railway service in an easily-understandable manner. The remaining eight (8) cases have been left out due to the similarities in the service standard. Therefore, under the current study for Master Planning, the following four (4) cases have been critically reviewed and compared.

- Case A-A where the highest standard of transport services is expected.
- Case B-B and Case C-B where, like the Japanese Shinkansen case, the existing line continues its operations.
- Case D-C where the required investment can be reduced to the possible minimum.

| West Coast Line \ New East-West Line | Case A | Case B | Case C |
|---|---|---|---|
| Case A | O | * | * |
| Case B | * | O | * |
| Case C | * | O | * |
| Case D | * | * | O |

In all these cases, electrification is confirmed to have an advantage over non-electrification as the result of comparative analysis of their economics.

(2) Present status of railway

The MRA's railway network has a total length of about 1,600 km (mostly of single track), being operated by employee totalling to about 10,000. In 1980, it carried about 7 million passengers, or 1.6 billion passenger-km, and about 3.6 million tons of cargo freight, or 1.2 billion ton-km. In 1981, the MRA recorded revenues of M$143 million and expenses of M$185 million.

Traffic volume:

| Item / Year | Passenger | | Freight | |
|---|---|---|---|---|
| | No. of passenger carried | Passenger-km | Total tonnage carried | Ton-km |
| | (1,000) | (million) | (1,000) | (million) |
| 1970 | 5,175 | 620 | 3,691 | 1,202 |
| 1971 | 5,269 | 655 | 3,381 | 1,102 |
| 1972 | 5,748 | 729 | 3,456 | 1,175 |
| 1973 | 5,646 | 798 | 3,471 | 1,088 |
| 1974 | 5,967 | 953 | 3,302 | 984 |
| 1975 | 6,109 | 1,014 | 2,782 | 822 |
| 1976 | 6,400 | 1,145 | 3,305 | 1,008 |
| 1977 | 6,383 | 1,223 | 3,787 | 1,209 |
| 1978 | 5,998 | 1,269 | 4,142 | 1,293 |
| 1979 | 6,243 | 1,372 | 4,188 | 1,357 |
| 1980 | 7,067 | 1,587 | 3,607 | 1,195 |

Maximum speed of trains:

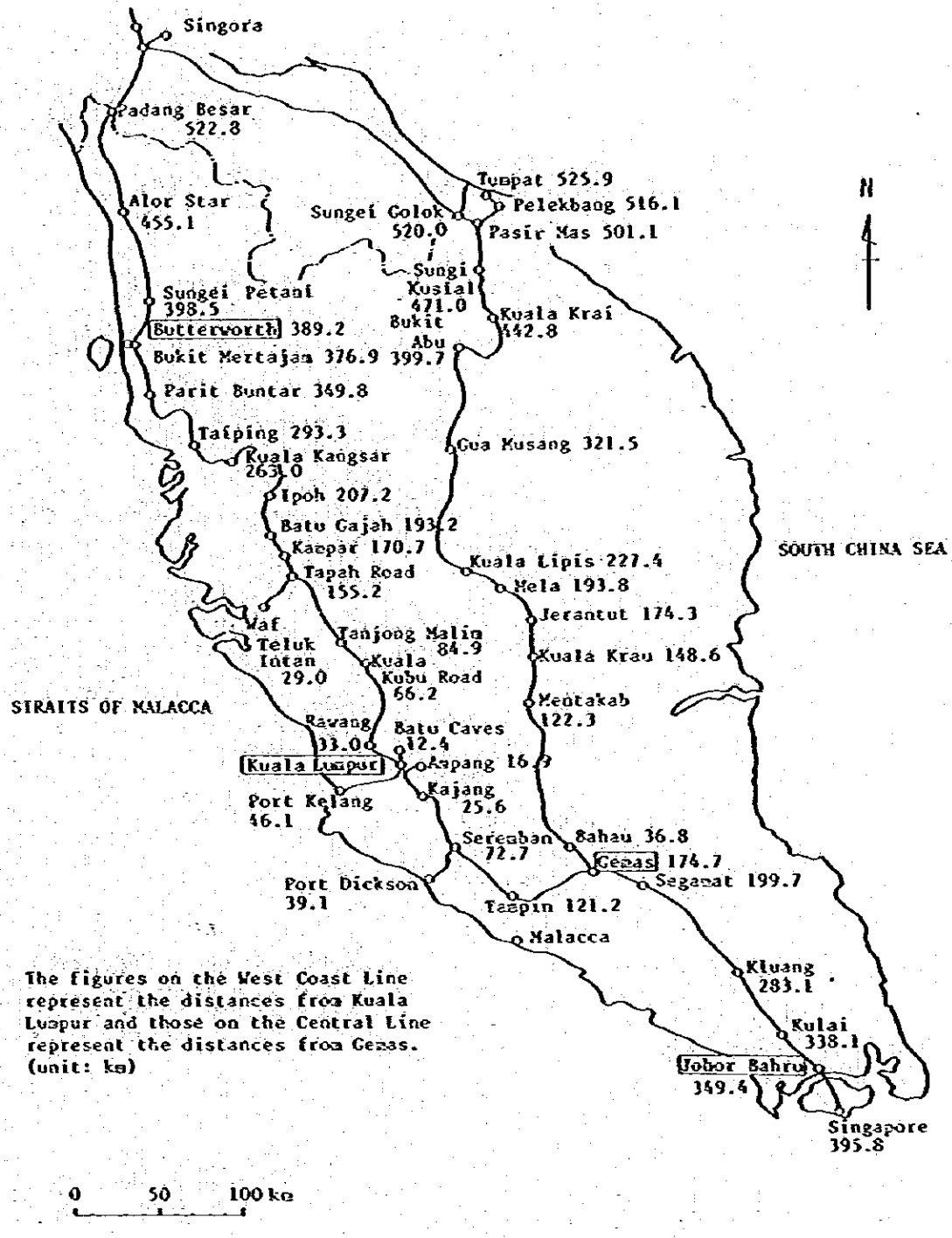
| | |
|---|---|
| Express passenger train | 80 km/h (50 mph) |
| Local passenger train | 72 km/h (45 mph) |
| Freight train | 64 km/h (40 mph) |

No. of rolling stock (as of January 1, 1982):

| | | |
|---|---|---|
| DL | 90 for trains<br>45 for shunting | ) 135 |
| PC | 49 for express trains<br>312 for local trains | ) 361 |
| FC | 2,243 2-axle cars<br>2,913 bogie cars | ) 5,156 |

Facilities:

Rail, signalling and telecommunication equipment, rolling stock and workshop are considerably time worn.




Railway Network Map

(3) Socio-economic framework

1) Population growth rate and GDP growth rate as the base for this study have been assumed as follows:

Population growth rate

| | |
|---|---|
| 1981 - 1990 | 2.4% annually |
| 1991 - 2005 | 2.0% annually |

GDP growth rate

| | |
|---|---|
| 1981 - 1990 | 7.9% annually |
| 1991 - 2005 | 6.5% annually |

2) All projects now under preparation and construction for road, airports and ports, but excepting railway are assumed completed as scheduled. Traffic demand forecast in this study is made on this assumption.

a) Malaysian population grew at 3.0% p.a. throughout 1960's, at 2.6% p.a. in the 1970's, which are relatively high. The Fourth Malaysia Plan envisages population growth at 2.4% p.a. through 1990. Beyond 1990, 2.0% p.a. growth is assumed.

b) Malaysian GDP grew at 7.9% in the 1970s. It is forecasted that the same rate of 7.9% could be achieved in the 1980s. However, due to the worldwide economic depression the actual growth rate fell short of the target level originally considered: 6.9% in 1981 and 3.9% in 1982. Despite these actual low growth rates, the Malaysian authority requested to use higher growth assumptions for purpose of this Master Planning study: 7.9% p.a. throughout 1980s and 6.5% p.a. between 1991 and 2005 respectively.

Incidentally, the World Bank and the Institute of Developing Economies of Japan indicate the following growth rates for the Malaysian economy.

| | | |
|---|---|---|
| ° World Bank | 1980 - 1985 | 7.6% |
| | 1986 - 1990 | 8.1% |

- Institute of Developing Economies of Japan

| | | |
|---|---|---|
| 1980 - 1990 | High scenario | 9% |
| | Low scenario | 7% |

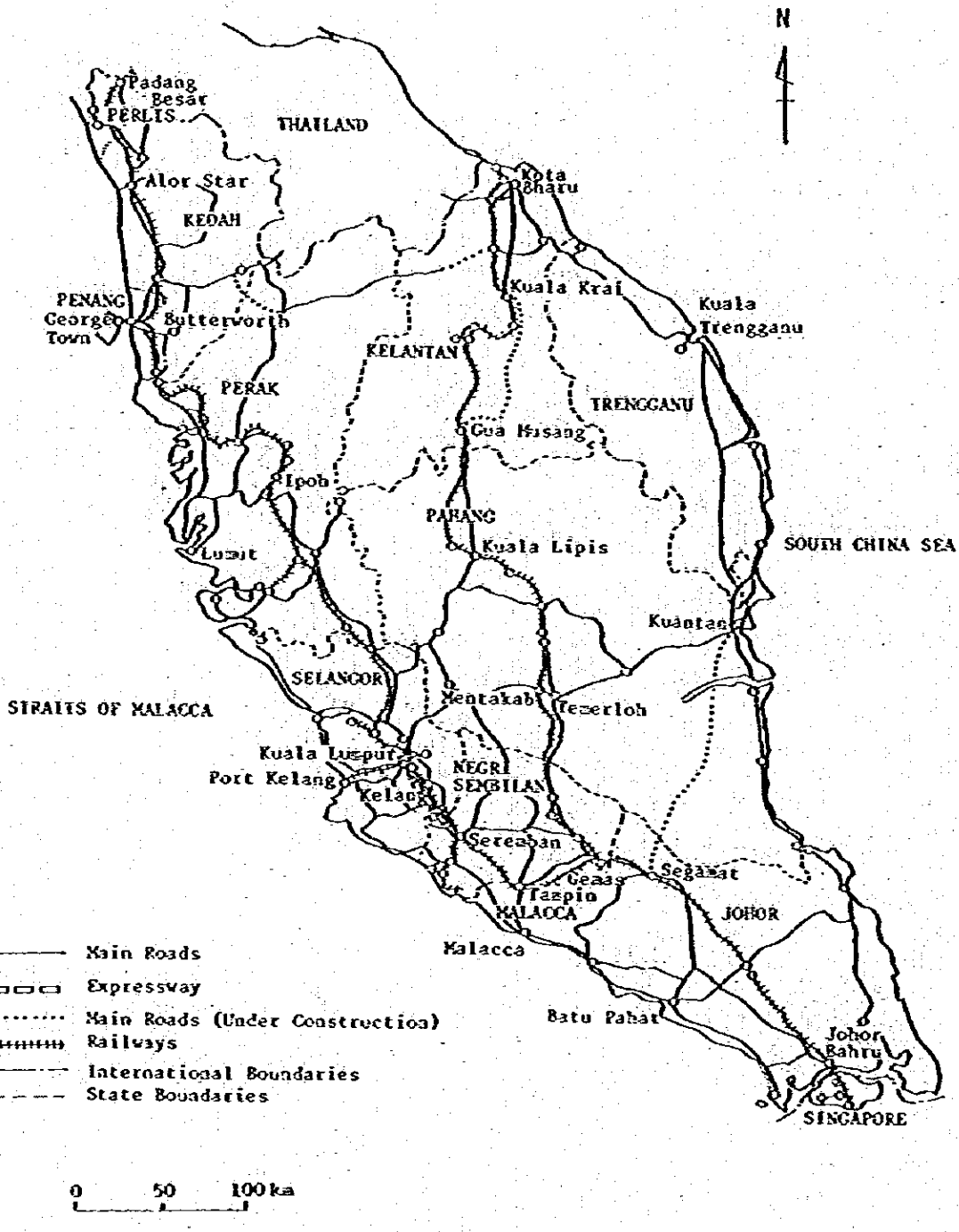
These forecasts, including the assumptions for the current study, may have to be adjusted downward in due course of time since the effects on the world economy of oil price decrease which took place in late 1982 have not fully been taken into account in the forecasts.

Such effects on the world economy will, in one way or other, be transferred to the Malaysian economy, (which should be cautiously monitored).

c) Main roads now under construction are

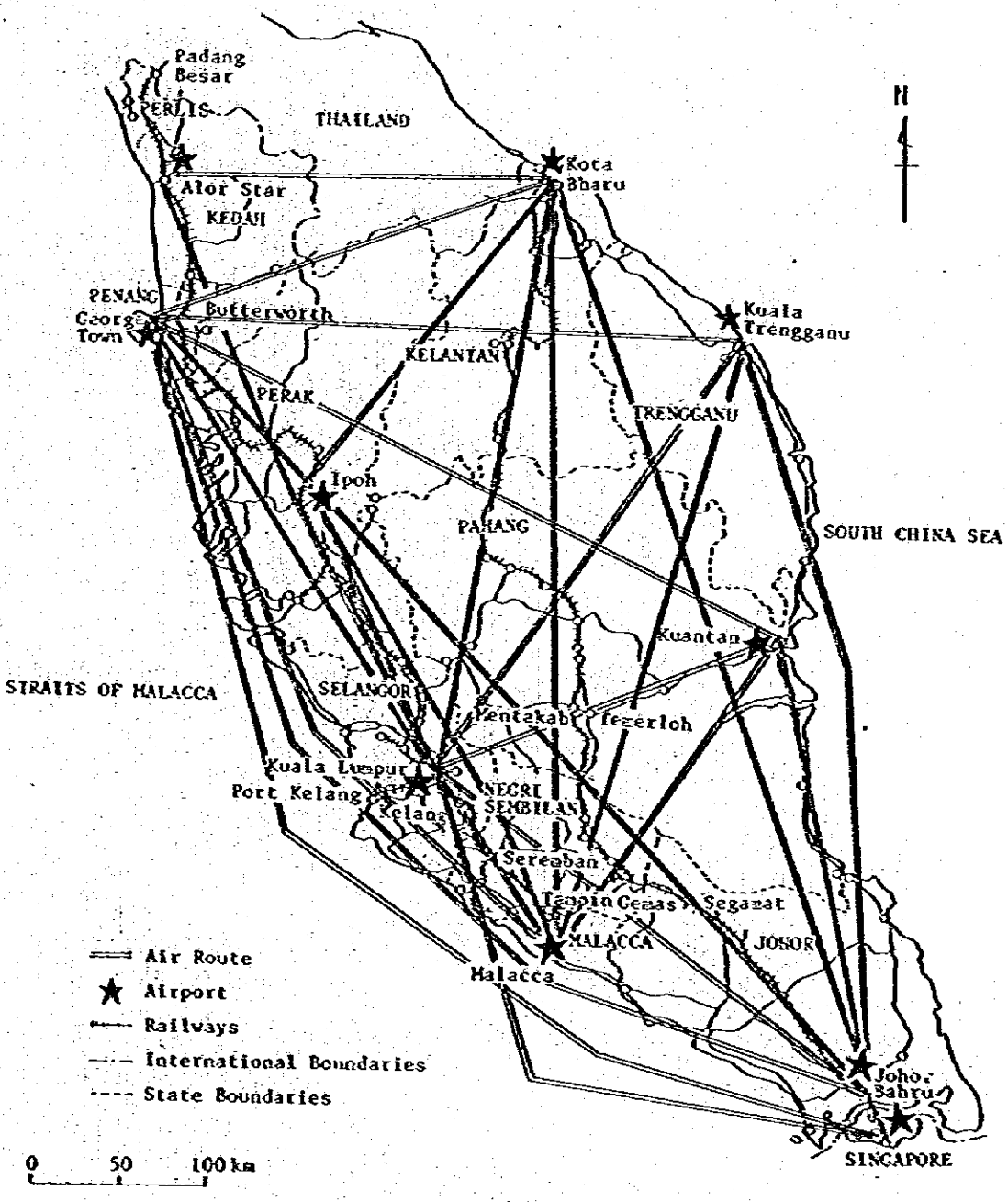
(i) Inter-urban Toll Expressway (773 km),
(ii) Kuantan - Segamat Highway (149 km), and
(iii) Gua Musang - Kuala Krai Road (115 km).

At present, no overall Master Plan to coordinate the road network throughout the whole Peninsula of Malaysia exists. Individual road construction plans are prepared separately.



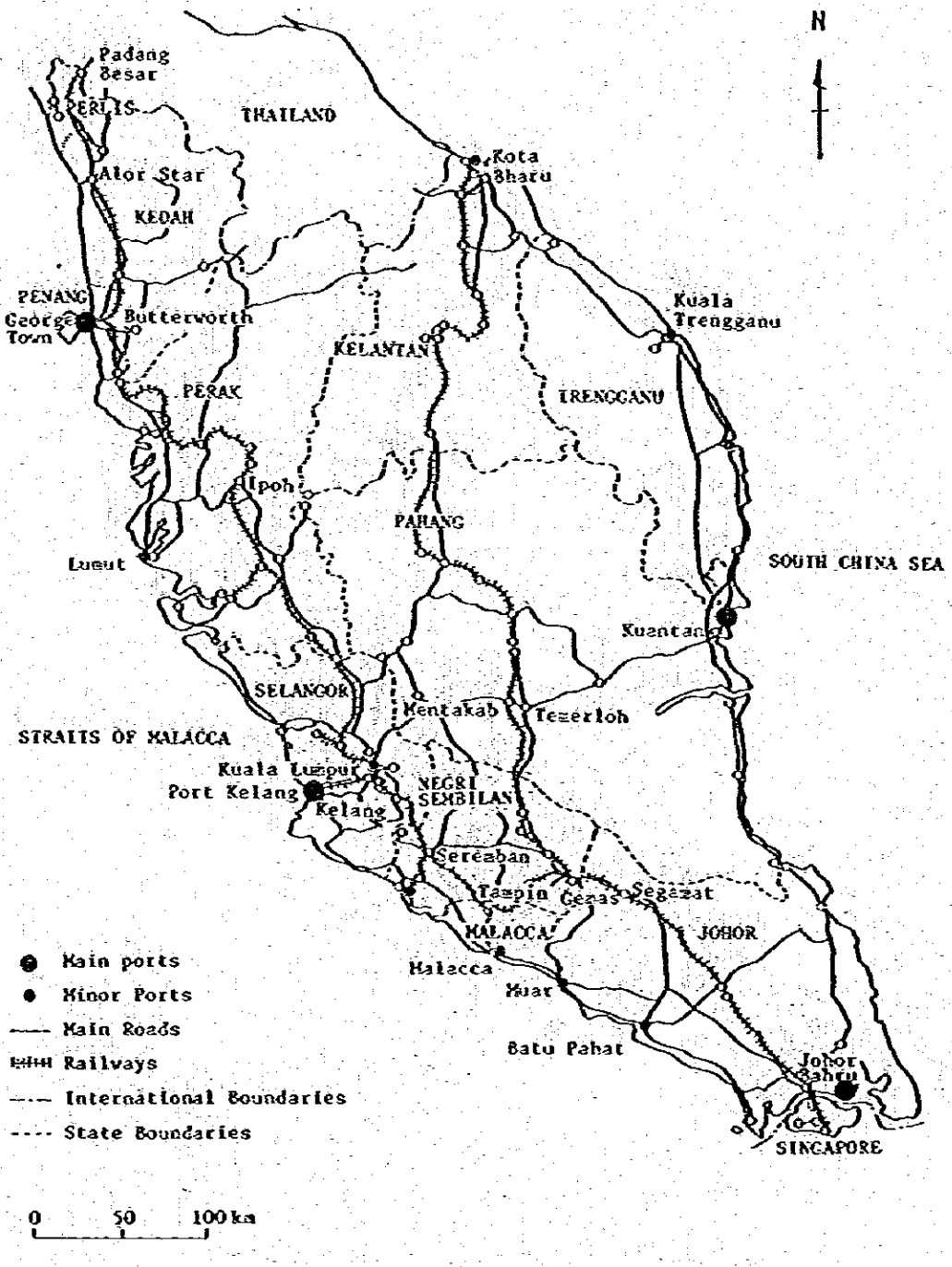

Present Road and Railway Network

d) Since major cities in the Peninsula are located at nearly 300 to 400 km distance from each other, passenger traffic between Kuala Lumpur and Penang, Kuala Lumpur and Singapore and Kuala Lumpur and Kuala Trengganu are currently serviced by air transportation system. These air traffic may possibly be adversely affected when the high-speed railway service along these routes are made available. However, in view of the proven fact that air- and surface-transportation play different roles, air traffic will still continue to be an important mode of domestic traffic even after the completion of railway network.




Present Air Transport Network

e) In addition to the existing major ports of Kelang, Penang, Johor and Kuantan, expansion are now under way for Kuala Trengganu Port and Kelantan Mini-port.




Present Port Locations

(4) Traffic demand forecast

1) Assumptions for forecast

① Both of the West Coast Line and the New East-West Line would be completed by 1989 and start commercial operation in 1990.

② The scheduled speed of trains would be as follows:

(km/h)

| Trains \ Alternatives | | West Coast Line | | | New East-West Line | | |
|---|---|---|---|---|---|---|---|
| | | A | B | C & D | A | B | C |
| Passenger | Super express | 130 | 130 | 100 | 130 | 130 | 100 |
| | Express | 110 | 110 | 80 | 110 | 110 | 80 |
| | Local | 80 | 60 | 60 | 80 | 80 | 60 |
| Freight | Through | 80 | 60 | 60 | 80 | 80 | 60 |
| | Local | 60 | 50 | 50 | 60 | 60 | 50 |

③ The carrying capacities of other traffic modes, such as road, air flight and marine shipping, would be limitless.

④ The existing relative fare and tariff structures among various traffic modes would remain unchanged.

2) Estimated passenger demand

Passenger Traffic Demand (Inter-zone Transport)

Unit: 1,000 persons, (%)

| Year and case \ Traffic mode | | Railway | Private car & taxi | Long-distance bus | Airline | Total |
|---|---|---|---|---|---|---|
| 1981 (Share) | | 4,618 (8.3) | 32,232 (57.8) | 16,460 (29.5) | 2,464 (4.4) | 55,773 (100) |
| 2005 | A-A (Share) | 31,794 (17.3) | 115,828 (63.1) | 30,045 (16.4) | 5,825 (3.2) | 183,492 (100) |
| | B-B (Share) | 31,794 (17.3) | 115,828 (63.1) | 30,045 (16.4) | 5,825 (3.2) | 183,492 (100) |
| | C-B (Share) | 25,156 (13.7) | 120,605 (65.7) | 31,368 (17.1) | 6,362 (3.5) | 183,492 (100) |
| | D-C (Share) | 20,690 (11.3) | 123,750 (67.5) | 32,356 (17.6) | 6,696 (3.6) | 183,492 (100) |

Note: 1. Excluding passenger traffic between Thailand and Malaysia.
2. Including passenger traffic between Thailand and Singapore.
3. With regards to the traffic related to roads, passenger traffic on the shorter routes compared with the railway (Butterworth - Kota Bharu, Kuala Lumpur - Kuala Lipis - Kota Bharu and Segamat - Kuantan) is included.

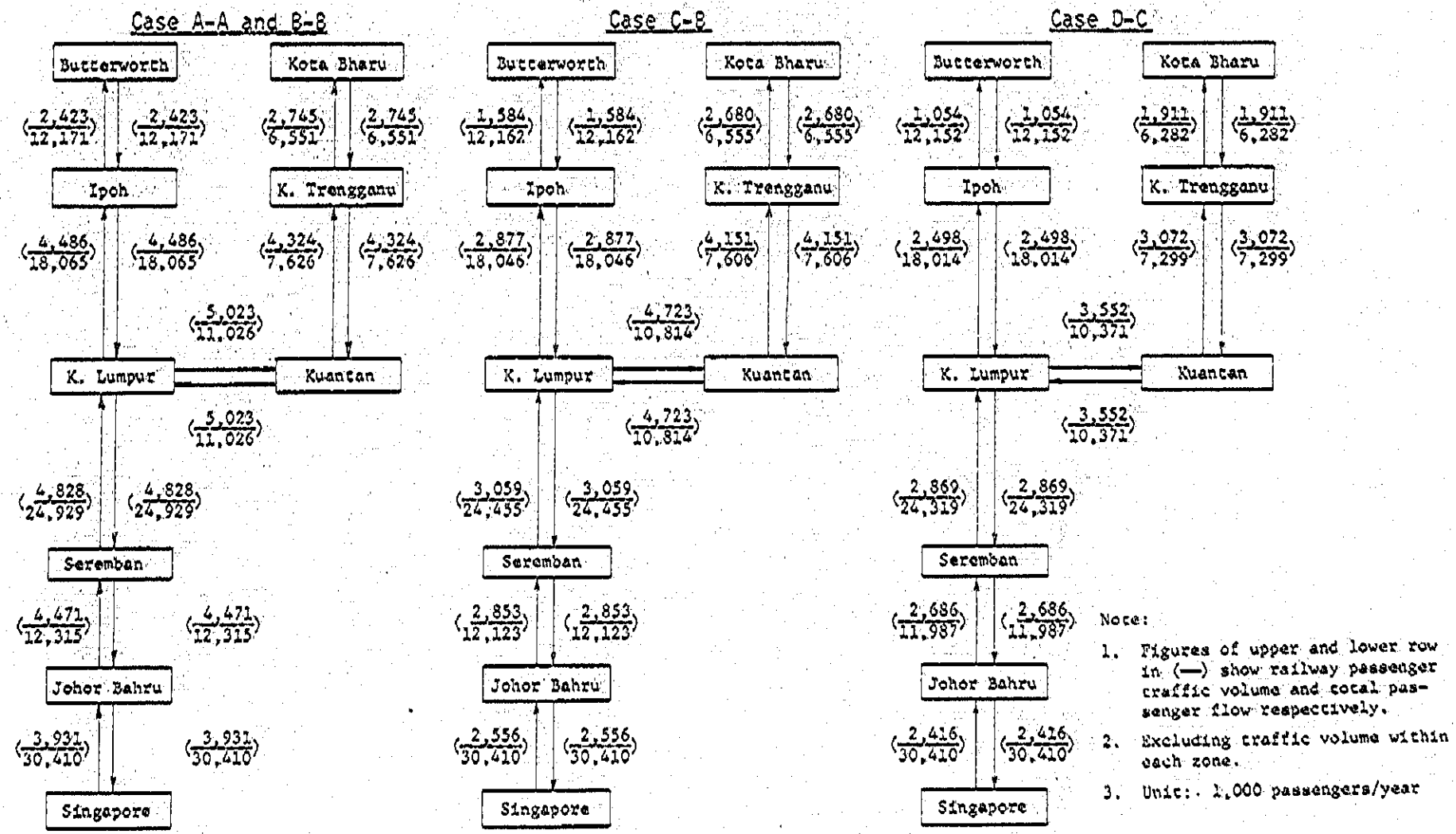
3) Estimated freight demand

Freight Traffic Volume and Share by Traffic Modes and Alternative Cases

Unit: 1,000 tons, (%)

| Year and case \ Traffic mode | | Railway | Lorry | Coastal shipping | Total |
|---|---|---|---|---|---|
| 1980 (Share) | | 3,529.3 (10.9) | 25,438.3 (78.2) | 3,544.2 (10.9) | 32,511.8 (100) |
| 2005 | A-A (Share) | 12,262.8 (7.6) | 129,816.0 (80.1) | 20,035.2 (12.3) | 162,114.0 (100) |
| | B-B (Share) | 8,090.1 (5.0) | 133,129.5 (82.1) | 20,894.4 (12.9) | 162,114.0 (100) |
| | C-B (Share) | 8,920.8 (5.5) | 133,749.7 (82.5) | 19,443.5 (12.0) | 162,114.0 (100) |
| | D-C (Share) | 10,081.6 (6.2) | 131,317.7 (81.0) | 20,714.7 (12.8) | 162,114.0 (100) |

# Passenger Traffic Demand at Cross Section between Main Stations (2005)

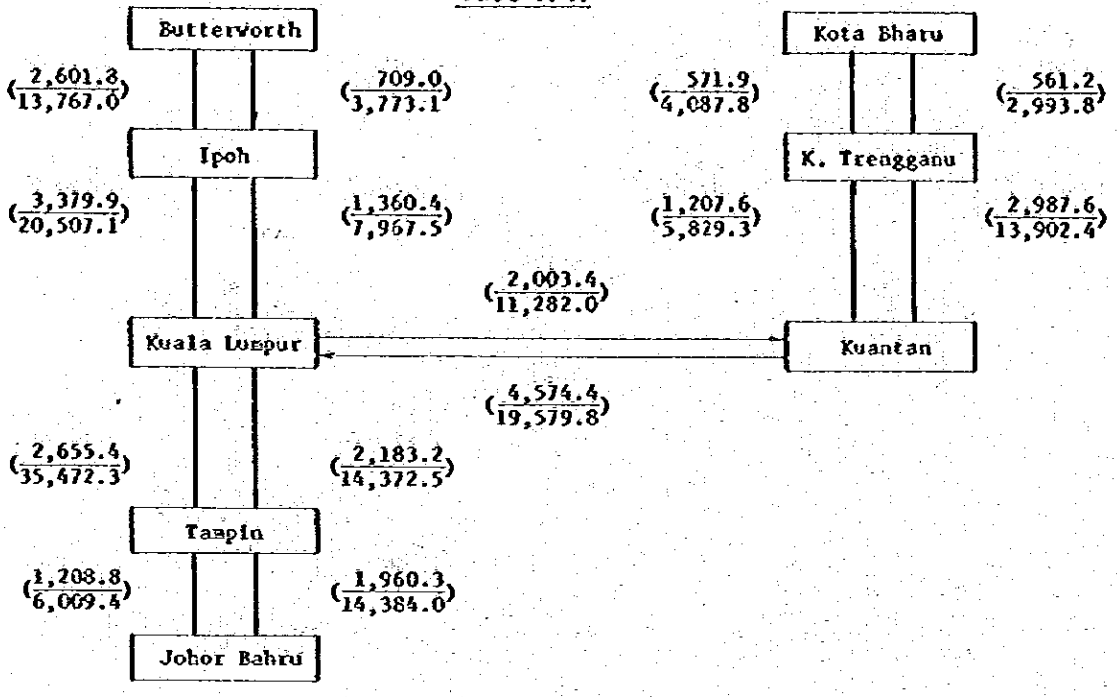



Note:

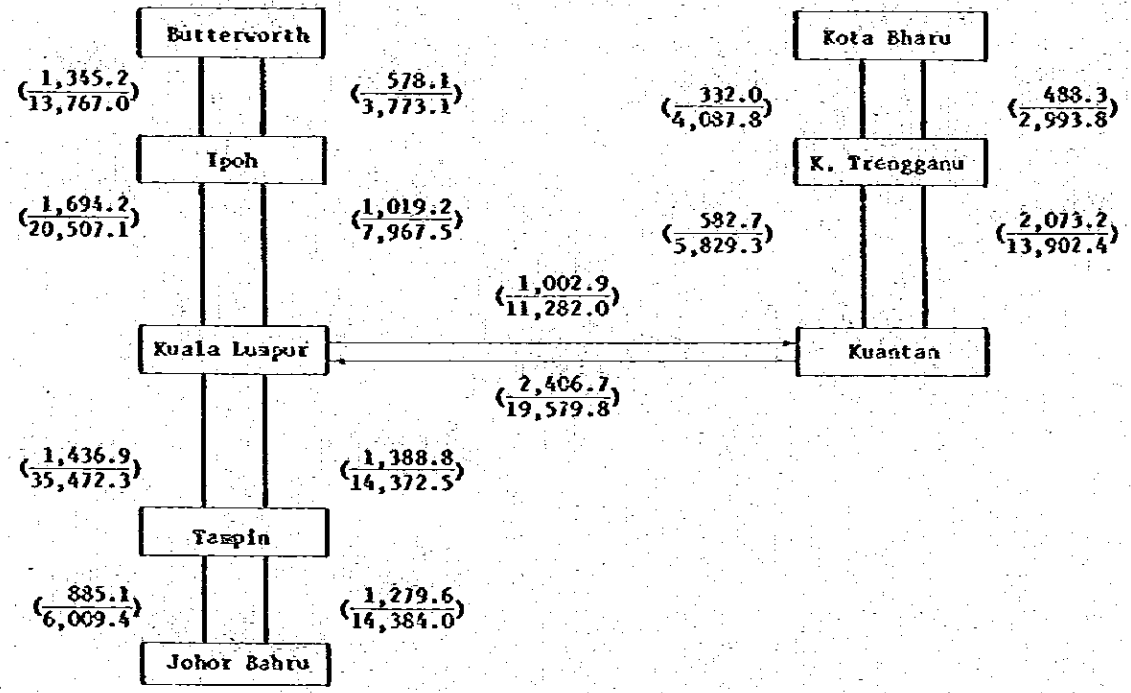
1. Figures of upper and lower row in (—) show railway passenger traffic volume and total passenger flow respectively.
2. Excluding traffic volume within each zone.
3. Unit: 1,000 passengers/year

## Freight Traffic Demand at Cross Section between Main Stations (2005)

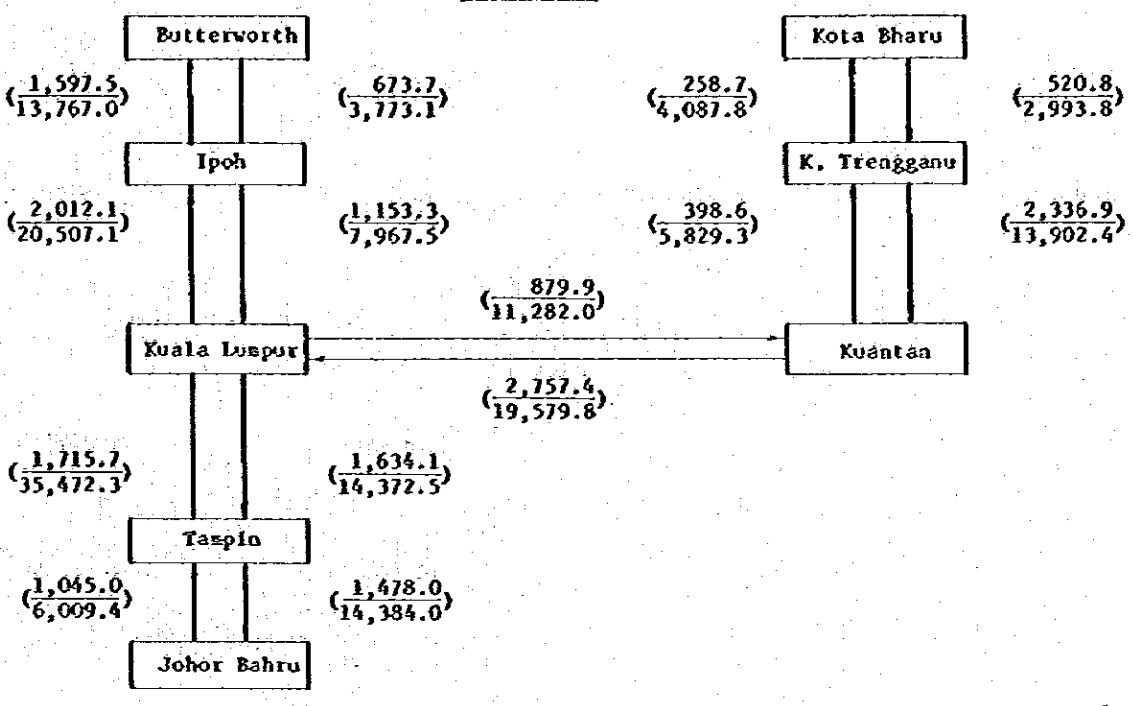
### Case A-A



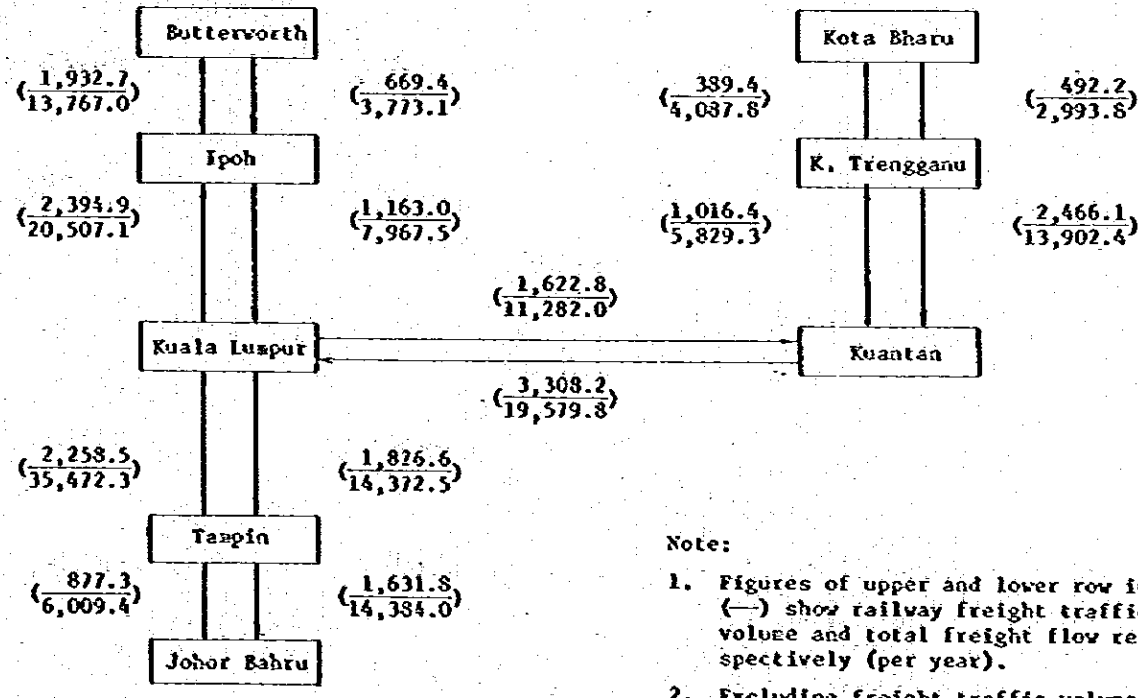

### Case B-B



## Case C-B




## Case D-C




Note:

1. Figures of upper and lower row in (—) show railway freight traffic volume and total freight flow respectively (per year).
2. Excluding freight traffic volume within each state.
3. Unit: 1,000 tons/year

In view of the objective of the current study which has to be achieved within a limited time, the foregoing basic assumptions are made in a simplified manner. Therefore, a sensitivity analysis has been conducted for the following three cases:

- The case where the annual growth rate of GDP would be reduced to 5% for the period of 1991 - 2005;
- The case where the expressway between Kuala Lumpur and Kuantan would be opened by 2005; and
- The case where the railway relative fare rate to those for other traffic modes, would be increased by 20%.

The results are shown below:

Sensitivity Analysis of Railway Traffic Demand
(Case A-A, in 2005)

| | Passenger | | Freight | |
|---|---|---|---|---|
| | (1,000 persons) | | (1,000 tons) | |
| Base case | 31,794 | (100%) | 12,263 | (100%) |
| Economic growth rate of 5% per year beyond 1990 | 26,707 | (84%) | 9,913 | (81%) |
| Opening of expressway between Kuala Lumpur and Kuantan by 2005 | 30,036 | (95%) | 10,958 | (89%) |
| Railway relative fare increased by 20% compared with other modes | 28,218 | (85%) | | |

(5) Construction and operations

1) Type and maximum speed of train

The type and maximum speed of train has been specified as shown in the table below:

Unit: km/h

| Type of train \ Gauge | | Standard | Meter |
|---|---|---|---|
| Passenger | Super express | 160 | 120 |
| | Express | 160 | 120 |
| | Local | 120 | 100 |
| Freight | Through | 120 | 100 |
| | Local | 120 | 100 |

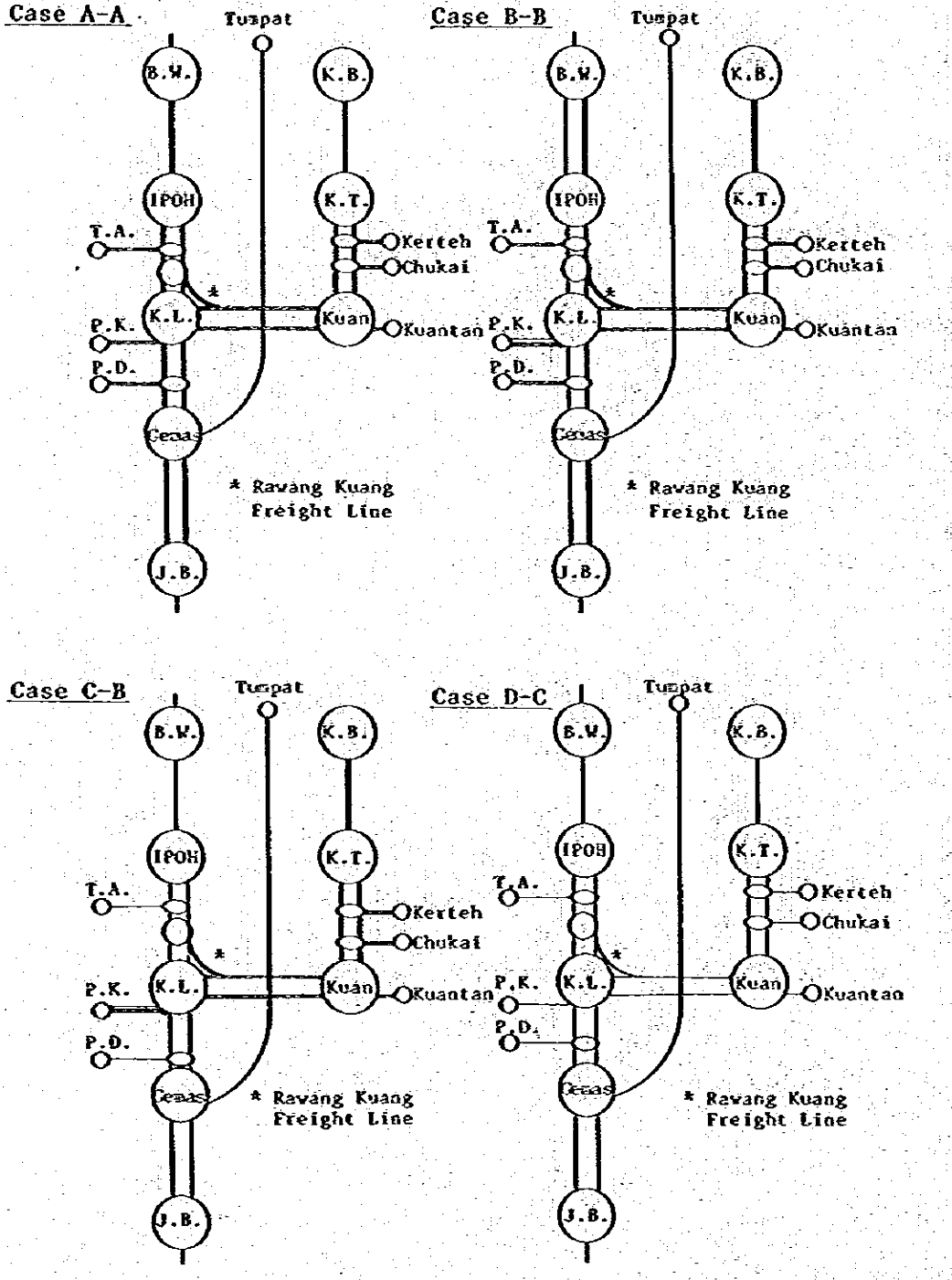
2) Number of locomotives, passenger cars and wagons

Total number of locomotives, passenger cars and wagons required in 2005 is estimated as follows:

| Case | Locomotive | | Passenger car | Freight wagon |
|---|---|---|---|---|
| | E.L | D.L | | |
| A-A | 105 | 46 | 965 | 4,427 |
| B-B | 99 | 46 | 934 | 2,765 |
| C-B | 102 | 46 | 918 | 3,154 |
| D-C | 115 | 46 | 839 | 3,734 |

3) Conceptual track layout

The number of tracks as may be required from the estimated traffic demand in 2005 are as shown in the following diagram.



4) Construction, maintenance and operation costs

Unit: Million M$ (in 1981)

| Case | Construct cost | Maintenance and operation costs in 2005 |
|---|---|---|
| A-A | 11,589 | 354 |
| B-B | 11,572 | 327 |
| C-B | 9,959 | 290 |
| D-C | 9,230 | 264 |

a) The track capacity for the single track section is specified as follows. Any section in excess of those limits in the track capacity requires the conversion into the double track system.

Standard guage 60 trains per day (a total of both directions)
Meter gauge 48 trains per day (a total of both directions)

b) The topographic map as the basis for the estimates of construction cost is of a reduced scale of 1 to 63,360 published in the 1960s. The geological map used for this purpose is of a scale of 1 to 500,000.

Therefore, technical analysis of further details as to the geological conditions in the central mountainous zone and the swampy zone along the east coast zone will require future studies.

1) Construction

① In regards to the foundation of track, earth banking and cutting are assumed. Track structures are designed, in principle, for ballast track construction.

② The electrification system is applied as the electrification indicates a better economics over the non-electrification. Signals are designed for the ATS and CTC system considering the maximum train speed. The telecommunication facility has been designed for the optical fiber communication system in anticipation of future diversified utilization.

③ The passenger and freight trains are designed for the electric locomotive hauling system for convenience of maintenance. The diesel locomotive is to be used for shunting purpose within the station yard.

ii) Operation and maintenance

The new railway system introduced in this project is of technologically high standard, which requires a small number of manpower but great technical skill and high level technology for the operation and maintenance. The training of the operation and maintenance specialists will be an extremely important issue.

(6) Economic and financial analysis

Economic Internal Rate of Return (E.I.R.R.) and Financial Internal Rate of Return (F.I.R.R.) are calculated as follows:

| | E.I.R.R. (%) | F.I.R.R. (%) |
|---|---|---|
| Case A-A | 13.8 | 9.4 |
| Case B-B | 12.6 | 8.3 |
| Case C-B | 11.5 | 8.8 |
| Case D-C | 12.9 | 7.8 |

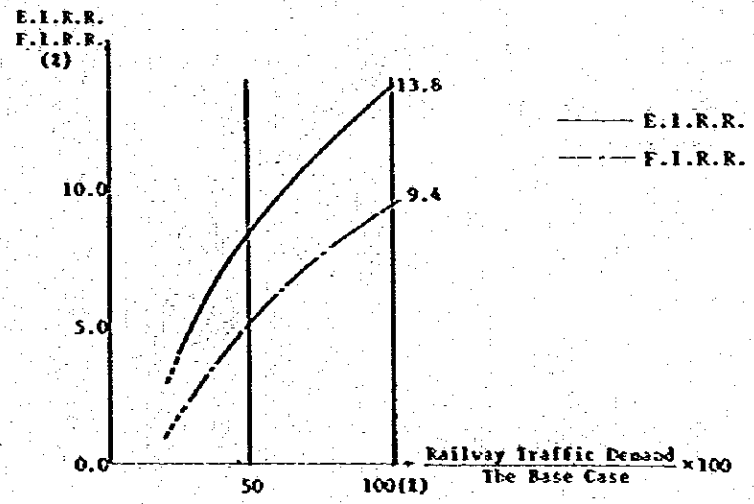
(Assumption: GDP growth rate 1981 - 1990 7.9%/year
1991 - 2005 6.5%/year)

The current study is attempting to compare four (4) alternative cases deduced from simplified assumptions for Malaysian economy. It should also be noted that the impacts of decreased oil prices on the world economy are not fully considered in this study due to the time limitation.

Moreover, future traffic demand for railway will be influenced by other factors than economic growth, such as population growth, service levels of other transport modes and so on.

Therefore, a trial has been conducted to briefly explain the relationship between traffic demand and E.I.R.R. or F.I.R.R. for case A-A as shown below.

Relationship between Traffic Demand and E.I.R.R./F.I.R.R. (Case A-A)




Note:

Construction cost is fixed while operation cost is varied in proportion to traffic volume.

(7) Railway development strategy

As the result of comparison of E.I.R.R. and F.I.R.R., Case A-A is selected as the Master Plan toward the target year of 2005 among the four (4) alternatives.

In fact, however, in determining implementation of individual projects, full consideration must be given to the possible impacts upon the Project feasibility from the change of conditions assumed for this study. Especially, the following matters should be cautiously thought-through.

① Future trend of the world economy and its influence on the Malaysian economy

② In-depth study with a higher accuracy of technical aspect (especially in geology)

③ Phased implementation of the Project

④ Training program for personnel to upgrade technical skills

⑤ Reduction of cost for construction and availability of governmental support

⑥ Business diversification and improvement of efficiency

| | Traffic volume (2005 A.D) | Estimated cost (1981) | Internal rate of return |
|---|---|---|---|
| Case A-A | Passenger<br>13,018 million passenger-km<br>Freight<br>5,238 million ton-km | Construction<br>11,589 million M$<br>Maintenance & operation<br>354 million M$/year | E.I.R.R 13.8%<br>F.I.R.R. 9.4% |
| Case B-B | Passenger<br>12,718 million passenger-km<br>Freight<br>3,255 million ton-km | Construction<br>11,572 million M$<br>Maintenance & operation<br>327 million M$/year | E.I.R.R. 12.6%<br>F.I.R.R. 8.3% |
| Case C-B | Passenger<br>10,594 million passenger-km<br>Freight<br>3,534 million ton-km | Construction<br>9,959 million M$<br>Maintenance & operation<br>290 million M$/year | E.I.R.R. 11.5%<br>F.I.R.R. 8.8% |
| Case D-C | Passenger<br>8,038 million passenger-km<br>Freight<br>4,234 million ton-km | Construction<br>9,230 million M$<br>Maintenance & operation<br>264 million M$/year | E.I.R.R. 12.9%<br>F.I.R.R. 7.8% |

Note: Assumed as GDP growth rates are 7.9%/year until 1990 and 6.5%/year in 1991 - 2005.

# *CHAPTER 1.*
# *INTRODUCTION*

# CHAPTER 1 INTRODUCTION

## 1-1 Background of the Study

Malaysia possesses strong economic power backed up by the world's prominent rubber industry and abundant natural resources. The nation's infrastructures including roads, ports, harbors, telecommunication and electric power are relatively developed in the west coast of the peninsula.

In the recent years, with discovery and exploitation of offshore oil field and natural gas, rapid development has been made by new construction or improvement of ports, harbors and by development of large industrial areas in the east coast region.

Although the present railway facilities have become superannuated, they should be able to contribute greatly to the national development. With such understanding, the Government of Malaysia and JICA reached an agreement to prepare a Master Plan on the Railway Development.

The Scope of Work was established in April 1982 and the detailed items of the study were agreed in August 1982 by both sides. The study has started in September 1982.

## 1-2 Purpose of the Study

The purpose of this study is to formulate the railway development Master Plan including electrification and gauge conversion toward the target year of 2005 A.D.

## 1-3 Outline and Phasing of the Study

The study is phased largely into three stages and main work items for each stage are as specified hereunder.

1st stage: Preparatory work in Japan

1) Review of all collected data

2) Review of general policy for implementation of the study

3) Preparation of Inception Report

2nd stage: Until presentation of Interim Report
(Work in Malaysia including a part of work in Japan)

4) Submission and explanation of Inception Report

5) Hearing and discussion with government authorities concerned

6) Data collection and analysis

7) Site reconnaissance

8) Discussion of preconditions on Railway Development Plan

9) Traffic demand forecast

10) Planning of Master Plan alternative

11) Preliminary cost estimation

12) Preliminary economic and financial evaluation of alternatives

13) Comparative study and evaluation of alternatives

14) Submission and explanation of Interim Report

15) Selection of Railway Development Stragety

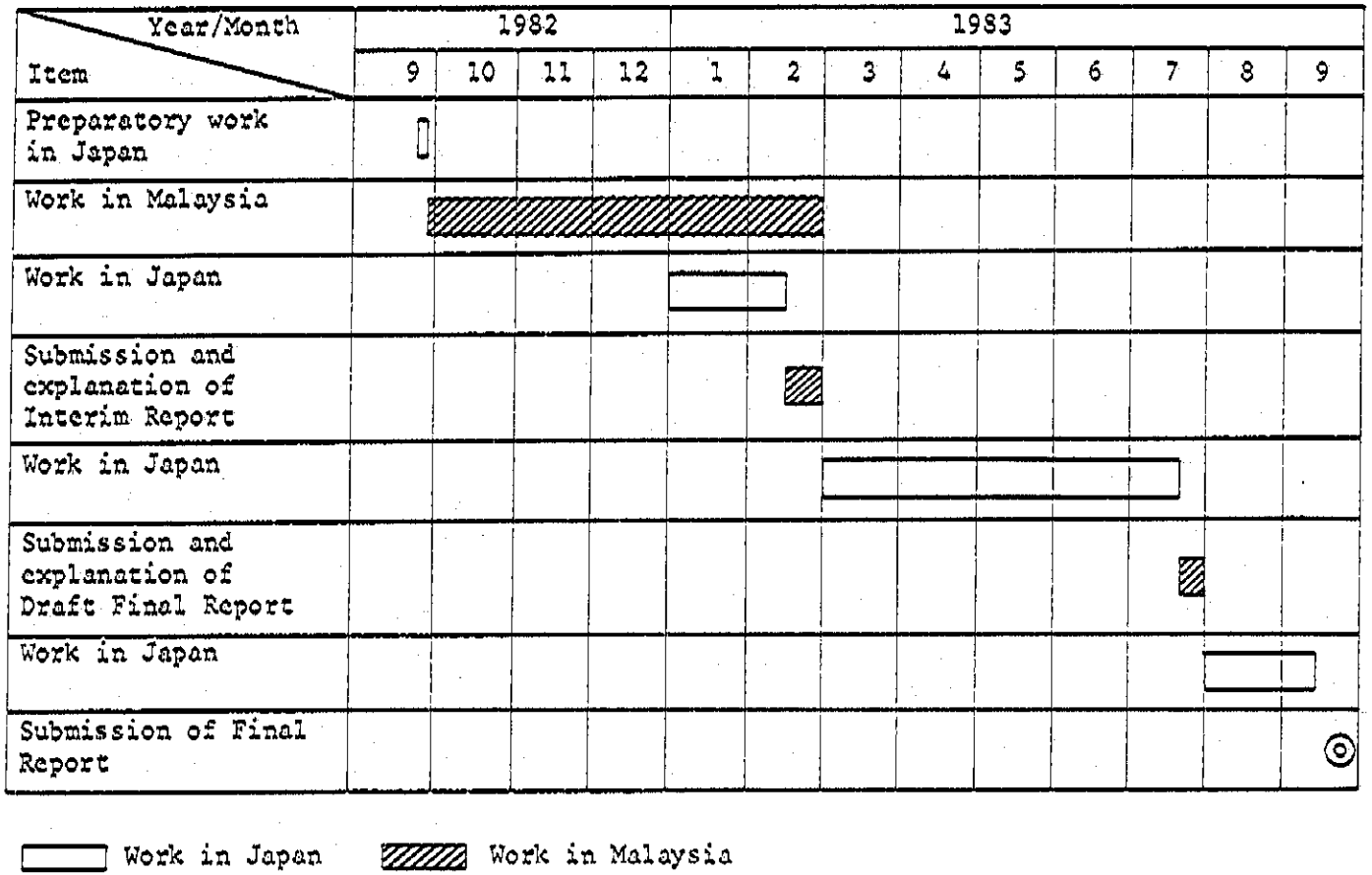
3rd stage: Until presentation of Final Report
(Work in Japan)

16) Submission and explanation of Draft Final Report

17) Modification of Draft Final Report according to the comments by the Covernment of Malaysia

18) Submission of Final Report

Study Time Schedule



## 1-4 Basic Policies of the Study

This study has been conducted in line with the following basic policies by due reference to the results of preliminary study conducted by JICA in April and August, 1982, and the inception report submitted and approved in September, 1982.

### (1) Traffic demand forecast

Traffic demand has been forecasted for the target year of 2005 A.D. in accordance with the existing data and information.

### (2) Alternatives of the railway development strategy

1) Butterworth - Johor Bahru Line (the West Coast Line)

Case A:

The existing West Coast Line will be converted into an electrified double track line with the standard gauge.

Case B:

A new electrified line with the standard gauge will be constructed, and the existing West Coast Line will also continue its operation.

Case C:

The improvement works such as electrification and double tracking of the existing West Coast Line will be implemented according to the demand forecast. In this case, the possibility of conversion into standard gauge will be highly considered in carrying out the Study as the future plan of the Railway Development.

Case D:

The improvement works such as electrification and double tracking of the existing West Coast Line without gauge standardization will be implemented according to the demand forecast.

2) Kuala Lumpur - Kuantan - Kota Bharu (the New East-West Line)

Case A:

A new electrified double track line with the standard gauge will be constructed.

Case B:

A new standard gauge line will be constructed. The specification of this line concerning electrification/non-electrification and single/double track structures will be decided according to the demand forecast.

Case C:

A new meter gauge line will be constructed. The specification of this line concerning electrification/non-electrification and single/double track structures will be decided according to the demand forecast.

3) Gemas - Tumpat Line (the Central Line) and the Branch Lines of the West Coast Line (the Branch Lines)

The Central Line and the Branch Lines have been studied as needed by the scope of the Railway Development of the West Coast Line and the New East-West Line.

(3) Establishment of Alternative Plans

As aforestated, there are to be considered twelve (12) different cases as tabulated below as the combined results of four (4) cases for the West Coast Line and three (3) cases for the New East-West Line.

After consultation with the MRA authority the combined cases of a distinctive feature have been chosen among them by exclusion of those cases with much similarity. As a result, the four (4) alternative cases, marked out with a circle in the following table, have been selected in this Master Plan Study. They are as follows:

- o Case A-A planned to provide transport services of the highest grade.
- o Case B-B and Case C-B planned still to operate the existing line together with the new line of high grade. (This is the case of the JNR's Shinkansen Line.)

o Case D-C planned to restrain the scale of investment to a possible minimum.

| West Coast Line \ New East-West Line | Case A | Case B | Case C |
|---|---|---|---|
| Case A | O | * | * |
| Case B | * | O | * |
| Case C | * | O | * |
| Case D | * | * | O |

1-5 Organization for the Study

1-5-1 JICA Supervisory Committee

| | | |
|---|---|---|
| Shigeru Morichi | Chairman | Associate Professor, Department of Civil Engineering, Tokyo Institute of Technology |
| Koichi Aoki | Member | Director of the Designing Department, Japan Railway Construction Public Corporation |
| Keizo Kasuga | Member | Deputy Director, Civil Engineering and Electricity Division, Railway Supervision Bureau, Ministry of Transport |
| Satoru Onoyama | Member | Deputy Director, Division of Safety Operation, Railway Supervision Bureau, Ministry of Transport |
| Yasutaka Kikuchi | Member | Technical Officer, International Affairs Division, Secretariat to the Minister, Ministry of Transport |
| Kazuo Notake | | (Social Development Cooperation Department, JICA) |
| Norio Fukushiro | | Social Development Cooperation Department, JICA |

## 1-5-2 JICA Study Team

| | |
|---|---|
| Masayuki Nishida | Leader |
| Masaki Yachida | Acting Leader |
| Shuichi Takahashi | Regional Development Plan |
| Noriyoshi Nagamatsu | Traffic Demand (Passenger) |
| Tanehiko Aibara | Traffic Demand (Freight) |
| Masanao Koyama | Transport Plan |
| Masao Suzuki | Railway Management |
| Tetsuya Yamagata | Rolling Stock Plan |
| Yukinori Kyuma | Electrification Plan |
| Motoo Sakai | Electrification Plan |
| Akira Yamaguchi | Signalling/Telecommunication Plan |
| Takato Kosuda | Signalling/Telecommunication Plan |
| Giichi Tanaka | Signalling/Telecommunication Plan |
| Takashi Taneichi | Signalling/Telecommunication Plan |
| Shigeru Matsubara | Route Selection |
| Yuzuru Kusunoki | Route Selection |
| Hitoshi Ishihara | Construction Plan |
| Michio Nakamura | Construction Plan |
| Tsutomu Sekiguchi | Construction Plan |
| Yukichi Ushiishi | Structure Plan |
| Shusuke Miyazaki | Track Construction Plan |
| Tetsunosuke Iijima | Track Construction Plan |
| Koichi Isumi | Station Facility Plan |
| Hikaru Ishikawa | Station Facility Plan |
| Yoshiaki Okada | Economic and Financial Analysis |

1-5-3 Government officials concerned in Malaysia

Economic Planning Unit (EPU)

| | |
|---|---|
| Tan Sri Dato' Sallehuddin bin Mohamed | Director General |
| Abdul Rahim bin Din | Deputy Director General |
| Ali Abul Hassan bin Sulaiman | Director, Infrastructure and Public Utilities Section |
| Siti Hadzar bt. Mohd. Ismail | Deputy Director, Infrastructure and Public Utilities Section |
| Kamaruzzaman bin Shariff | Director, External Assistance and General Services Section |
| Ismail bin Mohamed | Principal Assistant Director (Land Transport) |
| Wong Peg Har | Principal Assistant Director (External Assistance) |
| Mohd. Aminuddin bin Hashim | Assistant Director (External Assistance) |
| Kamarulzaman bin Abdul Ghani (Until January 1983) | Assistant Director (Railways) |
| Md. Ashari bin Mamat | Assistant Driector (Railways) |

Malayan Railway Administration (MRA)

| | |
|---|---|
| Dato' Ahmad Badri bin Mohamed Basir | General Manager |
| Abdul Rahim bin Abdul Jalal | Deputy General Manager |
| Dr. Mohamed Iwaz bin Abdul Karim | Deputy General Manager (Development) |
| Hanim bt. Ali | Head of Research and Planning Unit |
| Masri bin Ahmad | Head of Administration Unit |
| Shaikh Ahmad bin Abu Bakar | Head of Personnel Unit |
| Chan Kim Beng | Head of Computer Unit |
| S. Doraipandian | Head of Investigation & Accident Prevention Unit |
| Oon Peck Lin | Director of Development |
| Mohamed Zin bin Yusop | Director of Traffic Department |
| Abdul Rahim bin Osman | Director of Commercial Department |
| Chuah Chow Hee | Director of Civil Engineering Department |
| D. Gabriel | Director of Financial Department |
| P. Satyamoorthy | Director of Signalling and Communication Department |
| Lee Jee Luan | Director of Mechanical Engineering Department |

| | |
|---|---|
| Omar bin Abdullah | Deputy Director of Traffic Department (Financial & Admin.) |
| C. Mahadevan | Deputy Director of Civil Engineering Department |
| R. Paranchothi | Deputy Director of Signalling & Communication Department |
| Mazlan bin Hj. Waad | Deputy Director of Mechanical Engineering Department, Mechanical Section |
| Zainal bin Abdullah | Deputy Director of Mechanical Engineering Department, Electrical Section |
| P. P. Abdul Razak | Deputy Director of Mechanical Engineering Department, Loco Operation Section |
| Ahmad Rahimi bin Jaafar | Assistant Director of Development, Electrical Section |
| **Ministry of Transport (MOT)** | |
| Datuk Syed Zainal Abidin bin S.A.M. Jamallulail | Deputy Secretary General I |
| Kassim bin Sarbani | Under Secretary (Land Transport) |
| Hew Kuan Wai | Principal Assistant Secretary (Road Transport) |
| Heidi Ng Poh Mooi | Principal Assistant Secretary (Railways) |
| Cleopas Lim | Mechanical Engineer |
| **Implementation Coordination Unit (ICU)** | |
| Lim Wen See | Director, Infrastructure Section |
| Bakri Ismail | Engineer, Infrastructure Section |
| **Ministry of Foreign Affairs** | |
| Zulkifli bin Adnan | Assistant Secretary, Political Division I |
| **Ministry of Trade and Industry** | |
| Abu Bakar Hj. Abdullah | Principal Assistant Director, Domestic Trade Division |
| Ali bin Luman | Assistant Director, Domestic Trade Division |
| Mohd. Zaharil Kassim | Assistant Director, Domestic Trade Division |

| | |
|---|---|
| **Highway Planning Unit (HPU)** | |
| E. Balasumbramaniam | Director |
| Mohd. Amir bin Hj. Kassim | Senior Executive Engineer |
| **Directorate of National Mapping** | |
| Ab. Majid bin Ab. Hamid | Deputy Director I, Topographical Survey Division |
| Chia Wee Tong | Deputy Director II, Topographical Survey Division |
| Mej. Pahrurrazi bin Hj. Maaruf | Assistant Director, Mapping Division (Military) |
| **Geology Department** | |
| Yunus Ab. Razak | Geologist, Engineering Geology Division |
| **Public Works Department (PWD)** | |
| Chan Gim Tian | Senior Executive Engineer, Road Section |
| **Telecommunication Department (TD)** | |
| Khoo Seng Keat | Assistant Director, Local Network Division |
| **National Electricity Board (NEB)** | |
| G. Lalchand | Senior Planning Engineer (Transmission) |
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| **Malaysian Industrial Development Authority (MIDA)** | |
| Siti Maimun bt. Hj. Kamso | Deputy Director, Planning Division |
| K. Haridass | Economist, Planning Research and International Cooperation Division |
| Komala Devi Perumal | Economist, Planning Research and International Cooperation Division |
| **Heavy Industries Corporation in Malaysia (HICOM)** | |
| Abdul Rahim Abdul Manaf | Deputy Manager, Corporate Planning Division |
| Low Shim Boon | Assistant Manager, Corporate Planning Division |
| Francis Khoo Soon Hock | Assistant Manager, Corporate Planning Division |
| Makmon Maoon | Assistant Manager, Project Implementation and Management Division |

# *CHAPTER 2.*
# *PRESENT STATUS OF RAILWAY*

# CHAPTER 2 PRESENT STATUS OF RAILWAY

## 2-1 Outline of Operation

### 2-1-1 General status

The Malayan Railway Administration (MRA) is the governmental corporation established under the Railway Ordinance in 1948.

Its network consists of the West Coast Line extending from Kuala Lumpur, the nation's capital, north to Padang Besar, the border town to Thailand, and south to Singapore and the Central Line branched off from Gemas to the east coast, including a few branch lines to the ports and harbours. (Fig. 2-1-1 and Table 2-1-1)

The total route length reaches about 1,600 km of non-electrified single track of meter gauge.

MRA is operated by the organizational structure as shown in Fig. 2-1-2, with a total employment of about 10,000 personnel. It carried passengers of 1,600 million passenger-km and freight of 1,200 million ton-km in 1980, thus earned an income of M$141 million against an outgo of M$162 million after depreciation.

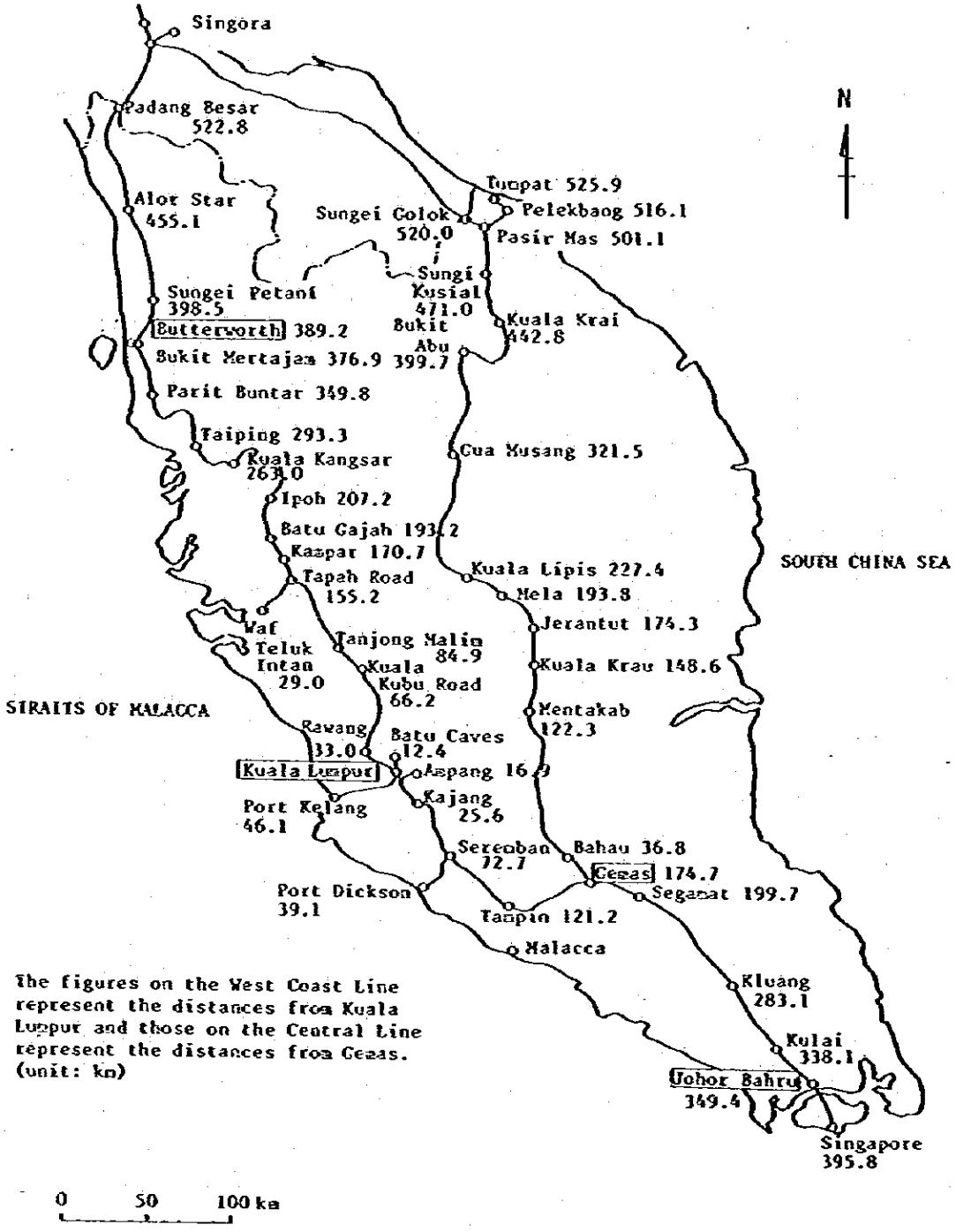



Fig. 2-1-1 Railway Network Map

Table 2-1-1 Route Length of Malayan Railway Administration (MRA)

(Dec. 1982)

| No. | Name of Line | Section | Length | |
|---|---|---|---|---|
| | | | Miles | km |
| 1 | West Coast Line | Butterworth - Singapore | 487.63 | 785.0 |
| 2 | Central Line | Gemas - Tumpat | 326.65 | 525.9 |
| 3 | Central Line Sg. Golok Branch | Pasir Mas - R. Panjang | 11.79 | 19.3 |
| 4 | Kedah Line | Bukit Mertajam - Padang Besar | 90.63 | 145.9 |
| 5 | Telok Anson Branch Line | Tapah Road - Waf Telok Anson | 18.0 | 29.0 |
| 6 | Batu Cave Line | Kuala Lumpur - Batu Cave | 7.54 | 12.4 |
| 7 | Port Kelang Line | Kuala Lumpur - Port Kelang | 28.54 | 46.1 |
| 8 | Ampang Line | Spg. Salak Selatan - Ampang | 4.39 | 7.2 |
| 9 | Port Dickson Line | Seremban - Port Dickson | 24.24 | 39.1 |
| 10 | Jurong Line | Bt. Timah - Jurong | 7.2 | 11.7 |
| | Total | | 1,007.41 | 1,621.6 |

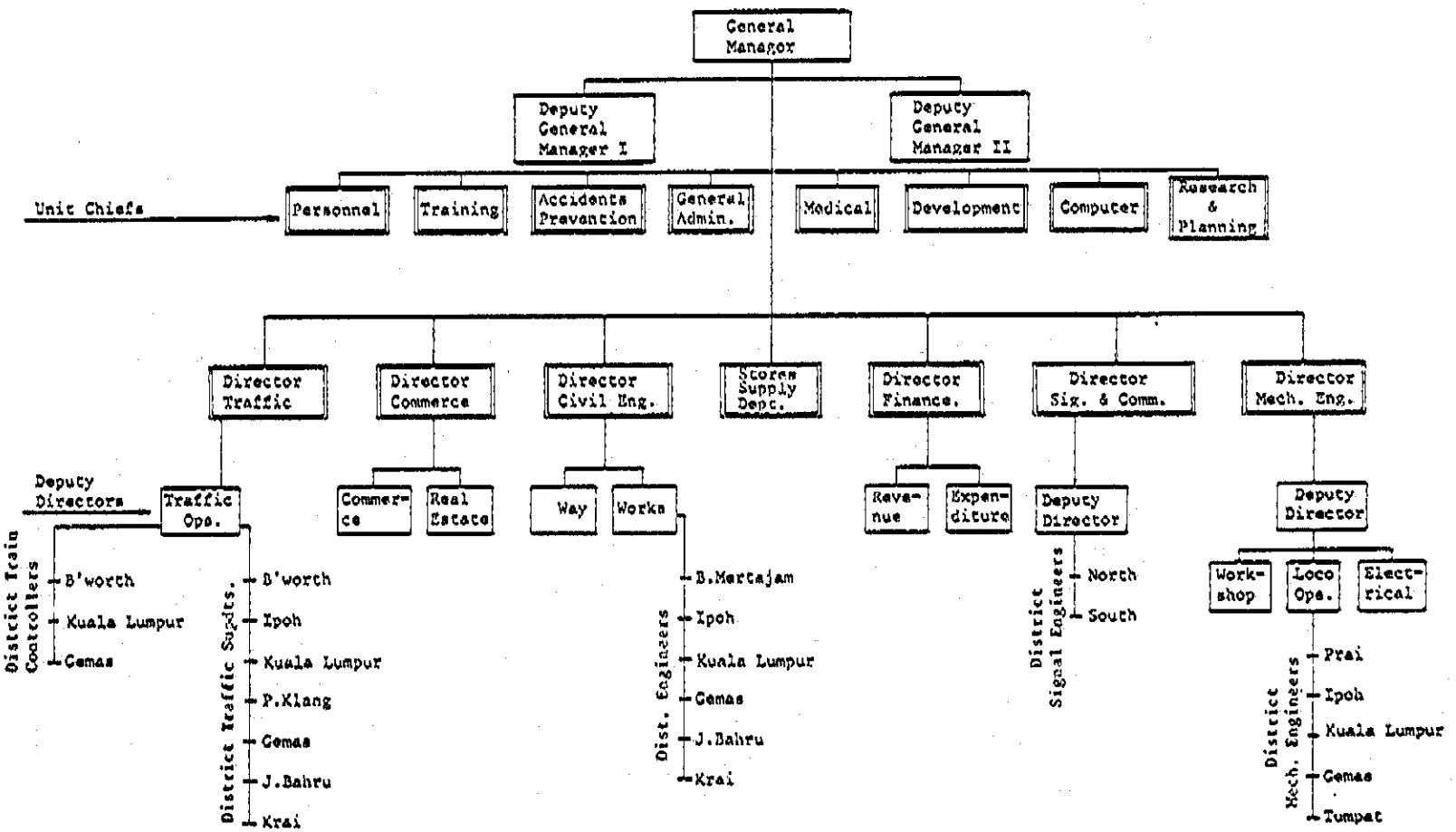



Fig. 2-1-2 Organization Chart (Dec. 1982)

## 2-1-2 Traffic volume and fares

### (1) Traffic volume

Total volume of passenger traffic in 1980 numbers to about 7 million passengers annually, equivalent to about 1,600 million passenger-km. Freight traffic totals to about 3.6 million tons, corresponding to about 1,200 million ton-km.

The increasing tempo of traffic volume has been slugguish in both passenger and freight traffics as shown in Table 2-1-2.

Table 2-1-2 Trend of Annual Traffic Volume

| Item / Year | Passenger | | Freight | |
|---|---|---|---|---|
| | No. of passenger carried | Passenger-km | Total tonnage carried | Ton-km |
| | (1,000) | (million) | (1,000) | (million) |
| 1970 | 5,175 | 620 | 3,691 | 1,202 |
| 1971 | 5,269 | 645 | 3,381 | 1,102 |
| 1972 | 5,748 | 729 | 3,456 | 1,175 |
| 1973 | 5,646 | 798 | 3,471 | 1,088 |
| 1974 | 5,967 | 953 | 3,302 | 984 |
| 1975 | 6,109 | 1,014 | 2,782 | 822 |
| 1976 | 6,400 | 1,145 | 3,305 | 1,008 |
| 1977 | 6,389 | 1,273 | 3,787 | 1,209 |
| 1978 | 5,998 | 1,269 | 4,142 | 1,293 |
| 1979 | 6,243 | 1,372 | 4,188 | 1,357 |
| 1980 | 7,067 | 1,587 | 3,607 | 1,195 |

### (2) Fare and freightage

The present fare and freightage system was set up in 1976, and only minor revisions to the rate of tariff has been made since then.

#### 1) Passenger fare

The passenger fare is set for each of three different classes such as 1st, 2nd and 3rd. The base rate for each class is as follows.

(Unit: ₦/km)

| 1st class | 2nd class | 3rd class |
|---|---|---|
| 10.5 | 5.0 | 3.0 |

2) Freight

The rate system for freightage is divided into two categories. One is for main freight and another is for general freight. Although scheduled rates are established for each of those freight categories, most of carriage rates are decided in a negotiation with each customer, as the result of which the negotiated rate is set considerably down below the level of scheduled rate of freightage.

2-1-3 Income and outgo

(1) Income

Annual income, for a period of 1979 through 1981, is shown in Table 2-1-3. Whilst the income from passenger traffic shows an increasing tendency, the income from freight traffic has been in the gradual decrease.

Table 2-1-3 Annual Income

(Unit: million M$)

| | Passenger | Freight | Others | Total |
|---|---|---|---|---|
| 1979 | 50.4 | 65.0 | 20.1 | 135.5 |
| 1980 | 57.9 | 62.8 | 20.1 | 140.8 |
| 1981 | 60.1 | 60.0 | 22.9 | 143.0 |

(2) Outgo

Annual outgo for a period of 1979 through 1981 is shown in Table 2-1-4.

Table 2-1-4 Annual Outgo

(Unit: million M$)

| | Management and maintenance cost | Depreciation cost | Interest paid | Total |
|---|---|---|---|---|
| 1979 | 118.9 | 13.9 | 8.4 | 141.2 |
| 1980 | 137.9 | 14.3 | 9.6 | 161.8 |
| 1981 | 158.7 | 15.3 | 11.2 | 185.2 |

## 2-1-4 Train operation

### (1) Train operation system

Main routes of train operation are as follows.

1) Passenger train (including mixed train)

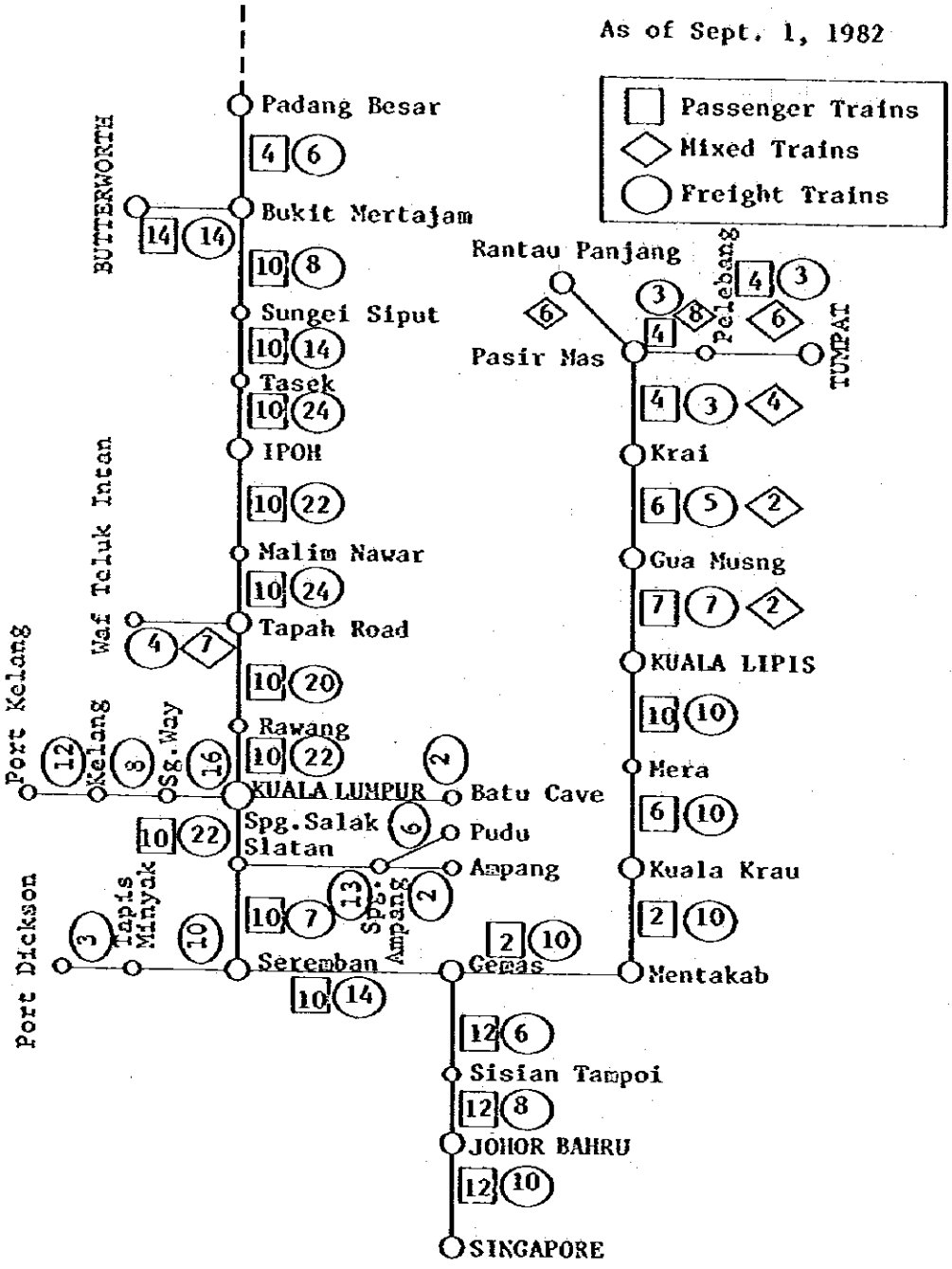
| | | |
|---|---|---|
| Butterworth | - | Kuala Lumpur |
| Kuala Lumpur | - | Singapore |
| Gemas | - | Tumpat - Rantau Panjang |
| Butterworth | - | Padang Besar |

2) Freight train

| | | |
|---|---|---|
| Prai | - | Kuala Lumpur |
| Kuala Lumpur | - | Singapore (Jurong) |
| Gemas | - | Tumpat - Rantau Panjang |
| Prai | - | Padang Besar |
| Kuala Lumpur | - | Port Kelang |
| Seremban | - | Port Dickson |

### (2) Number of trains in operation

Number of trains in operation for main sections are as shown in Fig. 2-1-3.




Train formation

Passenger train: Max. 14 cars
Freight train : Max. hauling capacity is 1,000 tons.

Fig. 2-1-3 Number of Trains in Operation per Day (for both directions)

(3) Annual train-kilometers

(Unit: 1,000 km)

| Year | 1979 | 1980 | 1981 |
|---|---|---|---|
| Passenger train | 3,807 | 4,142 | 4,225 |
| Freight train | 4,562 | 4,434 | 4,179 |

(4) Train speed

1) Maximum

Express passenger train: 80 km/h (50 mph)
Local passenger train : 72 km/h (45 mph)
Freight train : 64 km/h (40 mph)

2) Scheduled speed (Express passenger train)

Butterworth - Kuala Lumpur 65 km/h
Kuala Lumpur - Singapore 67 km/h

(5) Train formation and hauling capacity

1) Express train formation (max.)

Locomotive + 1st class coach × 3 + 2nd class coach × 8
+ Restaurant car × 1 = Locomotive + Coach × 12

2) Local train formation (max.)

Locomotive + Coach × 14

3) Hauling capacity by freight train

(Unit: ton)

| Railway division / Speed classification | Trunk line | | Branch line |
|---|---|---|---|
| | Butterworth - Singapore (except Taiping - P. Rengas) | Taiping - P. Rengas | |
| 64 km/h | 800 | 800 | 900 |
| 56 km/h | 930 | 800 | 930 |

Each of five (5) locomotives specially designated has a haulage capacity of 1,000 tons for the whole section except for the section between Taiping and P. Rengas where hauling capacity is restrained to 800 tons.

(6) Car depot

Car depots are located at Prai, Ipoh, Kuala Lumpur, Gemas and Tumpat, each serving as the general depot for locomotives, passenger coaches and freight wagons.

## 2-2 Outline of Facilities

### 2-2-1 Track and civil structure

(1) Specifications of permanent way

1) Gauge : 1,000 mm

2) Minimum radius of curvature: 176 m

3) Maximum gradient : 12.5 °/₀₀

4) The cross section of the formation level and diagram of earthwork track is as shown in Fig. 2-2-1.

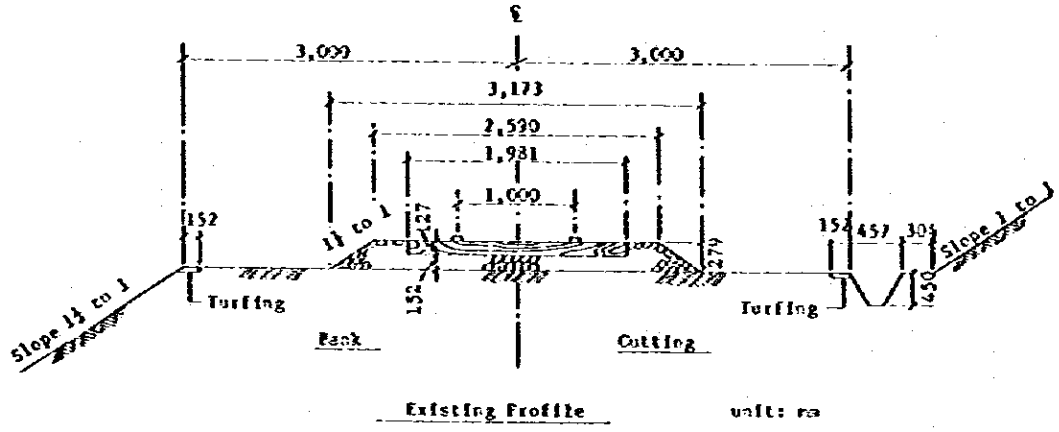



Fig. 2-2-1 Diagram of Earthwork Track

5) The construction gauge and the rolling stock clearance are as shown in Fig. 2-2-2. But, the tunnel and the through truss bridge are constructed in a scaled-down gauge.

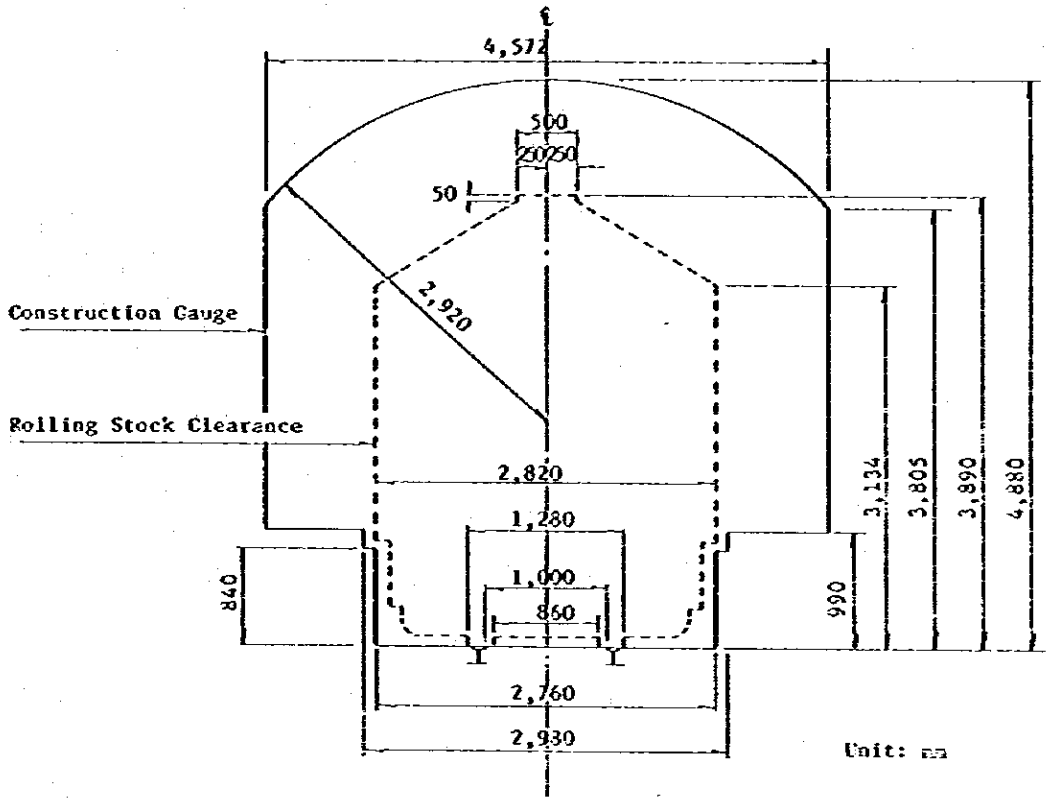



Fig. 2-2-2 Construction Gauge and Rolling Stock Clearance

6) Live load

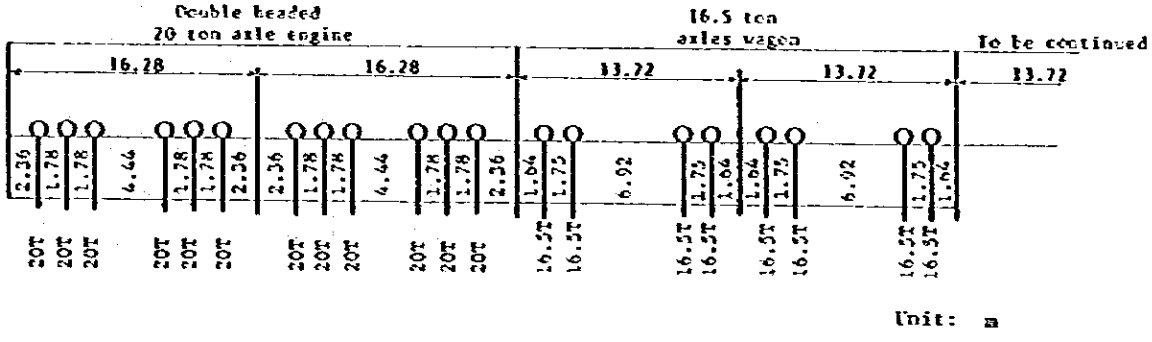



Fig. 2-2-3 Live Load

(2) Track

1) Rail

About 60% of the rails are of BS80A (39.80 kg/m), and are used for the West Coast Line (Butterworth - Singapore, 784.5 km) and for the Central Line extending from Gemas. The average aging is about 20 years or less. For other branch lines, rails of BS60 are used. They are all more than 50 years old.

Track strengthening was done in some areas. In those areas, twelve 40-feet rails were welded to make 480-feet long (146.3 m) rails. Jointing of rails is done by fishplates.

2) Sleeper

Wooden sleepers made of Kerving or Kempas wood with the dimensions of 9 1/2" × 5" × 6'6" (24.1 cm × 12.7 cm × 198.1 cm) are used.

The intervals between sleepers are 457 mm at the rail jointed areas. And in general area, those intervals are 685 mm (37 pcs/25 m), but, in the area of soft formation, those are 660 mm.

Conversion of sleepers to those of prestressed concrete is now planned. A new factory was built for manufacturing prestressed concrete sleepers, and it will soon go into the stage of trial production. (The production capacity - 100,000 pcs/year)

3) Fastening

Fastening is mainly done by spring spikes. But experimental switching to pandrol with tie plate is underway at the time of renewal of the rails.

4) Ballast

Crushed stones are used for ballast. The standard thickness is 6" (152 mm). But, actually the ballast thickness is not sufficient except in some areas. Particularly under sidetracks in some stations, there is almost no ballast.

Currently, the railroad track strengthening is undertaken in some sections, where the introduction of tamper is attempted.

5) Turnout

For a main track, No. 15 or No. 12 turnouts are used except some special cases. For a sidetrack, either No. 9 or No. 10 turnouts are in use.

Out of the total of about 1,500 turnouts, about one half are of 80 lbs rail, and the remains are of 60 lbs.

## 2-2-2 Electric facilities

### (1) Signalling

1) Interlocking device

The existing interlocking devices of most stations are of outdated mechanical type and are not functioning well. All trains in transit are forced to slow down their speeds at those stations, thus causing the increase in the time of train operation.

Types and quantities of interlocking devices currently used by MRA are as shown in Table 2-2-1.

Table 2-2-1 Interlocking Device

(Dec. 1982)

| Type | Station | Remarks |
|---|---|---|
| Relay interlocked | 2 | |
| Electromechanical interlocking | 1 | Singapore |
| Mechanical interlocking | 72 | |
| High point indicator | 18 | |
| Partially interlocked | 7 | |
| Non-interlocked | 41 | |
| Total | 141 | |

2) Block system

Double-line block instruments are used in the double track section near Kuala Lumpur. The single track section is equipped mostly with the token block system instruments, mainly by use of tablet and key token, but partially with the tokenless block system.

At present, the new installation work of the tokenless block system is being carried out at 24 stations located between Kuala Lumpur and Ipoh and at 3 stations on the Port Dickson Branch Line. Since the tablet equipment is heavily superannuated without any spare parts, it is being replaced with the key token equipment which come from the section where the conversion work into the tokenless block has been comleted.

Existing block systems on the West Coast Line and on the Central Line are shown in Fig. 2-2-4, together with Table 2-2-2 which presents types of block systems and number of sections where those are equipped.

Table 2-2-2 Block System

(Dec. 1982)

| System | Number of sections |
|---|---|
| Double line block | 2 |
| Tokenless block | 11 |
| Tablet (short section) | 58 |
| Key token (short section) | 69 |
| Key token (long section) | 25 |
| Staff & ticket working | 21 |
| Total | 186 |

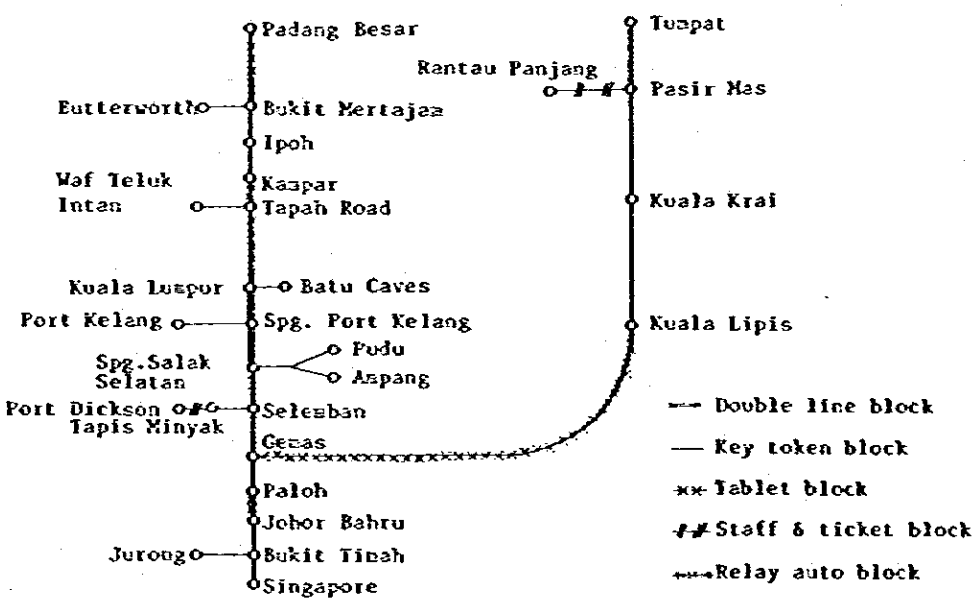



Fig. 2-2-4 Block System (Dec. 1982)

3) Level crossing

a) Number of level crossing

Types and number of existing level crossings are as shown in Table 2-2-3.

Table 2-2-3 Level Crossings

(Dec. 1982)

| Type | Number |
|---|---|
| Public level crossing | 176 |
| Private level crossing | 174 |
| Occupation level crossing | 32 |

b) Level crossing protection

Level crossing protection consists of the following equipment :

i) Interlocked gate crossing
The gate is closed by the operator, at the time of which it is interlocked with the signal equipment for trains.

ii) Automatic gate crossing
The gate automatically closes when train approaches.

iii) Crossing alarm
The crossing alarm devices are being installed at 150 points.

(2) Telecommunication

Transfer of the telecommunication system from the Telecommunication Department (TD) to the MRA was completed on January 1, 1983.

1) Telecommunication lines

Most of the existing telecommunication lines are made of bare wire and are frequently cut down by superannuation and sometimes by falling trees. Under the present circumstance, therefore, it is difficult to secure good communication channels.

Main component lines and their numbers are as shown in Table 2-2-4.

2) Telephones

Although telephones are available in various types by purposes, the dispatch telephone in particular is of the Western type which is featured remarkably by its superannuated quality. This, coupled with low grade communication channels using bare wire, renders some difficulties to dispatching operations. Thus, all the existing organizations are equipped with the public telephones of TD, in addition to the inter-office telephones for the MRA's exclusive use.

Types and use of telephones are as shown in Table 2-2-4.

Table 2-2-4 Channels and Telephones

(Dec. 1982)

| Facility | Type | Purpose | Quantity |
|---|---|---|---|
| Transmission | Bare wire | Dispatch telephone channel, Block channel | Route length: 1,600 km<br>Total of wire length: 30,300 km |
| Telephone | Dispatch telephone | Dispatch operations | 163 |
| | DC signalling telephone set | Communication in the yard | 83 |
| | Magcetic telephone set | For communication between stations and between a station and level crossing, and long distance communication | 79 |
| | Block telephone | Blocking communication | 176 |
| | Signal post telephone set | For communication between signal cabin and train crew | 16 |
| | PBX telephone | Communication in the station yard (automatic telephone) | 27 |
| | Total | | 544 |

3) Other communication facilities

Main railway stations are equipped with PBX telephones of small capacity, telex machines, amplifier sets for passenger information service and electric clocks.

4) Dispatch center

The dispatch center is located at Butterworth, Kuala Lumpur and Gemas and is planned for new construction at Kuala Krai.

Areas under the responsibility of each dispatch center are as follows.

Butterworth : Padang Besar - Ipoh
Kuala Lumpur: Ipoh - Gemas
Gemas : Kuala Lipis - Singapore

(3) Computer system

The computer system was introduced for the first time in 1968. The machine currently in use is ICL-2903 type.

1) Components

| | | |
|---|---|---|
| Central processing unit | : 1 | (250 hs) |
| Memory unit | : 32kW | |
| Magnetic tape unit | : 4 | |
| Magnetic disk unit | : 2 | (EDS-60) |
| Line printer | : 1 | (600 LPM) |

2) Applicable service categories

Applicable service categories are as listed hereunder, all being processed by batch mode.

a) Personnel system
b) Rent bills system
c) Stock inventory system
d) Customers bills system
e) Payroll accounting system
f) Management statistics system
g) Financial accounting system
h) Rolling stock reporting system
i) Ticket statistic system
j) Vehicle loan system

2-2-3 Rolling stock and workshop

(1) Rolling stock

1) Present status

Total number of rolling stocks owned is broken down into 135 diesel locomotives, 361 passenger cars and 5,156 freight wagons (including privately-owned wagons).

As shown in Table 2-2-5, they are distributed by ages. Those over the age of 20 account for 34% of diesel locomotives, 70% of passenger cars and 66% of freight wagons. Evidently, they are superannuated to a considerable extent.

Because of this;

- there are many cars in the workshop for temporary repair, and
- the number of days required for repair in the workshop tends to be prolonged, because many of necessary spare parts have to be imported.

As a result,

- The utilization rate of rolling stock is declined less than the appropriate level, thus giving pressure to the effective and smooth car assignments.
- Consequently, they are not in a condition to undergo regular repair services at the workshop to the satisfactory extent.

Table 2-2-5 Distribution of Rolling Stock by Age

(Jan. 1, 1982)

| Type \ Years | | 0 ∿ 5 | 6 ∿ 10 | 11∿15 | 16∿20 | 21∿25 | 26∿30 | 31∿40 | 41∿ | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| DL | Main line | | | 49 | 15 | 26 | | | | 90 |
| | Shunting | 10 | | | 15 | | | 20 | | 45 |
| | Total | 10 | | 49 | 30 | 26 | | 20 | | 135 |
| PC | Express | 15 | 34 | | | | | | | 49 |
| | Others | 13 | | 10 | 37 | 34 | 51 | 23 | 144 | 312 |
| | Total | 28 | 34 | 10 | 37 | 34 | 51 | 23 | 144 | 361 |
| FC | 2-axle | | 1 | 5 | 307 | 283 | 585 | 526 | 536 | 2,243 |
| | Bogie | 109 | 815 | 253 | 253 | 175 | 417 | 718 | 173 | 2,913 |
| | Total | 109 | 816 | 258 | 560 | 458 | 1,002 | 1,244 | 709 | 5,156 |

2) Diesel locomotive

Major design factors for the diesel locomotive are as shown in Table 2-2-6.

Table 2-2-6 Major Design Factors for Diesel Locomotive

(Jan. 1, 1982)

| | Class 22 | Class 21 | | Class 20 | Class 18 | Class 17 | Class 15 |
|---|---|---|---|---|---|---|---|
| Weight in working order (t) | 84.0 | 50.65 | 49.27 | 92.4 | 46.25 | 35.36 | 44.09 |
| Diesel output (HP) | 1,700 | 1,060 | | 1,500 | 600 | 410 | 350 |
| Max. tractive effort (lb) | 58,300 | 34,940 | | 54,000 | 34,164 | 24,200 | 33,000 |
| Axle arrangement | Co - Co | B - B | | Co - Co | 0-6-0 | C | C |
| Max. operation speed (MPH) | 60 | 60 | | 60 | 15 | 35 | 15 |
| Type of transmission | Electric | Hydraulic | | Electric | Electric | Hydraulic | Electric |
| Brake system | Air & vacuum | Air & vacuum | | Vacuum | Air & vacuum | Air & vacuum | Vacuum |
| Number of vehicles | 39 | 15 | 10 | 26 | 10 | 15 | 20 |
| Manufacture year | 1971 | 1965 | 1969 | 1957 | 1979 | 1964 | 1948-49 |

3) Passenger car

Air conditioning is available only for 8 percent of total passenger cars; 1st-class coaches for the express train and 1st-class sleeping coaches for the night train.

While passenger coaches for express trains are purchased from outside, those for local trains are internally produced, renewed and repaired at Sentul workshop (except trucks).

4) Freight car

Bogie-type cars account for 56% of the total. Since 90% of the 2-axle cars exceed the age of 20 and all newly manufactured freihgt cars in recent years are of bogie type, it is expected that conversion into the bogie type will be accelerated from now on.

(2) Workshop

All the rolling stocks are undergoing repair and maintenance at the Sentul Workshop.

However, the existing workshop is getting superannuated as the general tendency notwithstanding investment efforts for expansion of the working yard for repair of passenger cars and engines, and for improvement of inspection facilities of engine accessories and main motor equipment.

# *CHAPTER 3.*
# *SOCIO-ECONOMIC FRAMEWORK*

# CHAPTER 3 SOCIO-ECONOMIC FRAMEWORK

## PREFACE

In this Project the base year for forecasting is set at 1990 and 2005 respectively. Forecast of the socio-economic frame is of vital importance for the formulation of a traffic plan inclusive of railway. Without exact general understanding and forecasting of socio-economic framework it would be possible by no means to forecast traffic demand to the most accurate extent.

In fact, however, it is a hard word of diversity. In particular, the long-term forecast toward the target year of 2005 as requested under this study is especially difficult due to many uncertain factors at the present time when everything is changing violently.

To achieve accurate result of forecast over a long range, the data available right now would not serve the purpose sufficiently unless they are analyzed and supplemented. Furthermore, single case of forecast is not sufficient in order to draw an accurate picture of future socio-economic framework, instead a few cases of forecast should be undertaken at least.

Nevertheless, as a matter of fact the forecast of the socio-economic frame had to be simplified to some extent because of the time limit allowable for this study, for example, only one month was allocated for the data collection.

Under such circumstances as mentioned above, the following methods have been applied in this study.

### (1) Data

Utmost importance has been attached to the plans and indexes authorized by the Malaysian Government in connection with forecasting.

Incidentally, there are two problems as follows with regard to the data on which the forecast is based in the study.

1) The Malaysian Government now intends to complete its mid-term review of the 4th Malaysia Plan (1981 - 1985), which is a basic datum of utmost importance for the forecast, from the end of 1983 to the beginning of 1984. Reflecting slowdown of economic growth of Malaysia as a result of lingering depression of world economy, the mid-term review may most probably be directed toward revision of the 4th Malaysia Plan downward below the level originally aimed at. Notwithstanding this prospect, it was impossible to incorporate the foreseeable result of such mid-term review into this forecast because of the time schedule of study. Therefore, it should be noted that the data used for this study are based upon the 4th Malaysia Plan before review, thus making the forecasted result rather optimistic in view of the present situation.

2) The data available at present cover the period only up to the year 1990. Almost none of data may serve as the basic data for forecast beyond the year 1990.

   Therefore, along with restriction in the time schedule forecast had to be made inevitably on a rather straightforward basis.

(2) Alternative Cases for Forecast

Basically, only one case has been taken up for forecast.

However, as far as the growth rate of economy in Malaysia is concerned, two alternative cases have been forecasted and the results have been used in sensitivity analysis of demand forecast.

## 3-1 National Economic Plan

The Government of Malaysia has been working out the master plan for economic development to cover a period every five (5) years in and after 1966. At present, the 4th Malaysia Plan (1981 - 1985) is being executed.

1st Malaysia Plan (1966 - 1970)
2nd Malaysia Plan (1971 - 1975)
3rd Malaysia Plan (1976 - 1980)
4th Malaysia Plan (1981 - 1985)

In particular, those Master Plans at the second and thereafter have been formulated and executed in accordance with the New Economic Policy (NEP) as the Malaysia's National Basic Policy and the Outline Perspective Plan (OPP) as the implementation plan.

The New Economic Policy is the nation's basic guide line published in 1970 with the following aim and objective:

- To realize the high economic growth
- To stamp out poverty
- To level off socio-economic gap and unbalance between races

In the meantime, the Outline Perspective Plan defines the following measures as the basic programs to be realized for a period of 20 years from 1971 to 1990 in order to accomplish the aim and objective of the New Economic Policy.

(1) Maintenance of economic growth at high level

To achieve the economic growth of 7.9% per annum (in real term) during the period of 20 years from 1971 to 1990 inclusive.

(2) Eradication of poverty

To reduce largely the poverty-stricken people by job creation in rural areas including land development and by concentrated effort toward absorbing of the rural population into the commercial/industrial sector.

(3) Levelling-off of socio-economic gap and unbalance between races

1) To form up the occupational composition well-balanced with the composite ratio of race in each field and stratum of the nation's socio-economy. In particular, priority must be given to the race of Malay, so that they can be increased in number in the commercial/industrial sector and at the managerial level, in which they are engaged in a relatively small number.

2) As a step toward balancing in the ownership of the property between the races, all company managements are obligated to assign, at least, 30% of the company's stock to the hand of the Malay.

(4) In order to materialize the foregoing three points, the plan aims at not only promotion for economic development plan including regional development projects, but also export promotion and inflation control by all possible means.

## 3-2 Achievement in the 1970s and Present Status

### 3-2-1 Economic growth and industrial structure

The characteristic features of the Malaysian national economy in the 1970s may be represented by successful achievement of high growth and drastic reform of industrial structure in line with the aim and objective of the New Economic Policy.

As for the economic growth, it recorded high growth rate of 7.9% per annum in terms of GDP being supported by strong demand home and abroad. As compared with the economic growth rate of 3% or so in the major advanced countries for the corresponding period, it can be said that the growth achieved by Malaysia was really satisfactory.

In terms of the industrial structure, it can be said that the 1970s was the decade in which the manufacturing, construction and commercial service industries achieved expansion of business with relative decline of weight of the agricultural sector. Throughout the period of 1970s the value added in the agricultural, forestry and fishery sector did not increase any more than 4.3% at annual growth rate, with the resultant decline of its weight in the GDP from 30.8% in 1970 to 22.2% in 1980.

On the other hand, the manufacturing industry achieved a highest increase rate of 12.5% per annum, as the result of which its share in the GDP increased significantly from 13.4% in 1970 to 20.5% in 1980.

Both of construction and service industries also showed a high rate of annual increase such as 9.6% and 8.6% respectively and contributed greatly to the nation's economic growth. Structural reform was developed not only between the industrial sectors but also inside each sector.

(1) Agriculture

The Government exerted its effort to push forward the policy toward diversification of the agriculture, in order to try to enhance the value added of agricultural products and also to cope with the changing trend or diversified pattern of demand for agricultural products at home and abroad. The most conspicuous move in this direction was a remarkable increase in the production of palm oil. Because of such large increase, too much dependency upon rubber product, as had conventionally been so, could be reduced to some extent.

(2) Mining industry

Although the mining industry increased its value added at an annual average increase of 4.6% throughout the decade of 1970s, there exists a large gap between the former half and the latter half; that is, only 1% for the 1971 - 1975 period and 8.9% for the 1976 - 1980 period. This is evidently due to a significant increase of oil production in and after 1976. At present, petroleum is being produced to a level of about 280 thousand barrels per day, which has brought a leap in the share of petroleum in the mining sector from 29% in 1970 to 63% in 1980.

The other cause for such large increase of share in the petroleum production may be attributable to a relative decrease in the tin production. As a matter of fact, the production activity of tin showed a stagnant move because tin resources was getting exhausted. Consequently, the production declined at an annual average rate of 1.8% for the decade of 1970s. Accordingly, its share in the mining sector decreased from 53% in 1970 to 33% in 1980.

(3) Manufacturing industry

The manufacturing industry during its 1970s achieved a high growth rate of 12.5% annually. Its share in the GDP in 1980 became nearly comparable with that of the agricultural, forestry and fishery sector. Under such high growth the structural reformation was making steady progress as follows within the sector.

- Growth of resource based industries
  Particularly, growth of wood-associated industry (for timber, veneer and plywood) and rubber-associated industry (for tire, tube and shoes)

- Growth of textile, electric appliance and electronics industries
- Growth in the production of intermediate goods

Table 3-2-1 Malaysia: Gross Domestic Product by Sector of Origin, 1970-80

Million M$ in 1970 price

| Sector | 1970 | 1975 | 1980 | Average annual growth rate (%) | | | Share of GDP (%) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 1971 -75 | 1976 -80 | 1971 -80 | 1970 | 1975 | 1980 |
| Agriculture, forestry and fishing | 3,797 | 4,804 | 5,809 | 4.8 | 3.9 | 4.3 | 30.8 | 27.7 | 22.2 |
| Mining and quarrying | 778 | 792 | 1,214 | 0.4 | 8.9 | 4.6 | 6.3 | 4.6 | 4.6 |
| Manufacturing | 1,650 | 2,850 | 5,374 | 11.6 | 13.5 | 12.5 | 13.4 | 16.4 | 20.5 |
| Construction | 475 | 654 | 1,186 | 6.6 | 12.6 | 9.6 | 3.9 | 3.8 | 4.5 |
| Electricity, gas and water | 229 | 365 | 592 | 9.8 | 10.2 | 10.0 | 1.9 | 2.1 | 2.3 |
| Transport, storage and communications | 581 | 1,071 | 1,696 | 13.0 | 9.6 | 11.3 | 4.7 | 6.2 | 6.5 |
| Wholesale and retail trade, hotels and restaurants | 1,633 | 2,219 | 3,295 | 6.3 | 8.2 | 7.3 | 13.3 | 12.8 | 12.6 |
| Finance, insurance, real estate and business services | 1,036 | 1,468 | 2,155 | 7.2 | 8.0 | 7.6 | 8.4 | 8.5 | 8.2 |
| Government services | 1,367 | 2,210 | 3,398 | 10.1 | 9.0 | 9.5 | 11.1 | 12.7 | 13.0 |
| Other services | 306 | 478 | 657 | 9.3 | 6.6 | 7.9 | 2.5 | 2.8 | 2.5 |
| Less: Imputed bank service charges | 117 | 211 | 308 | - | - | - | - | - | - |
| Plus: Import duties | 573 | 665 | 1,120 | - | - | - | - | - | - |
| Equals: Gross domestic product at purchasers' value | 12,303 | 17,365 | 26,188 | 7.1 | 8.6 | 7.8 | - | - | - |

Source: 4th Malaysia Plan

3-2-2 Trade and balance of international payments

Whilst export increased at an annual rate of 7.6% in real terms for a decade of 1970s, import also increased at a higher pace of 9.8% annually.

However, in terms of prices the export price showed a rise of 10.6% each year while the import price rose at an annual rate of 9.2%. Thus, the former exceeded the latter by 1.4%. As the result, the surplus in the balance of trade continued to increase and the nation's liquidating capability to foreign debts was enhanced accordingly.

As shown in the following table, the nation's balance of international payments in the 1970s continued further increase in the surplus in trade, ordinary and overall balances, as a result of which the foreign currency reserve was registered to a sum of about 10 billion Malaysian dollars (equivalent to 4 billion U.S. dollars) in 1980. The big cause for changed trade structure was because of significant increase in the share of petroleum and palm oil in the export sector. In particular, petroleum ranked the top in terms of weight and value in 1980, which contributed largely to the nation's export increase in the latter half of the 1970s.

On the other hand, as a remarkable move in the import sector the brake was put on import of consumer goods under the guidance of the governmental policy to promote use of the alternatives to the imported goods.

Table 3-2-2 Malaysia: Balance of Payments, 1971-80

Unit: Million M$

| | Cumulative | |
|---|---|---|
| | 1971-75 (Actual) | 1976-80 (Estimate) |
| Exports of goods | 35,962 | 97,282 |
| -Imports of goods | 31,874 | 75,328 |
| =Trade balance | +4,088 | +21,954 |
| +Balance on services | -6,457 | -16,632 |
| +Net transfers | - 628 | - 487 |
| =Balance on current account | -2,997 | + 4,835 |
| +Official long-term capital | +2,327 | + 2,786 |
| +Corporate investment | +3,282 | + 6,911 |
| +Commercial credits | + 119 | - 158 |
| +Private financial capital | + 339 | + 2,285 |
| +Errors and omissions | -1,279 | - 5,537 |
| =Overall balance | +1,791 | + 6,552 |
| +SDR allocation | + 121 | + 150 |
| =Net change in external reserves (increase - /decrease +) | -1,912 | - 6,702 |

Source: 4th Malaysia Plan

### 3-2-3 Population

For a decade of the 1970s Malaysia had a population growth at an annual rate of 2.6%. This growth rate was still at a pretty high level though it became lower as compared with the corresponding rate of 3% in the 1960s.

Furthermore, the working population showed a high annual increase rate of 3.9% during the period of the 1970s in the consequence of the high birth rate for the period of the 1950s and 1960s.

Population by regions in Malaysia at present may be broken down as follows:

Table 3-2-3 Population by States

(1980)

| State | Population |
|---|---|
| Johor | 1,601,504 |
| Kedah | 1,102,200 |
| Kelantan | 877,575 |
| Malacca | 453,153 |
| Negri Sembilan | 563,955 |
| Pahang | 770,644 |
| Penang | 911,586 |
| Perak | 1,762,288 |
| Perlis | 147,726 |
| Salangor | 1,467,441 |
| Trengganu | 542,280 |
| Wilayah Persekutuan | 937,875 |
| Sabah | 1,002,608 |
| Sarawak | 1,294,753 |
| Total | 13,435,588 |

Source: Census of 1980

Table 3-2-4 Population of Major Cities and Administrative District

(1980)

| City | Population | District | Population |
|---|---|---|---|
| Alor Star | 71,682 | Kota Star | 286,897 |
| Butterworth | 76,651 | Utara | 200,397 |
| Bukit Mertajam | 28,408 | Tengah | 161,885 |
| Taiping | 149,282 | Larut Dan Matang | 253,707 |
| Kuala Kangsar | 14,650 | Kuala Kangsar | 144,488 |
| Ipoh | 300,325 | Kinta | 573,530 |
| Tapah | 10,578 | Batang Padang | 136,586 |
| Kuala Lumpur | 937,817 | Wilayah Persekutuan | 937,875 |
| Kajang | 30,012 | Ulu Langat | 182,498 |
| Seremban | 136,252 | Seremban | 207,792 |
| Tampin | 9,438 | Tampin | 58,427 |
| Segamat | 34,493 | Segamat | 153,635 |
| Kluang | 51,778 | Kluang | 184,831 |
| Johor Bahru | 249,880 | Johor Bahru | 417,430 |
| Karak | 4,635 | Bentong | 74,102 |
| Temerloh | 8,649 | Temerloh | 214,667 |
| Kuantan | 136,625 | Kuantan | 176,040 |
| Chukai | 16,059 | Kemaman | 66,187 |
| Dungun | 29,569 | Dungun | 60,543 |
| Kuala Trengganu | 186,608 | Kuala Trengganu | 241,271 |
| Pasir Puteh | 3,767 | Pasir Puteh | 84,321 |
| Kota Bharu | 170,559 | Kota Bharu | 281,161 |

Source: Census of 1980

3-2-4 Industrial and regional development plans

In order to achieve the main purposes of the New Economic Policy aiming at eradication of poverty and dissolution of any socio-economic unbalance between the races, it is a must to rectify the existing regional gap.

For instance, as shown in the following table, there still exists a pretty large gap by regions in Malaysia; the per capita income in the Selangor State indicated as the state of highest income is four times as much as that in the Kelantan State, the state of the lowest income.

Table 3-2-5 Malaysia: Summary of GDP and per Capita GDP Growth by State, 1971-80

Million M$ in 1970 price

| State | Gross domestic product | | Average annual growth rate(%) | Per capita GDP | | Average annual growth rate(%) |
|---|---|---|---|---|---|---|
| | 1971 | 1980 | 1972-80 | 1971 | 1980 | 1972-80 |
| High-income | | | | | | |
| Federal Territory Selangor | 3,826 | 8,126 | 8.7 | 2,152.9 | 3,176 | 4.4 |
| Middle-income | | | | | | |
| Johor | 1,476 | 2,941 | 8.0 | 1,083.7 | 1,726 | 5.3 |
| Malacca | 373 | 708 | 7.4 | 877.0 | 1,469 | 5.9 |
| Negri Sembilan | 583 | 1,090 | 7.2 | 1,144.5 | 1,817 | 5.3 |
| Pahang | 647 | 1,218 | 7.3 | 1,169.8 | 1,486 | 2.7 |
| Perak | 1,927 | 2,967 | 4.9 | 1,166.7 | 1,583 | 3.5 |
| Penang | 850 | 2,286 | 11.6 | 1,035.2 | 2,357 | 9.6 |
| Sabah | 905 | 2,028 | 9.4 | 1,302.9 | 1,847 | 4.0 |
| Sarawak | 920 | 1,816 | 7.9 | 915.2 | 1,382 | 4.7 |
| Low-income | | | | | | |
| Kedah/Perlis | 828 | 1,463 | 6.5 | 728.3 | 1,101 | 4.7 |
| Kelantan | 413 | 786 | 7.4 | 564.1 | 842 | 4.6 |
| Trengganu | 268 | 759 | 12.3 | 614.8 | 1,316 | 8.8 |
| Malaysia | 13,016 | 26,188 | 8.1 | 1,172.2 | 1,836 | 5.1 |

Source: 4th Malaysia Plan

To correct this situation, the Federal Government concentrated its effort for promotion of the agricultural and manufacturing industries in the rural areas. As a result, the economic growth rate achieved in some low-income states, such as Kedah, Perlis, Kelantan and Trengganu reached the level in excess of that in the State of Selangor. In particular, the State of Trengganu achieved a remarkable economic growth mainly with contribution of oil development.

As far as industrial sectors concerned, the Government put concentrated stress upon land development, resources exploitation and industrial promotion.

Table 3-2-6 Malaysia: Land Development by State, 1971-80

Unit: hectares

| State | *1 FELDA | *2 FELCRA | *3 RISDA | Regional authorities | State agencies | Private sector | Total land developed |
|---|---|---|---|---|---|---|---|
| High-income | | | | | | | |
| Selangor | 342 | - | - | - | 10,189 | 8,279 | 18,810 |
| Middle-income | | | | | | | |
| Johor | 81,645 | 12,782 | 2,308 | 16,307 | 18,735 | 11,038 | 142,815 |
| Malacca | 2,087 | 1,621 | - | - | - | 3,373 | 7,081 |
| Negri Sembilan | 62,710 | 6,735 | 2,807 | - | 5,567 | 12,878 | 90,697 |
| Pahang | 164,869 | 8,143 | 10,434 | 18,255 | 47,033 | 13,491 | 262,225 |
| Perak | 17,133 | 9,332 | 7,252 | - | 13,530 | 7,206 | 54,453 |
| Penang | - | - | - | - | - | - | - |
| Sabah | 1,428 | - | - | - | 57,815 | - | 59,243 |
| Sarawak | - | - | - | - | 76,654 | - | 76,654 |
| Low-income | | | | | | | |
| Kedah | 6,879 | 4,377 | 1,324 | - | 10,942 | 184 | 23,706 |
| Kelantan | 10,693 | 1,473 | 7,338 | 5,663 | 11,048 | 279 | 36,494 |
| Perlis | 3,187 | - | - | - | - | - | 3,187 |
| Trengganu | 22,732 | 6,247 | - | 15,623 | 41,492 | 4,599 | 90,693 |
| Total | 373,705 | 50,710 | 31,463 | 55,848 | 293,005 | 61,327 | 866,058 |

Note: *1 the Federal Land Development Authority
*2 the Federal Land Consolidation and Rehabilitation Authority
*3 the Rubber Industry Small holders Development Authority

Source: 4th Malaysia Plan

As noted from the above table, activities for land development were noteworthy in the States of Johor, Pahang and Negri Sembilan. Along with those states, land development projects in the low-income states were also showing a high tendency of growth, as observed by a total land area developed to about 150 thousand hectares in the States of Kedah, Perlis, Kelantan and Trengganu.

In the meanwhile, the nation's industrial production activities had been concentrated solely into a few states such as Selangor, Johor and Penang.

In 1971 the total industrial production only in the State of Selangor took the majority over 50% of the nation's total. To dissolve this regional development gap the Government encouraged the industrial promotion in those less developed states by providing various incentives to invite the industries into those states. After all such efforts, the regional gap could be corrected to some extent as shown in the following table.

Table 3-2-7 Malaysia: Gross Domestic Product by Industry of Origin and State, 1971

Million M$ in 1970 price

| | GDP at purchases' value | Population (1,000) | Per capita GDP (M$) | Ratio to Malaysian average |
|---|---|---|---|---|
| Johor | 1,476 | 1,362.0 | 1,083.7 | 0.92 |
| Kedah/Perlis | 828 | 1,136.9 | 728.3 | 0.62 |
| Kelantan | 413 | 732.2 | 564.1 | 0.48 |
| Malacca | 373 | 425.3 | 877.0 | 0.75 |
| Negri Sembilan | 583 | 509.4 | 1,144.5 | 0.98 |
| Pahang | 647 | 553.1 | 1,169.8 | 1.00 |
| Perak | 1,927 | 1,651.6 | 1,166.7 | 1.00 |
| Penang | 850 | 821.1 | 1,035.2 | 0.88 |
| Selangor | 3,826 | 1,777.1 | 2,152.9 | 1.84 |
| Trengganu | 268 | 435.9 | 614.8 | 0.52 |
| Peninsular Malaysia | 11,191 | 9,404.6 | 1,189.9 | 1.02 |
| Sabah | 905 | 694.6 | 1,302.9 | 1.11 |
| Sarawak | 920 | 1,005.2 | 915.2 | 0.78 |
| Malaysia | 13,016 | 11,104.4 | 1,172.2 | 1.00 |

Table 3-2-8 Malaysia: Gross Domestic Product by Industry of Origin and State, 1980

Million M$ in 1970 price

| | GDP at purchases' value | Population (1,000) | Per capita GDP (M$) | Ratio to Malaysian average |
|---|---|---|---|---|
| Johor | 2,941 | 1,703.7 | 1,726 | 0.94 |
| Kedah | 1,291 | 1,172.5 | 1,101 | 0.60 |
| Perlis | 172 | 157.2 | 1,094 | 0.60 |
| Kelantan | 786 | 933.6 | 842 | 0.46 |
| Malacca | 708 | 482.1 | 1,469 | 0.80 |
| Negri Sembilan | 1,090 | 599.9 | 1,817 | 0.99 |
| Pahang | 1,218 | 819.8 | 1,486 | 0.81 |
| Perak | 2,967 | 1,874.7 | 1,583 | 0.86 |
| Penang | 2,286 | 969.8 | 2,357 | 1.28 |
| Selangor | 4,144 | 1,561.1 | 2,655 | 1.45 |
| Federal Territory | 3,982 | 997.7 | 3,991 | 2.17 |
| Trengganu | 759 | 576.9 | 1,316 | 0.72 |
| Peninsular Malaysia | 22,344 | 11,849.0 | 1,886 | 1.03 |
| Sabah | 2,028 | 1,097.8 | 1,847 | 1.01 |
| Sarawak | 1,816 | 1,314.4 | 1,382 | 0.75 |
| Malaysia | 26,188 | 14,261.2 | 1,836 | 1.00 |

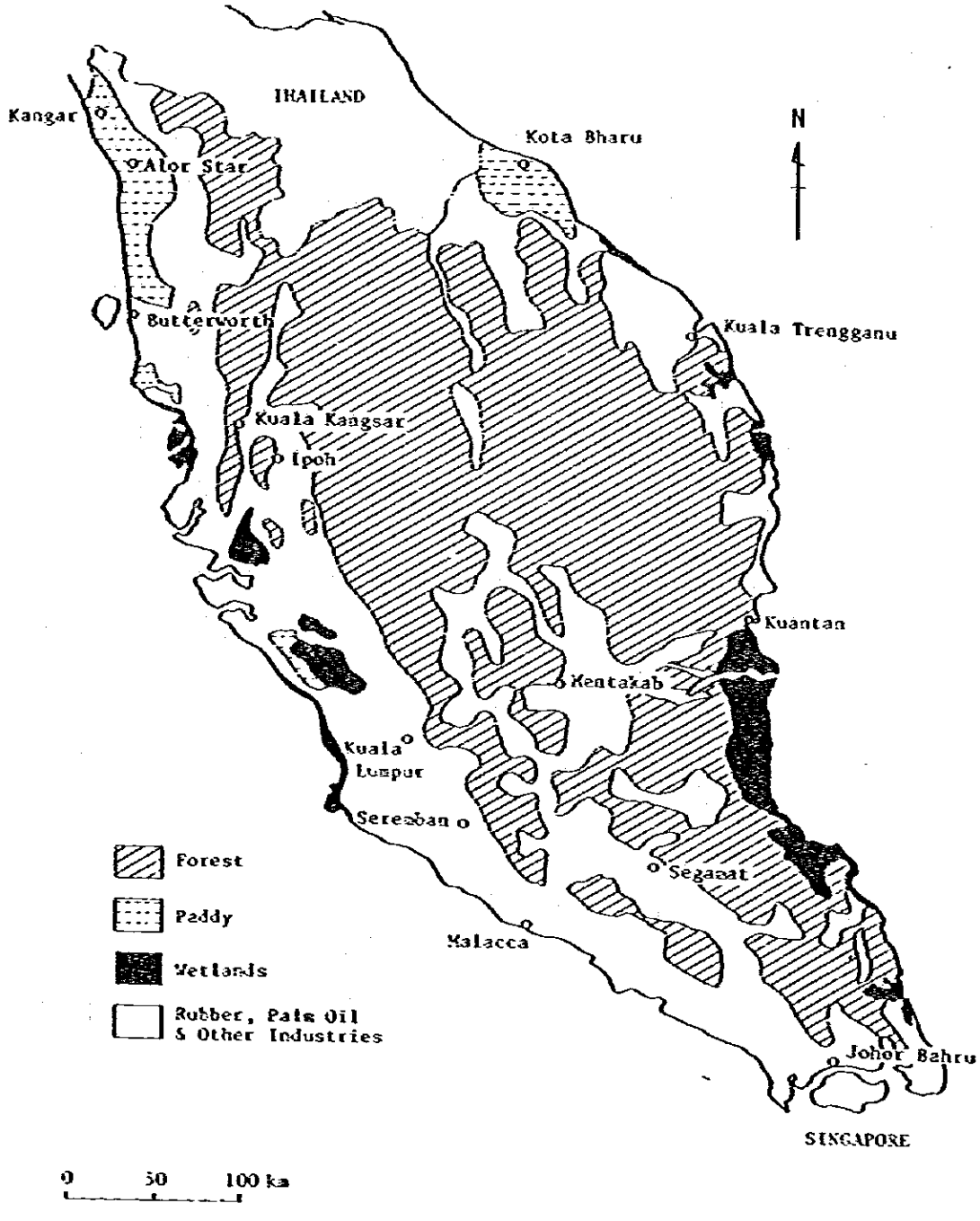



Fig. 3-2-1 Land Utilization (1974)

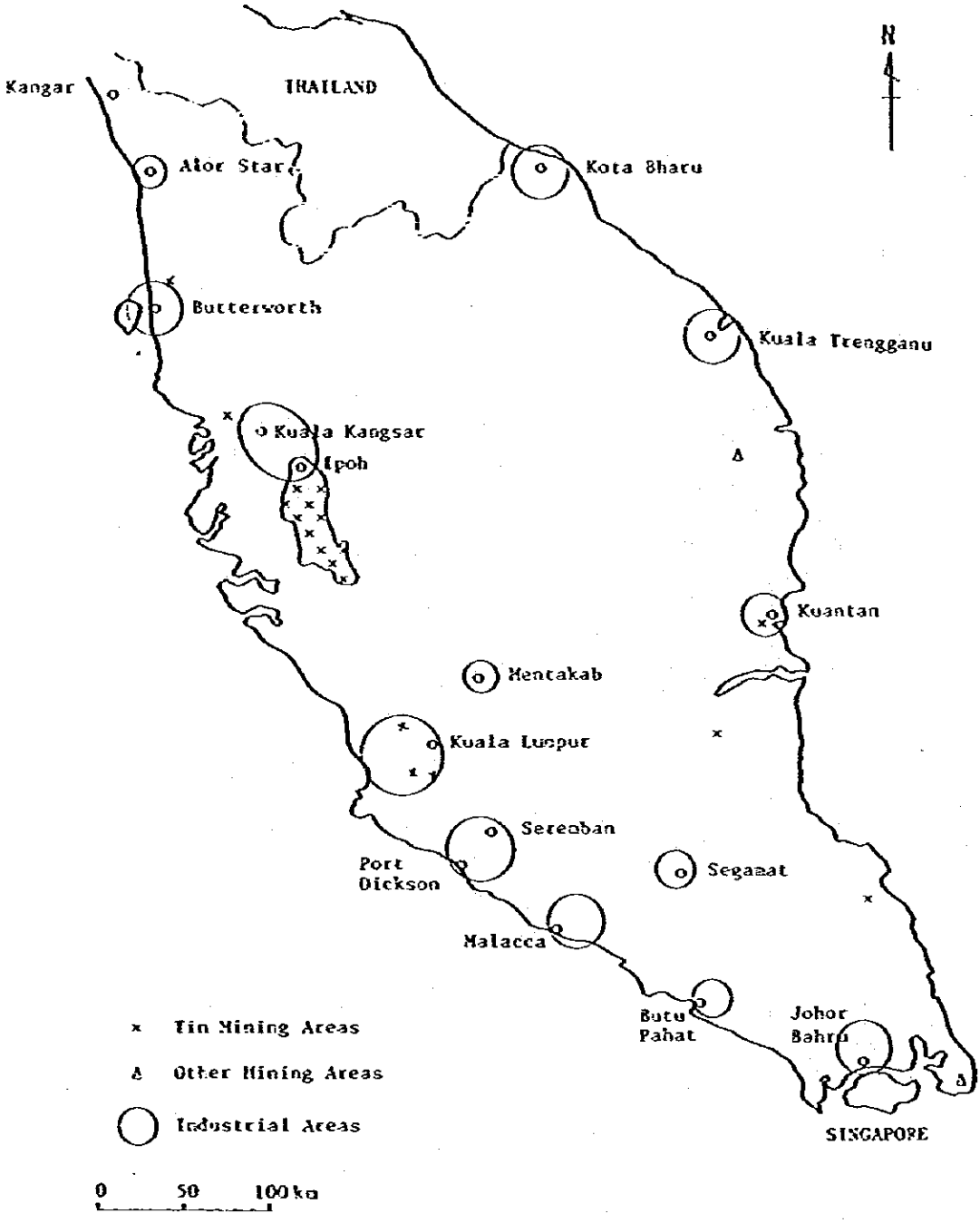



Fig. 3-2-2 Mining & Manufacturing Location Map