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社会開発協力部報告書

FINAL REPORT

# THE STUDY ON THE PERLIS PORT DEVELOPMENT PROJECT IN MALAYSIA

APRIL 1984

JAPAN INTERNATIONAL COOPERATION AGENCY

FINAL REPORT

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## PREFACE

In response to the request of the Government of Malaysia, the Japanese Government decided to conduct a feasibility study on the Development Project of the Port of Perlis and entrusted the study to the Japan International Cooperation Agency.

JICA sent to Malaysia a study team headed by Mr. Masao Ohno, Executive Director of the Overseas Coastal Area Development Institute of Japan, several times during the period from July 1983 to March 1984.

The team exchanged views with the officials concerned of the Government of Malaysia on the Project, and conducted field surveys and collected reference materials.

After the team returned to Japan, further studies were made and the present report has been prepared.

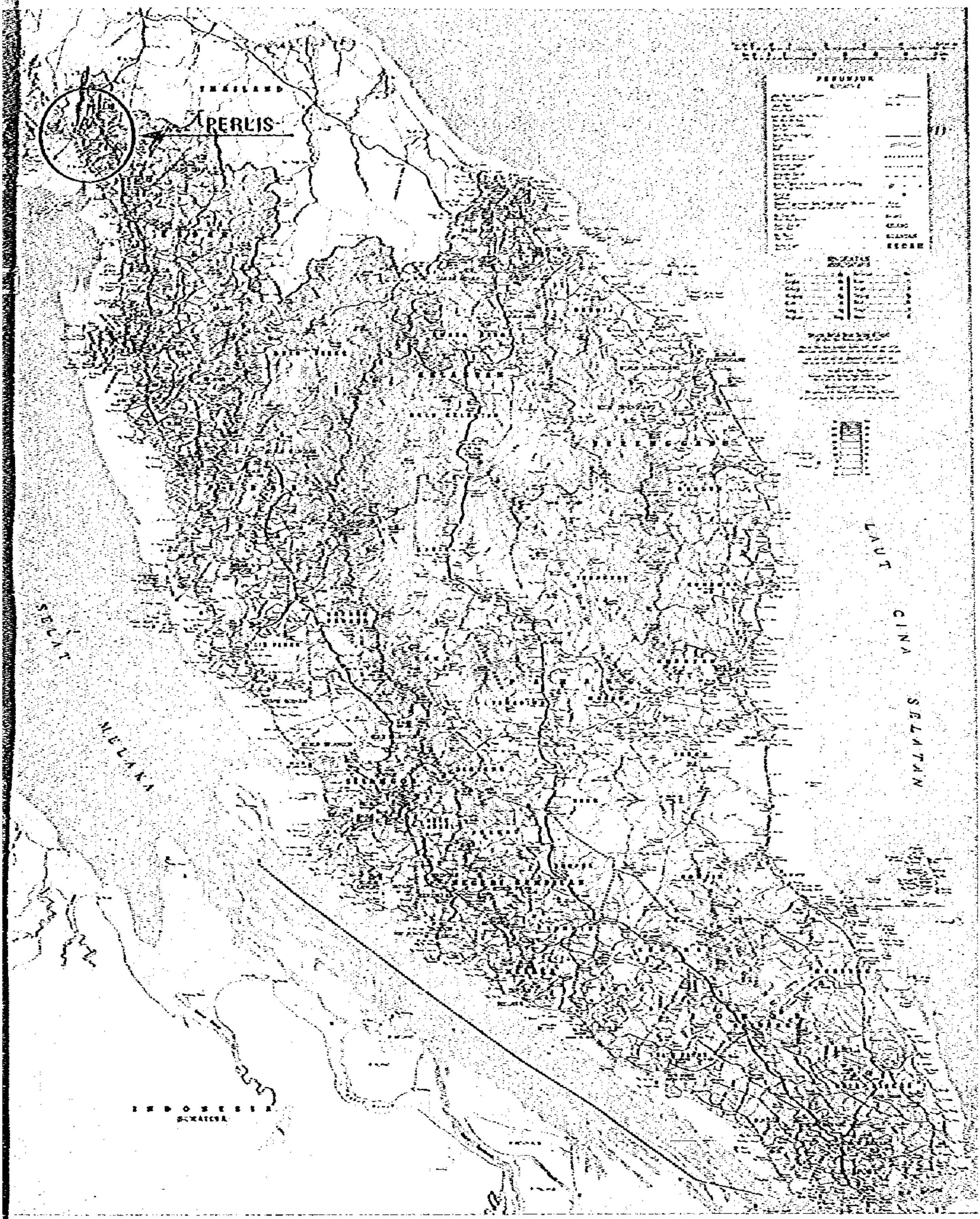
I hope that this report will serve for the development of the Project and contribute to the promotion of friendly relations between our two countries.

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

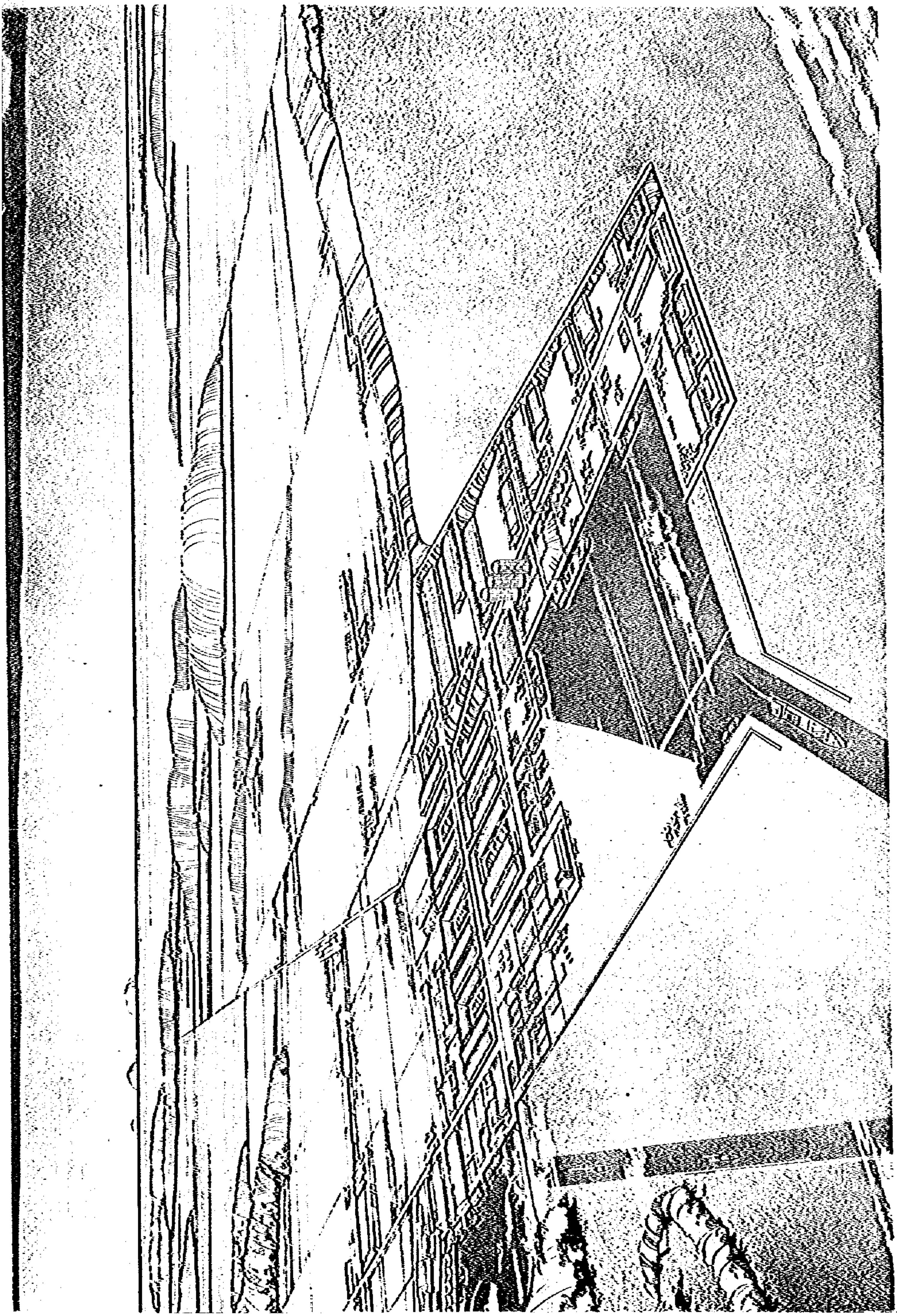
April 1984

Keisuke Arita

Keisuke Arita
President
Japan International Cooperation Agency



THAILAND
PERLIS
SELAT MELAKA
LAUT CINA SELATAN
INDONESIA



**Foreign Exchange Rate**

1US$ = M$2.3 = ¥235

## ABBREVIATION, ACRONYMS & MALAYSIAN WORDS

| | |
|---|---|
| AFC | Association of Fishermen's Cooperation |
| CIMA | Cement Industries of Malaysia Berhad |
| Cv | Coefficient of Consolidation |
| DID | Drainage and Irrigation Department |
| DWT, D/W | Dead Weight Tonage |
| EPU | Economic Planning Unit |
| FAMA | Federal Agricultural Marketing Authority |
| FELDA | Federal Land Development Authority |
| FMP | Fourth Malaysia Plan |
| F.I.R.R. | Financial Internal Rate of Return |
| F/C | Foreign Currency |
| GDP | Gross Domestic Products |
| GT, G/T | Gross Tonage |
| HWL | High Water Level |
| I.R.R. | Internal Rate of Return |
| JICA | Japan International Cooperation Agency |
| KTM | (Keretapi Tanah Melayu) Malayan Railway |
| LLW | Lowest Low Water Level |
| LPN | National Paddy and Rice Authority |
| L/C | Local Currency |
| L.S | Lump Sum |
| MADA | Muda Agricultural Development Authority |
| MAJUIKAN | Malaysia Fisheries Development Authority |
| MIDA | Malaysian Industry Development Authority |
| MSL | Mean Sea Level |
| MSY | Maximum Sustained Yield |
| M$ | Malaysia Dollar, Ringgit |
| N | Newton (= 0.102 kgf) |
| N | N-Value |
| PIAD | Perlis Integrated Area Development Project |
| PWD | Public Works Department |
| SEDC | Perlis State Economic Development Corporation |
| SEPU | Perlis State Economic Planning Unit |
| TDC | Tourist Development Corporation |
| US$ | United States Dollar |
| Wn | Moisture Content |
| ¥ | Yen |

CONTENTS

CONCLUSION

RECOMMENDATIONS

SUMMARY

OUTLINE OF THE STUDY

CHAPTER 1 THE PRESENT CONDITION AND FUTURE SITUATION OF THE PROJECT AREA

1.1 The Present Condition of the Project Area ..... 1

1.1.1 The Outline of Natural Conditions ..... 1

1.1.2 The Social and Economic Conditions ..... 5

(1) Population ..... 5

(2) Level of Production ..... 8

(3) Land Use ..... 9

(4) Industrial Structure ..... 11

(5) Standard of Living ..... 13

1.1.3 The Present Situation of Infrastructure Development ..... 15

(1) Ports and Fishing Ports ..... 15

(2) Roads ..... 15

(3) Railroads ..... 15

(4) Power ..... 15

(5) Water Resources ..... 15

1.2 The Present Conditions and Problems of the Proposed Port Development Sites ..... 21

1.2.1 The Natural Conditions ..... 21

(1) Meteorological Conditions ..... 21

(2) Sea Conditions ..... 22

(3) River Conditions ..... 25

(4) Soil Conditions ..... 26

(5) Characteristics of the Coast ..... 26

(6) Siltation of the Navigation Channel ..... 27

1.2.2 The Present Condition of the Ports ..... 48

(1) Kuala Perlis Port ..... 48

(2) Kuala Sanglang Port ........ 55

1.2.3 The Ports' Problems ........ 61

(1) Kuala Perlis Port ........ 61

(2) Kuala Sanglang Port ........ 62

1.3 The Future Social and Economic Conditions in the Project Area ........ 63

1.3.1 The Existing Regional Development Plans ........ 63

(1) The Fourth Malaysia Plan (FMP) ........ 63

(2) The Existing Regional Development Plan for Perlis State ........ 67

(3) Summary ........ 69

1.3.2 Estimating the Socio-Economic Frame ........ 70

(1) Population ........ 70

(2) GDP ........ 72

1.3.3 The Prospects for Industry ........ 74

(1) Perlis State ........ 74

(2) The Development of Langkawi Island ........ 101

(3) Thailand ........ 104

CHAPTER 2 THE BASIC PLAN FOR PORT DEVELOPMENT

2.1 The Basic Policy of the Perlis Port Plan ........ 107

2.1.1 Considerations about Port Development in Perlis State ........ 107

2.1.2 The Expected Port Functions in Perlis State ........ 108

(1) Fishing Port Functions ........ 109

(2) Passenger Transportation Base ........ 109

(3) Base for Trade with Thailand ........ 110

(4) Base for Cargo Transportation to Langkawi Island ........ 110

(5) Import/Export Base for Raw Materials and Products ........ 111

(6) Ship Repair ........ 111

2.2 The Proposed Scale of Port Development ........ 112

2.2.1 The Fishing Port Functions ........ 112

(1) The Estimation of Fish Handling Volume ........ 112

(2) The Estimation of the Number of Fishing Boats by Type and Gross Tonnage ........ 114

(3) The Estimation of the Required Scale for Each of the Fishing Port Facilities ........ 115

(4) Manpower Requirements ........ 121

2.2.2 The Commercial Port ........ 123

(1) Estimation of the Cargo and Passenger Volume ........ 123

(2) Proposed Scale of the Commercial Port Facilities ........ 138

2.2.3 The Factories on the Reclaimed Land ........ 146

(1) Concept of Establishment of Industry ........ 146

(2) Selection of Industry Types ........ 146

(3) Factory Sizes ........ 146

2.3 The Evaluation and Selection of a Port Development Site ........ 148

2.3.1 The Socio-Economic Evaluations of the Proposed Development Sites ........ 148

(1) Fishing Port Functions ........ 148

(2) Passenger Transportation Base ........ 149

(3) Base for Trade with Thailand ........ 149

(4) Base for Cargo Transportation to Langkawi Island ........ 150

(5) Base for Transporting Raw Materials and Products to and from the Factories ........ 150

(6) Ship Repair ........ 150

2.3.2 The Technical Evaluation of the Relevant Natural Conditions ........ 151

(1) Geographical Features ........ 151

(2) Wave Conditions ........ 151

(3) Soil Conditions ........ 152

(4) Maintenance of Navigation Channel ........ 153

2.3.3 Setting Up the Alternative Port Development Plans ........ 158

(1) The Basic Idea for Setting Up the Alternatives ........ 158

(2) The Presuppositions in Preparing the Alternative Port Facilities Layout Plan ........ 164

(3) The Port Facilities Layout Plan for Each Alternative ........ 167

2.3.4 The Selection of the Optimum Plan ........ 173

(1) Minimizing the Construction Cost ........ 173

(2) Effective Port Development ..... 174

(3) Urban Development Strategy ..... 174

2.4 The Master Plan ..... 175

2.4.1 The Port Facilities Layout Plan ..... 175

(1) The Alignment of the Navigation Channel ..... 175

(2) The Location of the Entrance to the Port ..... 175

(3) The Water Area Use Plan within the Port ..... 176

(4) The Training Wall Layout Plan ..... 179

2.4.2 The Construction Plan ..... 187

CHAPTER 3 THE SHORT TERM DEVELOPMENT PLAN

3.1 The Port Facilities Layout Plan ..... 191

(1) The Navigation Channel ..... 191

(2) The Basins ..... 191

(3) The Fishing Port Facilities ..... 191

(4) The Wharves for Passenger Boats and Vehicular Ferries ..... 192

(5) The Cargo Handling Wharf ..... 192

(6) Roads ..... 192

3.2 The Construction Plan ..... 208

3.2.1 The Design of Berth Structures ..... 208

(1) The Design Conditions ..... 208

(2) The Comparison of Berth Structure Designs ..... 209

(3) Breakwater and Revetment ..... 215

(4) Reclamation ..... 215

(5) Other Facilities ..... 218

3.2.2 The Construction Plan ..... 219

(1) The Construction Environment ..... 219

(2) The Construction of Principal Facilities ..... 219

(3) The Construction Schedule ..... 221

(4) Important Matters Involved in Construction ..... 223

(5) Maintenance Dredging ..... 223

3.2.3 The Cost Estimation ..... 224

(1) Construction Materials ..... 224

(2) Construction Equipment ..... 224

(3) Capability of Construction ..... 224

(4) Construction Base ..... 225

(5) Conditions of Construction Cots Estimation ..... 225

(6) Construction Cost ..... 225

3.3 The Port Administration and Management ..... 228

3.3.1 The Necessity of Establishing a Port Management Body ..... 228

3.3.2 The Scope of Business of the Port Management Body ..... 229

3.3.3 A Study of the Organization and Personnel of the Port Management Body ..... 229

3.4 The Economic Analysis ..... 233

3.4.1 General ..... 233

(1) Outline ..... 233

(2) The Comparison of the Alternative Plans ..... 233

(3) The Prices Used in the Cost-Benefit Analysis ..... 233

3.4.2 The Benefits ..... 233

(1) The Estimation of Benefits ..... 233

(2) The Benefit of Reducing the Transportation Cost for Port Cargoes ..... 235

(3) The Benefit of Increasing the Fish Handling Volume ..... 239

(4) Improvement in the Freshness of Fish through Increasing the Supply of Ice and Technical Innovation ..... 240

(5) Benefits from the Ship Repair Facilities ..... 240

(6) Creation of Added Asset Value by Reclamation for the Industrial Estate ..... 240

(7) Effect on Increasing Employment Opportunities ..... 240

3.4.3 The Costs ..... 241

(1) The Construction Cost ..... 241

(2) The Maintenance Costs and Operation Costs ..... 241

3.4.4 The Setting of Economic Prices ..... 242

(1) Exclusion of Transfer Items ..... 242

(2) Adjustment of Unskilled Labour Costs ........ 242
(3) The Foreign Exchange Rate ........ 242
3.4.5 The Economic Evaluation ........ 243
3.5 The Financial Analysis ........ 245
3.5.1 The Purpose and Assumptions of the Financial Analysis ........ 245
3.5.2 Revenue ........ 248
(1) The Commercial Port ........ 248
(2) The Fishing Port ........ 249
(3) Sales of the Reclaimed Land ........ 250
3.5.3 Expenditure ........ 251
(1) The Personnel Costs ........ 251
(2) The General Administrative Costs ........ 251
(3) The Labour Costs ........ 251
(4) The Maintenance/Operation Costs ........ 251
(5) The Maintenance Dredging Cost ........ 251
(6) Raw Material Costs of Fuel-Supply and Water-Supply ........ 251
(7) Miscellaneous Costs ........ 251
(8) Depreciation ........ 252
(9) Interest on Loans ........ 252
(10) Tax ........ 252
3.5.4 The Financial Statements ........ 253
3.5.5 The Financial Internal Rate of Return ........ 254
3.5.6 Comments ........ 257
3.5.7 Case-study ........ 257
(1) Approach to these Case-studies ........ 257
(2) Case I ........ 257
(3) Case II ........ 257
3.5.8 Sensitivity Analysis ........ 259

## TABLE LIST


| Table No. | Title | Page |
|---|---|---|
| 1.1.1 | Population of Perlis State by Mukim | 6 |
| 1.1.2 | Age Distribution – 1980 Census | 6 |
| 1.1.3 | Ethnic Composition of the Population | 7 |
| 1.1.4 | Population Density | 7 |
| 1.1.5 | Lifetime Immigrants, Emigrants and Net Migrants | 7 |
| 1.1.6 | Summary of GDP and Per Capita GDP Growth by State | 8 |
| 1.1.7 | Poverty Incidence (%) 1970~1982 | 9 |
| 1.1.8 | Land Use, Perlis State | 11 |
| 1.1.9 | Availability of Cultivatable Land in Malaysia, 1979 | 11 |
| 1.1.10 | Gross Domestic Product by Industry, Perlis State | 12 |
| 1.1.11 | Employment Estimates by Sector, Perlis State | 13 |
| 1.1.12 | Indicators for the Standard of Living | 14 |
| 1.2.1 | Mean Hourly Values of Temperature | 29 |
| 1.2.2 | Mean Hourly Values of Relative Humidity | 29 |
| 1.2.3 | Monthly Wind Wave and Swell Condition in Malacca Strait | 30 |
| 1.2.4 | Recent Flood Records at Kangar | 31 |
| 1.2.5 | Refraction Coefficient at Kuala Perlis | 31 |
| 1.2.6 | Ferries in Service Between Kuala Perlis and Langkawi Island | 51 |
| 1.2.7 | Number of Ferry Passengers | 51 |
| 1.2.8 | Number of Passengers Between Thailand and Malaysia | 51 |
| 1.2.9 | Number of Fishing Boats by Type and by Fishing Method at Kuala Perlis Port | 52 |
| 1.2.10 | Estimate of Marine Prodctus by Fishing Method at Kuala Perlis Port | 52 |
| 1.2.11 | Berthing Facilities at Kuala Perlis Port | 53 |
| 1.2.12 | Number of Fishing Boats by Type and Fishing Method at Kuala Sanglang Port | 58 |
| 1.2.13 | Marine Products by Fishing Method at Kuala Sanglang Port | 58 |
| 1.3.1 | Gross Domestic Product by Sector, Malaysia, 1970~1990 | 64 |
| 1.3.2 | GDP of Perlis State Estimated at FMP | 65 |

| Table No. | Title | Page |
|---|---|---|
| 1.3.3 | Allocation under FMP, Perlis State | 66 |
| 1.3.4 | Estimated Population of Perlis State | 68 |
| 1.3.5 | Population | 70 |
| 1.3.6 | Estimated Population | 71 |
| 1.3.7 | GDP, Actual and Estimated Value at FMP | 73 |
| 1.3.8 | Estimation of GDP at Perlis State | 74 |
| 1.3.9 | Present Area under Agriculture in Perlis State | 75 |
| 1.3.10 | Future Land Use of Perlis | 77 |
| 1.3.11 | Production of Sugarcane and Sugar in Perlis State | 78 |
| 1.3.12 | Quantities of Commodities Arranged by FAMA, Perlis State in 1982 | 80 |
| 1.3.13 | Domestic Export of Rice from Perlis State | 80 |
| 1.3.14 | Domestic Export of Major Agricultural Products from Perlis State | 81 |
| 1.3.15 | Forest Statistics in 1978 | 82 |
| 1.3.16 | Trend of Fish Landings, 1977~1982 | 84 |
| 1.3.17 | Trend of Perlis Fisheries | 84 |
| 1.3.18 | Annual Series of Fishery Commodities Export from Malaysia | 85 |
| 1.3.19 | Fishery Commodities Import to Malaysia | 85 |
| 1.3.20 | Trend Import/Export Fishes from Thailand | 85 |
| 1.3.21 | Import/Export Fishes from Thailand to Kedah/Perlis (1982) | 86 |
| 1.3.22 | Number of Licensed Fishing Boats (Perlis State, 1981) | 87 |
| 1.3.23 | Size, Type and Number of Fishing Boats of Perlis State (1982) | 87 |
| 1.3.24 | Number of Fishing Boats Licensed in Perlis State | 88 |
| 1.3.25 | Number of Thai Fishing Boats Coming to Kuala Perlis (1978~1983) | 88 |
| 1.3.26 | Number of Fishermen Working in Licensed Boats, 1982 | 90 |
| 1.3.27 | Trend of Fisheries Production of the Thailand, 1976~1981 | 93 |
| 1.3.28 | Disposition of Marine Fish Landings, 1981, Kedah/Perlis | 94 |
| 2.2.1 | Estimation of Fish Handling Volume | 112 |
| 2.2.2 | Total Marine Fish Landing, Perlis | 113 |
| 2.2.3 | Trend of Imported Fresh Fish, Fresh Prawn from the Thailand | 113 |
| 2.2.4 | Estimation of the Number of Fishing Boats by Type | 114 |

| Table No. | Title | Page |
| --- | --- | --- |
| 2.2.5 | Estimation of the Number of Using the Port on an Average Day | 114 |
| 2.2.6 | Required Extension of Quay in Fishing Port | 115 |
| 2.2.7 | Average Daily Handling Fish Volume | 115 |
| 2.2.8 | Required Area for Fish Market | 115 |
| 2.2.9 | Requirement for Ice Manufacturing Capacity | 116 |
| 2.2.10 | Requirement for Ice Manufacturing Area | 117 |
| 2.2.11 | Requirement for Ice Storage Capacity and Space | 117 |
| 2.2.12 | Required Daily Volume of Water | 118 |
| 2.2.13 | Required Fueling Volume a Day | 118 |
| 2.2.14 | Estimation of the Number of Fishing Boats by Type and Gross Tonnage in Perlis State | 119 |
| 2.2.15 | Estimation of the Number of Boats Using the Repair Facilities on an Average Year in the Planned Target Year of 2000 | 121 |
| 2.2.16 | Requirement of Staff for Fishing Port | 121 |
| 2.2.17 | Requirement of Workers for Fishing Port | 121 |
| 2.2.18 | Consumption of Petroleum in Perlis State | 125 |
| 2.2.19 | Estimation of Petroleum | 126 |
| 2.2.20 | Quantity of Fertilizer in 1982 in Perlis | 126 |
| 2.2.21 | Estimation of Ferry Passengers | 128 |
| 2.2.22 | Characteristics at Comparable Resorts | 129 |
| 2.2.23 | Cargo Handled by the Kuala Kedah-Langkawi Line in 1982 | 131 |
| 2.2.24 | Estimation of Cargo Handled by Perlis Port-Langkawi Line | 132 |
| 2.2.25 | Number of Passengers between Thailand and Malaysia | 133 |
| 2.2.26 | Major Commodities of Foreign Trade Statistics at Kuala Perlis Customs | 134 |
| 2.2.27 | Foreign Trade Statistics at Kuala Perlis Customs | 135 |
| 2.2.28 | Estimation of Foreign Trade Cargo Handled at Kuala Perlis Port | 136 |
| 2.2.29 | Estimation of Cargo and Passengers Handled at Kuala Perlis Port | 137 |
| 2.2.30 | Physical Dimensions of High-Speed Boat | 138 |
| 2.2.31 | Passenger Motor Cars Owned in Peninsular Malaysia | 139 |
| 2.2.32 | Estimate of the Number of Passenger Cars and Passengers Using Vehicular Ferry | 139 |

| Table No. | Title | Page |
|---|---|---|
| 2.2.33 | Physical Dimensions of Vehicular Ferry | 140 |
| 2.2.34 | Ships Arrival at West Malaysian Ports Coastal Trade, 1964~1981 | 142 |
| 2.2.35 | Specification of the Vessels in the 2,000 D/W Class | 143 |
| 2.2.36 | Calculation of the Required Quay Length | 144 |
| 2.2.37 | Estimate of Required Area for Storage Facilities | 145 |
| 2.2.38 | Selection of Industry Types on the Reclaimed Land | 146 |
| 2.2.39 | Size of Factories on the Reclaimed Land | 147 |
| 2.3.1 | Ground Level Settlement Calculation | 153 |
| 2.3.2 | Socio-economic Evaluation of the Proposed Development Sites | 159 |
| 2.3.3 | Technical Evaluation of the Proposed Development Sites | 159 |
| 2.3.4 | Comparison of Construction Cost of Alternatives | 161 |
| 2.3.5 | Alternative Plans for Port Development in Perlis State | 163 |
| 2.3.6 | Time Ratio for Tidal Level Exceeding an Arbitrary Level | 164 |
| 2.3.7 | The Minimum Required Sizes for the Port Facilities in the Master Plan | 166 |
| 2.3.8 | Estimation of Construction Cost for Alternatives | 173 |
| 2.3.9 | Comparison of Alternative Plan Construction Costs | 174 |
| 2.4.1 | Comparion of Alternative Plan Relating to the Location of Entrance to the Port | 176 |
| 2.4.2 | Construction Schedule of Master Plan | 188 |
| 2.4.3 | Construction Cost of Master Plan | 189 |
| 3.1.1 | The Minimum Required Sizes for the Port Facilities in the Short Term Development Plan | 193 |
| 3.1.2 | Proposed Scale of the Short Term Development Plan | 194 |
| 3.2.1 | Typical Soil Conditions | 209 |
| 3.2.2 | Safety Factors | 209 |
| 3.2.3 | Comparison of Economy and Workability | 214 |
| 3.2.4 | Result of the Settlement Calculation | 216 |
| 3.2.5 | Comparison of Counter Measures for Reclamation | 216 |
| 3.2.6 | Construction Schedule of Short Term Development Plan | 222 |
| 3.2.7 | Comparison of Maintenance Dredging Cost | 224 |
| 3.2.8 | Construction Cost of Short Term Development Plan | 226 |

| Table No. | Title | Page |
|---|---|---|
| 3.2.9 | Yearly Investment of Short Term Development Plan | 227 |
| 3.3.1 | Number of Personnel | 232 |
| 3.4.1 | Freight and Fare in Unit Cost | 238 |
| 3.4.2 | Economy of Transportation Cost | 239 |
| 3.4.3 | Annual Benefit of Increase of Fish Handling Volume | 239 |
| 3.4.4 | Construction Cost for 4 Years | 241 |
| 3.4.5 | Annual Administration and Operation Cost | 241 |
| 3.4.6 | Annual Maintenance Cost | 242 |
| 3.4.7 | Modified Construction Cost (M$) | 243 |
| 3.4.8 | Internal Rate of Return (I.R.R.) | 244 |
| 3.5.1 | Estimation of Ships Calling at Kuala Perlis Port (1990) | 246 |
| 3.5.2 | Construction Cost | 247 |
| 3.5.3 | Opening Balance Sheet (Beginning of 1988) | 247 |
| 3.5.4 | Long-Term Loan Schedule | 248 |
| 3.5.5 | Annual Revenue | 250 |
| 3.5.6 | Annual Maintenance Cost | 252 |
| 3.5.7 | Annual Management and Operation Cost | 253 |
| 3.5.8 | Fixed Assets Schedule of Beginning of Year | 253 |
| 3.5.9 | Statement of Revenue and Expenditure | 254 |
| 3.5.10 | Balance Sheet at Beginning of Year | 254 |
| 3.5.11 | Statement of Source and Application of Funds | 255 |
| 3.5.12 | Financial Internal Rate of Return | 256 |
| 3.5.13 | Statement of Revenue and Expenditure in Case I | 257 |
| 3.5.14 | Balance Sheet at Beginning of Year in Case I | 258 |
| 3.5.15 | Statement of Source and Application of Funds in Case II | 258 |
| 3.5.16 | Relation between Maintenance Dredging Cost at F.I.R.R. | 259 |

## FIGURE LIST


| Figure No. | Title | Page |
| --- | --- | --- |
| 1.1.1 | Topographic Features, Perlis | 2 |
| 1.1.2 | Topographical Map of Kuala Perlis | 3 |
| 1.1.3 | Topographical Map of Kuala Sanglang | 4 |
| 1.1.4 | Existing Land Use, Perlis State | 10 |
| 1.1.5 | Location of Ports and Network of Roads and Railways in Peninsular Malaysia | 17 |
| 1.1.6 | Existing Road and Railway Network in Perlis State | 18 |
| 1.1.7 | Electricity | 19 |
| 1.1.8 | Water Supply | 20 |
| 1.2.1 | Average Monthly Rainfall | 32 |
| 1.2.2 | Mean Annual Rainfall Isohyets, Perlis | 33 |
| 1.2.3 | Wind Rose Summary at Alor Setar, Kedah, 1968~1977 | 34 |
| 1.2.4 | Frequency of Mean Hourly Wind Speed | 35 |
| 1.2.5 | Tide Datum | 35 |
| 1.2.6 | Wave Refraction Diagram | 36 |
| 1.2.7 | Ocean Current Profile | 38 |
| 1.2.8 | Characteristics of Tidal Current at Kuala Perlis | 39 |
| 1.2.9 | Tidal Current Ellipse at Kuala Perlis | 40 |
| 1.2.10 | Drainage Network, Perlis | 41 |
| 1.2.11 | Soil Profile at Kuala Perlis | 42 |
| 1.2.12 | Soil Profile at Kuala Sanglang | 44 |
| 1.2.13 | Soil Testing Result (Kuala Perlis) | 45 |
| 1.2.14 | Soil Testing Result (Kuala Sanglang) | 46 |
| 1.2.15 | Beachline Transformation adjacent to Kuala Perlis | 47 |
| 1.2.16 | Beachline Transformation adjacent to Kuala Sanglang | 47 |
| 1.2.17 | Kuala Perlis Port | 49 |
| 1.2.18 | Existing Land Use of Kuala Perlis | 50 |
| 1.2.19 | Fishery Facilities of Kuala Perlis Port | 54 |
| 1.2.20 | Kuala Sanglang Port | 56 |

| Figure No. | Title | Page |
| --- | --- | --- |
| 1.2.21 | Existing Land Use of Kuala Sanglang | 57 |
| 1.2.22 | Fisheries Facilities of Kuala Sanglang | 60 |
| 1.3.1 | Average Annual Growth Rate of Population | 72 |
| 1.3.2 | Area Excluded from the Perlis Integrated Area Development Project | 76 |
| 1.3.3 | Rice Marketing System | 79 |
| 1.3.4 | Marketing System for Other Crops | 79 |
| 1.3.5 | Number of Types of Fishing Boats by Tonnage in Perlis State, 1977~1982 | 89 |
| 1.3.6 | Fishing Ground (Kedah/Perlis) | 91 |
| 1.3.7 | Reference of Fisheries Resource in the West Coast of Peninsular Malaysia | 92 |
| 1.3.8 | Landings of Marine Fish (Kedah/Perlis, 1977~1982) | 93 |
| 1.3.9 | Pulau Langkawi Resort | 103 |
| 1.3.10 | Port Activities in Satun Port | 104 |
| 2.2.1 | Trend of Fish Landing in Perlis and Import Fish from Thailand | 113 |
| 2.2.2 | Estimation of Number of Ferry Passengers | 130 |
| 2.2.3 | Shape of Ferry Wharf | 141 |
| 2.3.1 | Water Induced Angle at Kuala Perlis and Kuala Sanglang | 155 |
| 2.3.2 | Relationship between Moisture Content (Wn) and Depth | 155 |
| 2.3.3 | Moded Section for Settlement Calculation | 156 |
| 2.3.4 | Relationship between Time and Consolidation Degree | 156 |
| 2.3.5 | Typical Bottom Profiles at Kuala Perlis and Kuala Sanglang | 157 |
| 2.3.6 | Alternative Plans to Secure the Approach of Ships to the Quays | 160 |
| 2.3.7 | Profile of Structure | 162 |
| 2.3.8 | Alternative Plan (Plan A) | 170 |
| 2.3.9 | Alternative Plan (Plan B-1) | 171 |
| 2.3.10 | Alternative Plan (Plan B-2) | 172 |
| 2.4.1 | Alternative Plans Relating to the Location of the Entrance to the Port | 177 |
| 2.4.2 | Water Area Use Plan | 178 |
| 2.4.3 | Siltation Rate Distribution along the Navigation Channel | 181 |
| 2.4.4 | Optimum Length of Training Wall (Siltation Rate: 60 cm/year) | 182 |

| Figure No. | Title | Page |
|---|---|---|
| 2.4.5 | Optimum Length of Training Wall (Siltation Rate: 100 cm/year) | 183 |
| 2.4.6 | Master Plan | 185 |
| 3.1.1 | Short Term Development Plan | 195 |
| 3.1.2 | General Arrangement Plan of Fishing Port | 197 |
| 3.1.3 | General Arrangement Plan of Fish Market and Ice Manufacturing Facilities | 198 |
| 3.1.4 | Cold Storage and Processing Plan | 199 |
| 3.1.5 | Warehouse (to store fishing gear, materials, equipment, and fish bores, etc.) | 200 |
| 3.1.6 | Work Shop and Office for Dockyard | 200 |
| 3.1.7 | Sewage Disposal Facilities | 201 |
| 3.1.8 | Dockyard Facilities for Repairs of Fishing Boats | 202 |
| 3.1.9 | Layout of Slip Way | 203 |
| 3.1.10 | Layout Plan for Passenger and Vehicular Ferry Wharf | 204 |
| 3.1.11 | Ferry Access Bridge | 205 |
| 3.1.12 | Layout Plan for Cargo Wharf | 206 |
| 3.1.13 | Standard Sections of Port Road | 207 |
| 3.2.1 | Standard Cros Section of Alternative Plan A (Sheet Pile Quaywall) | 211 |
| 3.2.2 | Standard Cross Section of Alternative Plan B (Open Type Whalf with Vertical Piles) | 212 |
| 3.2.3 | Standard Cross Section of Alternative Plan C (L-Shape Concrete Block Type Quaywall) | 213 |
| 3.2.4 | Standard Cross Section of Breakwater | 215 |
| 3.2.5 | Standard Cross Section of Revetment | 215 |
| 3.2.6 | Relationship between consolidation Time and Settlement | 217 |
| 3.2.7 | Procedure for Construction of the Quaywall | 219 |
| 3.2.8 | Procedure for Dredging of the Channel | 220 |
| 3.2.9 | Procedure of Maintenance Dredging of Channel | 223 |
| 3.3.1 | Organization Chart of Port Management Body | 231 |
| 3.4.1 | Assumption of Cargo and Passenger Transportation | 237 |
| 3.5.1 | Relation between Maintenance Dredging Cost and F.I.R.R. | 260 |

# CONCLUSION

## Conclusion

### 1. The Necessity for Port Development in Perlis State

Perlis State, which is the northernmost state in Peninsular Malyasia, is at present one of the least developed states in the nation. This situation is considered to be the result of the lack of the conditions necessary for the industrialization which would improve the state's socio-economic conditions. These conditions include offering an abundance of natural resources, being close to market areas, and having a well developed infrastructure. There is, in addition, the geographical handicap.

The most effective way for the state to break out of the present situation is port development making the best use of its potential for coordinated industrial development. This is expected to give an incentive to the state and to play an important role as a nucleus of regional development.

### 2. The Master Plan for Port Development in Perlis State

Port Development in Perlis State for the purpose of regional development should provide for port functions to support fishing activities and ship repair operations, to serve as a base for passenger and cargo transportation to Langkawi Island and South Thailand, and as an import and export base for raw materials and products, as well as including a port related industrial area reclaimed from the sea.

In formulating a master plan for Perlis State port development, we first set up three alternative plans based on socio-economic and technical evaluations of the two proposed sites, Kuala Perlis Port and Kuala Sanglang Port. Comparative evaluations of these alternatives were carried out considering minimization of the construction costs, effective port developmnt, and urban development strategy. Based on a general consideration of these evaluations, the alternative plan concentrating development of port functions at Kuala Perlis Port, was selected as the Perlis State master port development plan.

The master plan (target year 2000) includes the reclamation of around 32 ha of tideland along the coastal area south of the Perlis River, construction of fish landing facilities for large fishing boats, pontoons for passenger boats, berthing facilities for vehicular ferries, wharves for cargo vessels, ship repairing facilities, and a site for factories, dredging the navigation channel and basins, and construction of breakwaters surrounding the basins.

Total construction cost of the master plan is estimated at M$68 million.

### 3. The Short Term Development Plan

The short term development plan (target year 1990), which is regarded as the first stage of the master plan, aims at constructing the port facilities necessary for solving present problems and for coping with future port demands.

The plan includes dredging of the navigation channel and basins, construction of breakwaters with a length of 1,195 m and a fish landing berth with a length of 150 m, two pontoons for passenger boats and port servicing boats, a cargo berth with a length of 410 m and a depth of 4.0 m, a cargo handling area, ship repairing facilities for fishing boats and the reclamation of land for an industrial area of 10.2 ha.

The total construction cost of the short term development plan is estimated at M$51.3 million (1983 prices), of which 49.6% is foreign currency.

The construction period is three and half years, from 1985 to 1988, including the engineering study period.

4. Economic and Financial Analysis

The economic analysis of the short term development plan shows that the economic internal rate of return (I.R.R.) is 9.9%. Considering the social benefits that are not analyzed quantitatively, it can be concluded that this project is feasible.

The financial analysis of the short term development plan, supposing that the Port Management Body will be established as an autonomous body for the administration of the port, that the local currency portion of the development investment funds is capital stock and that the foreign currency portion is long-term loans (Interest: 4.0% per annum, Term of Loan: 25 years), shows that the financial internal rate of return (F.I.R.R.) is 4.1% in case of the maximum maintenance dredging volume and that it will be possible to meet ordinary operating costs, to renew the facilities and to repay debts. We may, therefore, conclude that the Port Management Body will be financially self-supporting.

# RECOMMENDATIONS

## Recommendations

### 1. To Continue the Study of the Siltation of the Navigation Channel

The most important technical problem in planning the layout of port facilities is how to maintain the navigation channel.

Since, due to the combination of many natural factors, the siltation mechanism is very complex, a long term field survey and analysis are necessary to make the siltation mechanism clear and find an effective means to prevent it.

In this study the maintenance dredging plan was chosen as the optimum means to secure the approach of ships to the wharves, but this conclusion was derived from the results of natural condition surveys and analysis carried out only during the limitted period of the study.

Therefore it is required to perform further surveys, especially, bathymetric surveys of the navigation channel before and after dredging, and to study effective measures to maintain the channel.

### 2. To Make an Effort to Lighten the Burden of the Maintenance Dreding Cost

The volume of maintenance dredging in the navigation channel and basins at Kuala Perlis Port is estimated at 344,000 $m^3$ to 567,000 $m^3$, costing M$1.20 million to M$1.98 million a year.

In order to lighten the burden of expenditure for this dredging as much as possible, it is necessary to find timely and appropriate ways to carry it out. Such methods include joint dredging, in combination with the maintenance dredging of the flood mitigation waterway, while alocating the dredging cost, secondly requesting that the dredging be carried out by Marine Department dredgers, and finally owning a maintenance dredger jointly with several ports.

### 3. To Promote Effective Use of Facilities through an Appropriate Allotment of Functions between the Existing Port Area and the New Port Area.

It is necessary that the administration and management be considered carefully so as to suitably share port functions between the existing port facilities along the Perlis River and the new port facilities which will be constructed along the south shore.

The existing port area should function as a place for small fishing boats to land fish, layoff, and prepare, and as a base for passenger transportation to Thailand, while the new port area should be used for landing fish from large fishing boats, repairing fishing boats, berthing passenger and vehiclular ferry boats on the Langkawi Island route, and for handling cargoes. Especially, it is most important to contrive administrative methods so as to make the best use of the fisheries facilities in the new port area.

### 4. To Establish a New Port Administrative Organization Suited to the Character of Kuala Perlis Port

Kuala Perlis Port is characterized by the facts that it must play the role of a nucleus for regional development in Perlis State, that the port facilities are planned to exist separately at the existing port area and the new port area, and that the new port will have fishing port functions and commercial port functions using the some water area.

In consideration of these characteristics, it is desirable to establish an autonomous body to administer and manage the fishing port and the commercial port together, so that the port can be developed in tandem with the progress of regional development.

5. To Promote the Port and Urban Development, Taking Advantage of the Langkawi Island Development as Much as Possible.

With the development of tourism and the cement industry on Langkawi Island, transportation of cargoes and passengers is expected to increase steadily. Kuala Perlis should play an active role as the mainland window for this transportation.

Therefore, a synthetic plan for the urban development of Kuala Perlis should be prepared, and integrated with the port plan and the land use plan for SEDC's reclamation project. As well, the port facilities should be constructed to cope with the expansion of ferry service to include vehiclular ferries alongside the present passenger boats, keeping pace with the construction of port facilities on Langkawi Island.

# SUMMARY

Summary

# 1. The Present Condition and Future Situation of the Project Area

## 1.1 The Present Social and Economic Conditions of the Project Area

The population of Perlis State was 147,726 in 1980, accounting for 1.10% of the population of Malaysia.

The per capitra GDP of Perlis State was M$1,094 (in 1970 price) in 1980, 60% of the national average.

The land use report for Perlis State in 1980 shows that cultivated areas account for about 60%, of which the greater part consists of paddy fields. The 1980 statistics for gross domestic product (GDP) by industry in Perlis State show that the agricultural, forestry and fishing sector amounts to 44.2% of the total and manufacturing sector amounts to 9.3%.

## 1.2 The Present Conditions and Problems of the Proposed Port Development Sites

### (1) The Natural Conditions

Perlis State is the northernmost state of Peninsular Malaysia and faces on the Malacca Strait. Its area is 81,053 ha (200,200 acres) which makes it the smallest state in Malaysia. Kuala Perlis is located close to the state capital of Kangar and the international border with Thailand, while Kuala Sanglang is situated on the state border with Kedah.

Perlis State has a typically tropical climate characterized by distinct dry and rainy seasons. The seasonal winds are roughly classified into north-east monsoons and south-west monsoons, greatly influencing the climatic conditions of the Perlis area.

The Perlis coast between Kuala Perlis and Kuala Sanglang extends for about 20 km, forming a simple coastline with a shallow shore zone of very gentle gradient. Langkawi Island and Terutao Island shelter the Perlis coast from swells intruding from the Andaman Sea and wind waves generated in the Malacca Strait. These waves are also attenuated by breaking and bottom friction as they move into the shallow water area near the shore. The waves reaching Kuala Sanglang are more severe than those at Kuala Perlis.

The Perlis State coastal area is covered by a thick marine clay layer, which creates big problems for port construction.

Geotechnically, very soft marine clay with a high water content often causes circle ground sliding and subsidance of port facilities particularly on reclaimed areas. The stratum of marine clay at Kuala Sanglang is thicker than that at Kuala Perlis. Counter-measures such as stabilization of the existing marine clay layer or pile foundations to reach the bearing layer are necessary for the construction of port facilities.

This marine clay also creates a sedimentation problem in the navigation channel and the berthing area, as it is easily agitaged and transported by waves and tidal currents. The siltation rate in the navigation channel is estimated at over 60 cm/year, as estimated based on a comparison with field data from Satun Port in Thailand. Considering the extensive navigation channel necessary due to the very gentle bottom slope, the volume of maintenance dredging will be very great.

## (2) The Present Condition of the Ports

### 1) Kuala Perlis Port

Geographical Conditions

Kuala Perlis Port is located on the northernmost stretch of the west coast of Peninsular Malaysia, about 2 km south from the Thai border and about 10 km southwest from the state capital of Kanger. It is an estuary port built at the mouth of the Perlis River.

Port Activity

Kuala Perlis Port has dual functions as a commercial port and a fishing port. It is a base for the passenger ferry service to Langkawi Island and for the passenger traffic and coastal trade with the community of Satun in South Thailand.

The annual number of passengers are around 280,000 for Langkawi Island and around 300,000 for Thailand. The annual volume of cargoes presently handled at Kuala Perlis Port is estimated at 55,000 tons.

Kuala Perlis Port is the largest fishing port in Perlis State, and 2,351 fishermen (78% of the Perlis State total) and 467 boats (70%) are registered there. The catch in 1982 was 31,720 tons. Besides these boats registered at Kuala Perlis, a monthly average of 470 Thai fishing boats enter the port and land an annual catch of about 40,000 tons.

Port Facilities

Natural waterways formed by the flow of the Perlis River are used for the navigation channel at Kuala Perlis Port. The water depth of the channel is about 60 cm at low tide.

Closely packed berthing facilities line both banks about 1 km upstream from the estuary of the Perlis River. There are a ferry jetty, a small concrete jetty for cargo handling and 16 wooden pier type jetties for fish landing, of which one is a MAJUIKAN facility while the rest are private.

Present Problems

① Since the port mouth is less than 1 m deep at low tide, ferries and fishing boats must wait for high tide to go in and out.

② The ferry terminal berth is insufficient for the arrivals and departures of ferries bunched at high tide. So, the ferries must berth side by side and passengers often have to climb over one or two boats when boading or unboading, creating serious safety problems. The waiting room at the passenger terminal is small and offers little service to tourists.

③ Since the operation of the fishing boats largely depends upon the tide, the boats tend to leave port or return to port all at the same time. Therefore, the present limited capacity of the facilities makes landing and loading operations very congested.

④ Since the floors of the fish handling areas made of wood and obsolete, they are unsanitary and greatly affect the freshness of the fish.

⑤ With the increase of fish catches, the ice supply is falling short of the demand.

⑥ There is no hull repair shop for fishing boats nor any repair shops that can handle mechanical parts.

### 2) Kuala Sanglang Port

Keographical Conditions

Kuala Sanglang Port is located in southernmost Perlis State, at the mouth of the Sanglang River which forms the border with Kedah State. All the present port facilities of Kuala Sanglang are located on the Kedah State side of the river.

Port Activity

Kuala Sanglang Port functions only as a small fishing port. The number of registered fishermen is 209, only 7% of the Perlis State total and the number of registered fishing boats is 76. The catch in 1982 was 2,955 tons and there is no landing of catches from Thai fishing boats.

Port Facilities

A natural waterway, maintained by the force of the water flowing from the irrigation canal, is used for the navigation channel. The width of the waterway is about 60 m and at low tide water depth is about 20 cm, limiting exit and entry to even a small ship.

A total of 12 fish landing jetties, including one owned by MAJUIKAN, exist between the mouth of the north irrigation canal and the concrete bridge 200 m upsteam.

Present Problems

① Because the approaching waterway is very shallow and the low tide water depth is only 20 cm, the entrance and departure of large fishing boats is not possible.

② Presently landing jetties are installed on both sides of the canal but when there are many ships in port or when fishing boats berth on both banks, it is so narrow as to make traffic almost impossible.

③ Since there are no fishery related facilities such as refrigerating facilities or ice making facilities, not only ice, but also fishery materials and equipment, food, daily necessities, and supplies must be procured from somewhere else.

## 1.3 The Future Social and Economic Conditions in the Project Area

### (1) Estimating the Socio-economic Frame

The population of Perlis State in 2000 is estimated at 229,200, and its GDP at M$987,800,000.

### (2) The Prospects for Industry

#### 1) Perlis State

Agriculture

In the MADA area, Muda Phase II is now in progress, while in the rest of the State, the "Perlis Integrated Agricultural Development Project" is being carried out.

Mining

Quarried stone, sand and phosphate rocks are expected to be closely involved in port activities.

Fisheries

Fisheries production has been growing at a rapid pace up to now, but it will be very difficult to continue this due to limited fishing resources.

The fishing grounds of Perlis State are the same as those of Kedah State, and as they cover only a rather narrow and limited sea area, deep sea fishing has to be developed.

Perlis State is a fish supply base but as the State itself consumes only a small amount, the market is mainly influenced by the trends of demands in the big cities in the south.

Manufacturing

The major factories that will make use of the port facilities are the CIMA cement factory, the FELDA sugar factory, some cement product factories and some wood product factories.

2) The Development of Langkawi Island

A large-scale resort development plan has been drawn up for Langkawi Island and is named the "Langkawi Tourist Resort Concept Plan". With the advance of resort development, ferry passengers between Perlis State and Langkawi Island will increase.

3) Thailand

Passengers and cargoes between Thailand and Perlis State will increase in the future.

## 2. The Basic Plan for Port Development

### 2.1 The Basic Policy of the Perlis Port Plan

#### (1) Considerations about Port Development in Perlis State

The following basic considerations have been taken up in the study of port development in Perlis State.

① To maximize the impact of port development on regional development.

② To select which port functions should be developed, in light of the geographic and socio-economic characteristics of Perlis State.

③ To allocate the port functions for further development among the ports in Perlis State.

④ To pursue port development in stages so that it keeps pace with the maturity of overall regional development.

⑤ To evaluate the effect of port development not only from the economic viewpoint but also from the social viewpoint.

#### (2) The Expected Port Functions in Perlis State

It is proper that the port functions to be developed in Perlis State are determined from the geographical relationships with the surrounding ports, the way functions are shared between these ports, the scale of these functions, and the industrial activities within the state. From this point of view, the development of an international port in Perlis State is not considered, and due to the limited size of its hinterland there is a low possibility of development for domestic trade. Therefore future port expansion will be mainly related to the industrial activities in the state.

On the basis of the above, a list of port functions is given below.

A. The existing functions which must be continued or developed.

① Fishery port functions

② Passenger transportation base

③ Base for trade with Thailand

B. Additional functions to be expected in the future.

④ Base for cargo transport to Langkawi Island.

⑤ Base for transporting raw materials to, and products from, factories
⑥ Ship repair

## 2.2 The Proposed Scale of Port Development

### (1) The Forecasting of Port Demands

1) The estimation of Fish Handling Volume and Number of Fishing Boats

The future fish handling volumes are estimated as shown in Table 1.

Table 1 Estimation of Fish Handling Volumes

(Unit: tons)

| Year | Landing by local fishing boats | Landing by Thai fishing boats | Total |
|---|---|---|---|
| 1982 | 31,720 | 40,000 | 71,720 |
| 1990 | 46,820 | 46,800 | 93,620 |
| 2000 | 46,820 | 50,000 | 96,820 |

The increase over the 1982 volume must be handled at new port facilities, because present handling volume is already in excess of the handling capacity of the existing facilities.

The numbers of fishing boats in Perlis State are estimated as shown in Table 2, based on past trends. The number of boats smaller than 25 G/T is assumed to decrease, while that of boats larger than 25 G/T to increase.

Table 2 Estimation of the Number of Fishing Boats by Type

| Year | Non-powered | Outboard powered | Inboard powered | | | | Total |
|---|---|---|---|---|---|---|---|
| | | | Below 10 G/T | 10 ~ 25 G/T | 25 ~ 40 G/T | Above 40 G/T | |
| 1982 | 18 | 163 | 176 | 183 | 80 | 44 | 664 |
| 1990 | 5 | 50 | 120 | 150 | 100 | 45 | 470 |
| 2000 | 5 | 30 | 120 | 150 | 110 | 60 | 475 |

2) Estimates of the Cargo and Passenger Volume

The cargo volume and the number of passengers are estimated according to the regional development plans affecting the State, the expansion plans of major factories and the forecasts of future social and economic conditions, as shown in Table 3.

3) The Factories on the Reclaimed Land

The type and size of factories on the reclaimed land are estimated as shown in Table 4.

## Table 3 Estimation of Cargo Volume and Passengers Handled at Kuala Perlis Port

| | | | Year 1990 | | | | | | | Year 2000 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Total | Foreign | | | Domestic | | | Total | Foreign | | | Domestic | | |
| | | | | Total | Export | Import | Total | Outbound | Inbound | | Total | Export | Import | Total | Outbound | Inbound |
| Cargo (ton) | Perlis State | Rice | 41,000 | | | 33,000 | | 8,000 | | 41,000 | 33,000 | | 33,000 | 8,000 | 8,000 | |
| | | Wood | 5,000 | | | 5,000 | | | | 10,000 | 10,000 | | 10,000 | | | |
| | | Coal | 108,000 | | | | | | 108,000 | 162,000 | | | | 162,000 | | 162,000 |
| | | Phosphate | 6,000 | | | | | 6,000 | | 6,000 | | | | 6,000 | 6,000 | |
| | | Cement | 150,000 | | | | | 150,000 | | 250,000 | | | | 250,000 | 250,000 | |
| | | Cement product | 8,000 | | | | | 8,000 | | 17,000 | | | | 17,000 | 17,000 | |
| | | Petroleum | 25,000 | | | | | | 25,000 | 30,000 | | | | 30,000 | | 30,000 |
| | | Raw sugar | 21,000 | | | 21,000 | | | | 21,000 | 21,000 | | 21,000 | | | |
| | | Total | 364,000 | 59,000 | | 59,000 | 305,000 | 172,000 | 133,000 | 537,000 | 64,000 | | 64,000 | 473,000 | 281,000 | 192,000 |
| | Perlis-Langkawi line | | 41,000 | | | | 41,000 | 31,000 | 10,000 | 109,000 | | | | 109,000 | 82,000 | 27,000 |
| | Perlis-Thailand line | | 96,000 | 96,000 | 9,000 | 87,000 | | | | 189,000 | 189,000 | 17,000 | 172,000 | | | |
| | Total | | 501,000 | 155,000 | 9,000 | 146,000 | 346,000 | 203,000 | 143,000 | 835,000 | 253,000 | 17,000 | 236,000 | 582,000 | 363,000 | 219,000 |
| Passenger (person) | Perlis-Langkawi line | | 500,000 | | | | 500,000 | | | 800,000 | | | | 800,000 | | |
| | Perlis-Thailand line | | 500,000 | 500,000 | | | | | | 1,000,000 | 1,000,000 | | | | | |
| | Total | | 1,000,000 | 500,000 | | | 500,000 | | | 1,800,000 | 1,000,000 | | | 800,000 | | |

Table 4 Factories on the Reclaimed Land

| Industry Types | [1]Value of Output (M$ thousands) | | Employee (person) | | Area (ha) | | Port Cargo | Number of Factories |
|---|---|---|---|---|---|---|---|---|
| | 1990 | 2000 | 1990 | 2000 | 1990 | 2000 | | |
| Marine products | | | 50 | 80 | 0.5 | 1 | | 1 |
| Breed food | | 4,500 | | 16 | | 0.5 | | 1 |
| Sawing | 3,000 | 6,000 | 40 | 80 | 4 | 8 | ○ | 2 |
| Paper board | | 6,600 | | 40 | | 1 | | 1 |
| Cement products | 400 | 800 | 30 | 60 | 4 | 8 | ○ | 1 |
| Fertilizer | 1,000 | 1,000 | 20 | 20 | 1 | 1 | ○ | 2 |
| Auto repair shop | 300 | 1,000 | 15 | 50 | 0.2 | 1 | | 1 |
| Total | 4,700 | 19,900 | 140 | 296 | 9.7 | 20.5 | | 9 |

Note 1): price in year 1980

(2) The Required Sizes for the Facilities

The required sizes for the fishing port facilities are calculated on the basis of the estimated fish landing volume and number of fishing boats in the planned target years.

The required sizes of the commercial port facilities and the industrial area are calculated so as to meet the future port demands.

The results of these calculations are as shown in Table 5.

Table 5 The Minimum Required Sizes for the Port Facilities in the Target Years

| Functions | Facilities | Minimum Required Size of Facilities | | Remarks |
|---|---|---|---|---|
| | | Up to 1990 | Up to 2000 | |
| Commercial Port Facilities | | | | |
| Passenger Wharf | Berthing Facilities | Pontoon 2 units | Pontoon 2 units | Pontoon: length 30 m, width 10 m |
| | Passenger Terminal | 304 m² x 2 places | 304 m² x 2 places | One for Langkawi route, the other for Thai route |
| Vehicular Ferry Wharf | Berthing Facilities | length 40 m, water depth 3.5 m | length 40 m, water depth 3.5 m | with a access bridge |
| | Parking Area | 768 m² | 768 m² | |
| Cargo Wharf | Berthing Facilities | length 371 m, water depth 4 m | length 647 m, water depth 5.5 m | |
| | Warehouse | 3,630 m² | 3,630 m² | |
| | Open Storage | 11,280 m² | 17,892 m² | |
| | Cement Silo | 2,500 m² | 4,000 m² | Storage capacity: 8,000 tons (1990), 13,000 tons (2000) |
| | | 2 | 2 | |
| | Oil Tank | 2,000 m² | 2,000 m² | Storage capacity: 1,300 kℓ (1990), 1,500 kℓ (2000) |
| Fishing Port Facilities | Berthing Facilities | length 80 m, water depth 3 m | length 88 m, water depth 3 m | |
| | Fish Market | 1,019 m² | 1,157 m² | Daily handling volume 88 tons (1990) 100 tons (2000) |
| | Ice Making Facilities | 160 m² | 175 m² | Automatic ice machine 75 tons/day |
| | Ice Storage | 130 m² | 150 m² | Capacity; 150 tons (1990), 200 tons (2000) |
| | Cold Storage | 87 m² | 87 m² | Capacity: 100 tons |
| | Freezer | 19 m² | 19 m² | 20 tons capacity |
| | Water Supply Facilities | 200 tons tank | 200 tons tank | |
| | Oil Tank | 50 kℓ | 50 kℓ | |
| | Sewage Disposal Facilities | 140 m² | 140 m² | Capacity of disposition 100 m³/day |
| | Others | 1,615 m² | 1,615 m² | Office, Parking area, Warehouse, etc. |
| | Dock Yard Facilities | 9,377 m² | 9,377 m² | |
| Industrial Area | | 97,000 m² | 205,000 m² | |

## 2.3 The Evaluation and Selection of a Port Development Site

### (1) The Socio-economic Evaluation of the Proposed Development Sites

The socio-economic evaluation was a comparative study of the suitability of both sites, Kuala Perlis Port and Kuala Sanglang Port, with regard to the 6 port functions planned for ports in Perlis State. It became clear that from the socio-economic viewpoint Kuala Perlis Port is superior in regard to all 6 functions (see Table 6).

Table 6 The Socio-economic Evaluation of the Proposed Development Sites

| Type of port functions | Evaluation items | Comparative evaluation | |
|---|---|---|---|
| | | K. Perlis Port | K. Sanglang Port |
| Fishery port functions | Exsisting fishery activities | O | |
| | Accumulation of facilities and business functions | O | |
| | Distance from fishing areas | O | |
| | Distance to consumer area | | O |
| Passenger transportation base | Purpose of travel | O | |
| | Distance by sea | O | |
| | Distance from port of passenger origins and destinations | O | |
| Base for trade with Thailand | Distance by sea | O | |
| | Distance from port of cargo origins and destinations | O | |
| Base for cargo transportation to Langkawi Island | Distances | O | O |
| | Other causes for site selection | O | |
| Base for transportation raw materials and products to and from the factories | Distance from factory to port | O | |
| | Possibility of development of an industrial estate | O | |
| Ship repair | Convenience for users | O | |

Note: 'O' denotes superiority in the case of difference between the two sites and in case of no difference the 'O' mark is given to both sites.

### (2) The Technical Evaluation of the Relevant Natural Conditions of the Proposed Development Sites

The technical evaluation was a comparative study of both sites examining the effects of natural conditions upon port construction. It was found that Kuala Perlis Port has somewhat superior wave and soil conditions but that Kuala Sanglang Port has better topographical conditions. No significant difference is noted for the maintenance of waterways. However, Kuala Perlis Port is superior from an overall technical viewpoint (see Table 7).

Table 7 The Technical Evaluation of the Proposed Development Sites

| Items of natural conditions | Evaluation items | Comparative evaluation | |
|---|---|---|---|
| | | K. Perlis Port | K. Sanglang Port |
| Geographical features | Procurement of land on the coast | O | O |
| | Slope of seabed (water depth) | | O |
| Wave conditions | Design wave height | O | |
| | Calmness | O | |
| Soil conditions | Stability of structures | O | |
| Maintenance of navigation channel | Rate of deposition | O | |
| | Amount of maintenance dredging | | O |

Note: 'O' denotes superiority in the case of difference between the two sites and in case of no difference the 'O' mark is given to both sites.

(3) Setting Up the Alternative Port Development Plans

Three alternative plans for port development in Perlis State were set up as shown in Table 8, based on the difference in allotment of port functions to the two proposed sites and the variation of the means to secure the approach of ships to the wharves.

Table 8 Alternative Plans for Port Development in Perlis State

| Plan | Allotment of port functions | Means to secure the ship's approach to the wharves |
|---|---|---|
| A | Concentration of all port functions at K. Perlis Port | K. Perlis Port ........... Maintenance dredging plan |
| B-1 | Dispersion of port functions among K. Perlis Port and K. Sanglang Port (Allotting cargo wharf and industrial area to K. Sanglang Port) | K. Perlis Port ........... Maintenance dredging plan<br>K. Sanglang Port ...... Maintenance dredging plan |
| B-2 | | K. Perlis Port ........... Maintenance dredging plan<br>K. Sanglang Port ...... Trestle plan |

The port facilities layout plans (target year 2000) for each alternative plan are shown as Plan A, Plan B-1 and Plan B-2 in Fig. 1, Fig. 2 and Fig. 3 respectively.

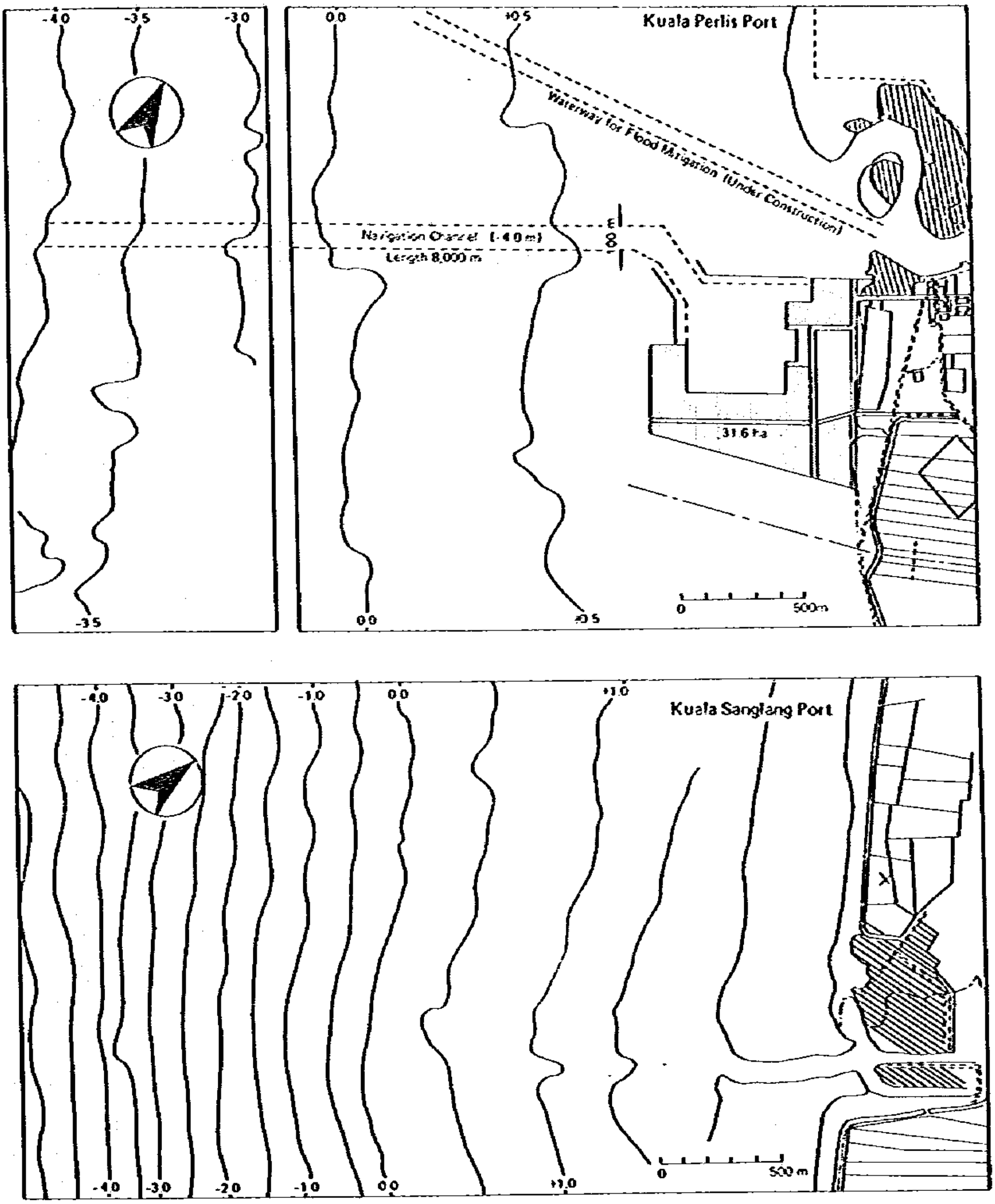



Fig. 1. Alternative Plan (Plan A)

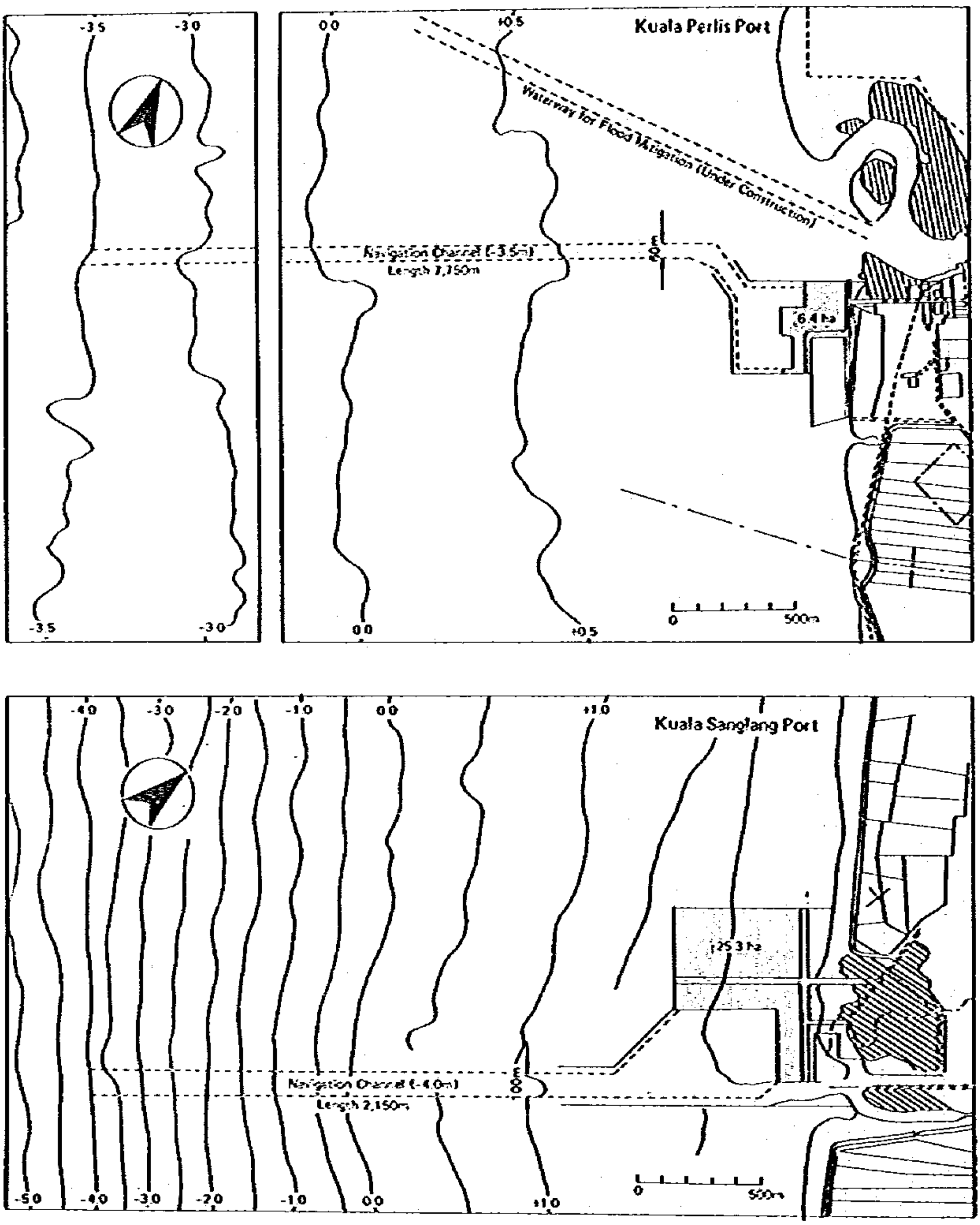



**Fig. 2 Alternative Plan (Plan B-1)**

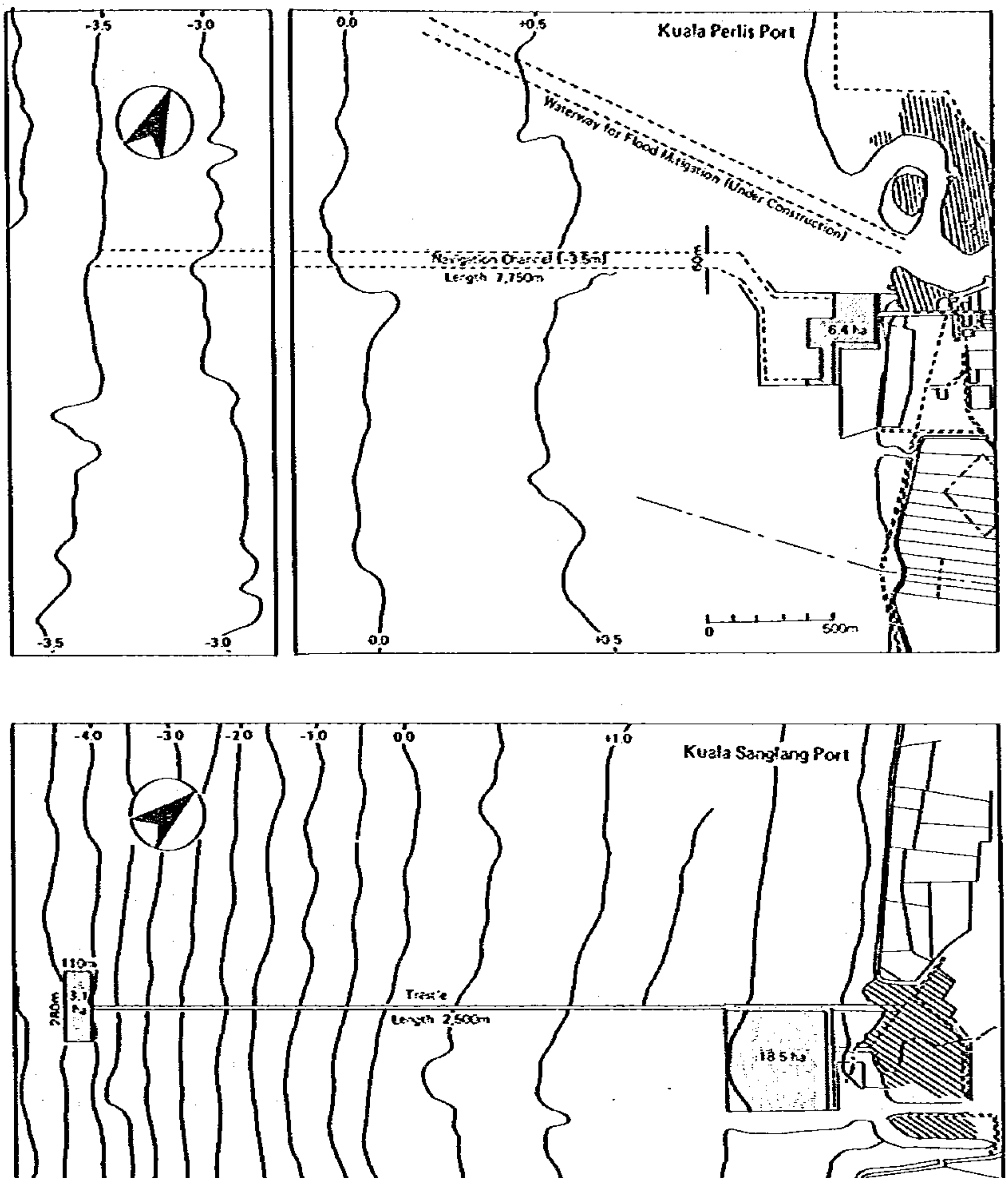



**Fig. 3 Alternative Plan (Plan B-2)**

(4) The Selection of the Optimum Plan

In order to select the optimum plan from among the alternatives, a comparative study was made from the viewpoints of minimizing the construction costs, effective port development and urban development strategy.

① Minimizing the Construction Costs

In order to compare the costs, total initial investment and maintenance investment, the total cost over the 25 year life span of the trestle was calculated and the ratios of the total costs are shown in Table 9.

Table 9 The Comparison of Alternative Plan Construction Costs

| Plan | Rate of deposition | |
|---|---|---|
| | 60 cm/year | 100 cm/year |
| A | 100 | 100 |
| B-1 | 110 | 107 |
| B-2 | 161 | 146 |

From the results of this comparison, it is learned that Plan A is the cheapest and is superior from the viewpoint of reducing the initial investment as much as possible.

② Effective Port Development

When carrying out development of small ports such as the port development in Perlis State, the common use of basic facilities to serve multiple functions will make better overall use of the development resources.

In this sense, it is desirable to concentrate functions on Kuala Perlis Port where the fishery and passenger transport functions are already developed to some extent.

③ Urban Development Strategy

In developing Perlis State, it is desirable to concentrate efforts to build Kanger into a nuclear city and expand its services over wider areas.

Considering this, port development, as well, should not be diversified into several places but be concentrated on Kuala Perlis Port in order to realize its role as a motivating force for regional development.

Overall consideration of the above evaluations led to selecting Plan A as the optimum plan, and Plan A was determined as the basic port facilities layout plan of the master plan for port development in Perlis State.

## 2.4 The Master Plan

### (1) The Port Facilities Layout Plan

The master plan shown in Fig. 4 was drawn up based on Plan A as augmented by further technical considerations, relating to the alignment of the navigation channel, the location of the entrance to the port, the water area use plan within the port and the layout of training walls.

### (2) The Construction Plan

The construction plan shall be executed in gradual stages. First is the short term development plan, second is the additional part which will start from 1991. Total amount of estimated construction cost is M$67,934,000.

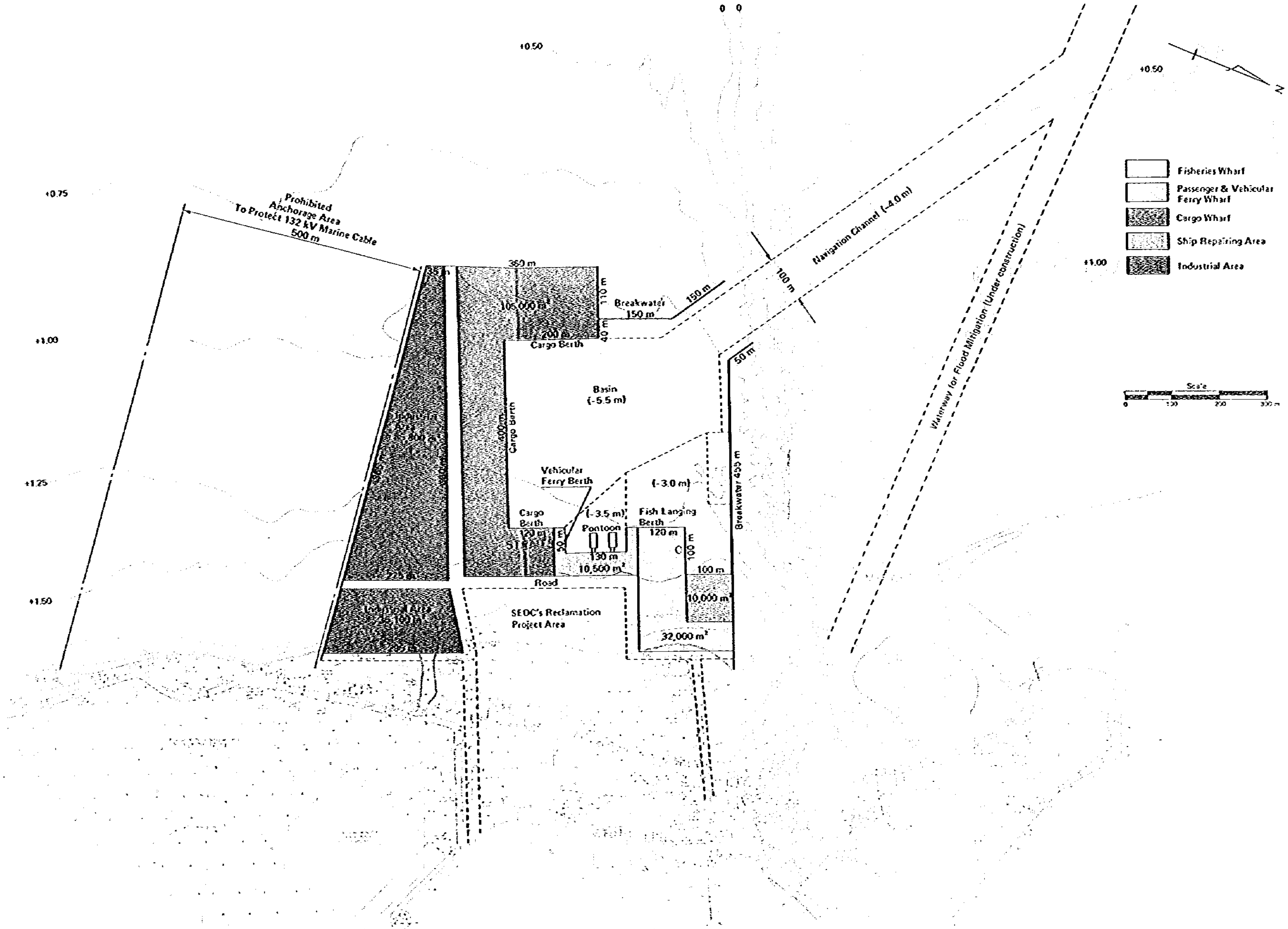



Fig. 4 Master Plan

## 3. The Short Term Development Plan

### 3.1 The Port Facilities Layout Plan

This project has the character of new port development, planned where there is no existing port function, and it is difficult to forecast when the next stage of the master plan will be implemented.

Thus the short term development plan (target year 1990) which, in the case of Kuala Perlis Port, is regarded as the first stage of the master plan, should be prepared to efficiently and safely cope with future port demands.

The port facilities layout plan of the short term development plan, based on the above considerations, is as shown in Fig. 5 and the proposed scale is as shown in Table 10.

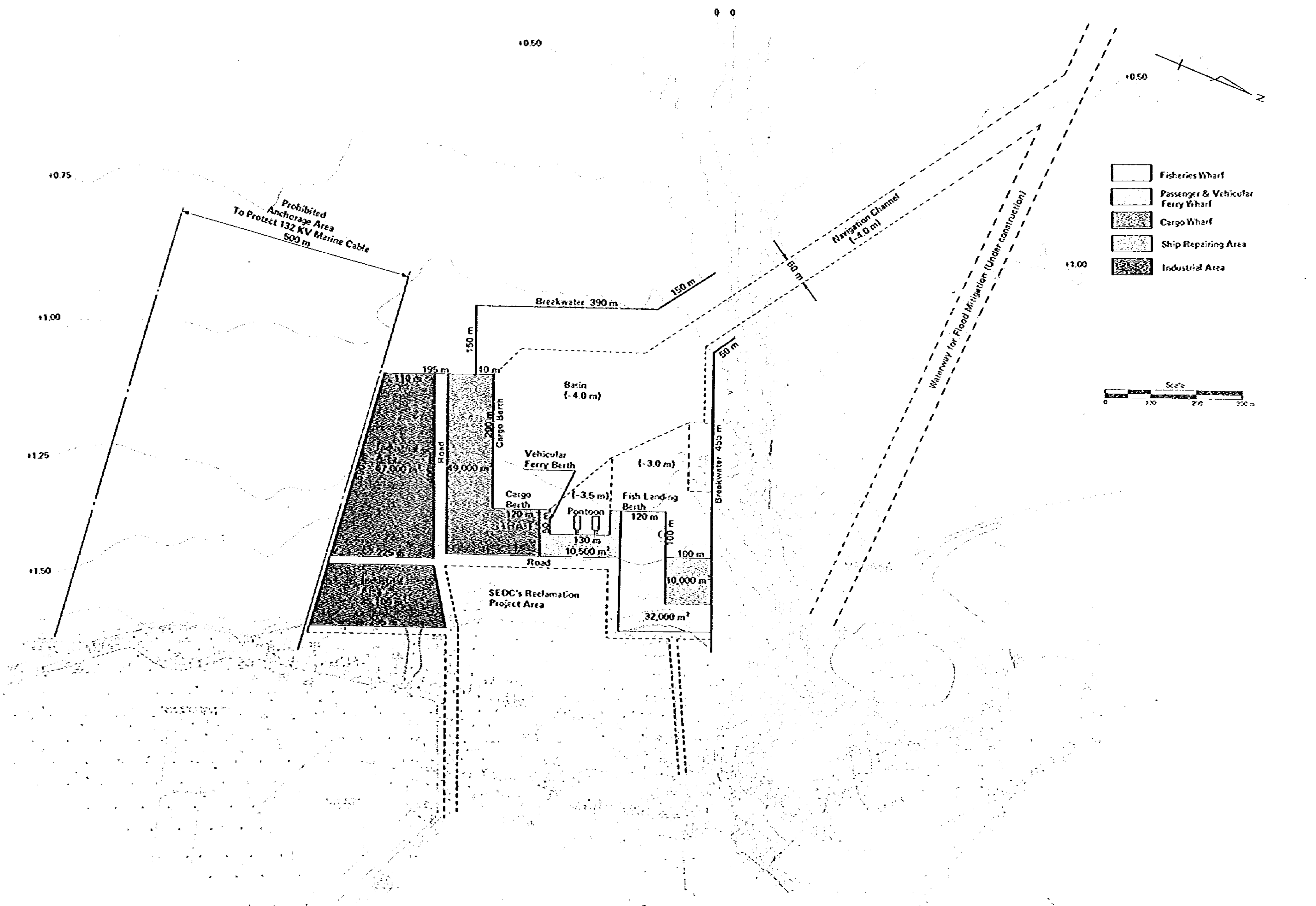



Fig. 5 Short Term Development Plan

Table 10 The Proposed Scale of the Short Term Development Plan

| | Items | Planned Scale |
|---|---|---|
| Port Facilities | Waterway | length 970 m, width 60 m, water depth 4.0 m |
| | Basin | area 180,600 $m^2$, water depth 3.0 ~ 4.0 m |
| | Breakwater | length 1,195 m |
| | Groin | length 1,000 m |
| | Berthing Facility | |
| | Fish Landing Berth | length 150 m, water depth 3.0 m |
| | Vehicular Ferry Berth | length 50 m, water depth 3.5 m |
| | Passenger Berth | pontoon (length 30 m, width 10 m) 2 units, water depth 3 m |
| | Cargo Handling Berth | length 410 m, water depth 4.0 m (tentative) |
| Land Use | Fishing Port Area | 32,000 $m^2$ |
| | Dockyard Area | 10,000 $m^2$ |
| | Passenger & Vehicular Ferry Terminal | 10,500 $m^2$ |
| | Cargo Handling Area | 49,000 $m^2$ |
| | Road | 51,950 $m^2$ |
| | Industrial Area | 102,100 $m^2$ |
| | Total | 255,550 $m^2$ |

### 3.2 The Construction Plan

#### (1) The Design of Berth Structures

For the cargo handling wharf, the following three alternative plans are compared with one another.

Alternative Plan A: Sheet Pile Type Quaywall
" B: Open Type Wharf with Vertical Piles
" C: L – Shaped Concrete Block Type Quaywall

As a result of comparing the economy and workability of these three plans (see Table 11), it has been decided to adopt the Alternative Plan A (Sheet Pipe Type Quaywall).

In order to prevent large waves and silt or mud from entering the basin, breakwaters consisting of rock banks, timber mats and vinyl plastic nets are to be constructed around the basin.

Heavy and/or important buildings and factories are to be supported by pile foundations in order to cope with the ground settlement, especially in the relaimed area.

#### (2) The Construction Plan and the Cost Estimation

The construction period is three and half years, from 1985 to 1988, including the engineering study period. The total construction cost is estimated at M$51,267,000, of which M$25,445,000 is foreign currency, and the rest (M$25,822,000) is local currency.

Table 11 Comparison of Economy and Workability

| Item \ Type | Plan A<br>Sheet pile type quaywall | Plan B<br>Open type wharf with vertical piles | Plan C<br>L-Shaped block type quaywall |
|---|---|---|---|
| Large construction craft | Pile driving crane<br>Sand compaction crane<br>Pump dredger | Pile driving barge<br>Sand compaction barge<br>Pump dredger | Floating dock<br>Sand compaction barge<br>Pump dredger |
| Workability | Very easy | Easy | Not so easy |
| Construction control | Very easy | Very easy | Not so easy |
| Amount of work | Small | Much | Much |
| Adaptability to change in ground | Good | Good | Adaptable |
| Requirement of corrosion prevention | Required | Required | Not required |
| Dredging volume ($m^3/m$) | 0 | 60 | 210 |
| Construction cost ratio (Plan A = 1.00) | 1.00 | 1.33 | 1.47 |

**Table 12 Construction Schedule of Short Term Development Plan**

| Item | | | 1985 | | 1986 | | | | 1987 | | | | 1988 | | | | 1989 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Description | Unit | Quantity | 9 | 12 | 3 | 6 | 9 | 12 | 3 | 6 | 9 | 12 | 3 | 6 | 9 | 12 | 13 | 6 | 9 | 12 |
| Engineering Study | L.S. | 1 | | | | | | | | | | | | | | | | | | |
| Mobilization/Demobilization | L.S. | 1 | | | | | | | | | | | | | | | | | | |
| Quaywall -4.0 m | m | 410 | | | | | | | | | | | | | | | | | | |
| -3.5 m | m | 550 | | | | | | | | | | | | | | | | | | |
| Sheet Pile | | | | | | | | | | | | | | | | | | | | |
| Sand Compaction Pile | | | | | | | | | | | | | | | | | | | | |
| Others | | | | | | | | | | | | | | | | | | | | |
| Dredging | | | | | | | | | | | | | | | | | | | | |
| Channel | $m^3$ | 497,210 | | | | | | | | | | | | | | | | | | |
| Basin | $m^3$ | 915,130 | | | | | | | | | | | | | | | | | | |
| Reclamation | | | | | | | | | | | | | | | | | | | | |
| Port Area | $m^3$ | 592,880 | | | | | | | | | | | | | | | | | | |
| Industrial Area | $m^3$ | 494,550 | | | | | | | | | | | | | | | | | | |
| Revetment | | | | | | | | | | | | | | | | | | | | |
| Port Area | m | 300 | | | | | | | | | | | | | | | | | | |
| Industrial Area | m | 700 | | | | | | | | | | | | | | | | | | |
| Breakwater | m | 1,195 | | | | | | | | | | | | | | | | | | |
| Facilities of Fishery | L.S. | 1 | | | | | | | | | | | | | | | | | | |
| Ship Repairing Facilities | L.S. | 1 | | | | | | | | | | | | | | | | | | |
| Pontoon | Set | 2 | | | | | | | | | | | | | | | | | | |
| Facilities of Car Ferry | L.S. | 1 | | | | | | | | | | | | | | | | | | |
| Tank, Oil Supply | L.S. | 1 | | | | | | | | | | | | | | | | | | |
| Office | L.S. | 1 | | | | | | | | | | | | | | | | | | |
| Road | | | | | | | | | | | | | | | | | | | | |
| Port Area | $m^2$ | 44,150 | | | | | | | | | | | | | | | | | | |
| Industrial Area | $m^2$ | 7,800 | | | | | | | | | | | | | | | | | | |

Table 13 Construction Cost of Short Term Development Plan

| Item | Unit | Quantity | Unit Price (M$) | F/C (M$ $10^3$) | L/C (M$ $10^3$) | Total (M$ $10^3$) |
|---|---|---|---|---|---|---|
| Mobilization/Demobilization | L.S. | 1 | | 416 | 422 | 838 |
| Quaywall (-4.0 m) | m | 410 | 15,927.0 | 4,320 | 2,210 | 6,530 |
| 〃 (-3.5 m) | m | 550 | 14,517.0 | 5,252 | 2,732 | 7,984 |
| Dredging (Channel) | $m^3$ | 497,210 | 3.5 | 1,193 | 547 | 1,740 |
| 〃 (Basin) | $m^3$ | 915,130 | 3.5 | 2,196 | 1,007 | 3,203 |
| Reclamation (Port Area) | $m^3$ | 592,880 | 8.5 | 771 | 4,268 | 5,039 |
| 〃 (Industrial Area) | $m^3$ | 494,550 | 8.5 | 643 | 3,561 | 4,204 |
| Revetment (Port Area) | m | 300 | 354.1 | 16 | 90 | 106 |
| 〃 (Industrial Area) | m | 700 | 354.1 | 37 | 211 | 248 |
| Breakwater | m | 1,195 | 947.5 | 170 | 962 | 1,132 |
| Road (Port Area) | $m^2$ | 44,150 | 25.0 | 110 | 994 | 1,104 |
| 〃 (Industrial Area) | $m^2$ | 7,800 | 25.0 | 20 | 175 | 195 |
| Facilities of Fishery | L.S. | 1 | | 3,900 | 2,100 | 6,000 |
| Ship Repairing Facilities | L.S. | 1 | | 360 | 440 | 800 |
| Pontoon | Set | 2 | 400,000.0 | 360 | 440 | 800 |
| Facilities of Car Ferry | L.S. | 1 | | 600 | 400 | 1,000 |
| Tank Oil Supply | L.S. | 1 | | 600 | 400 | 1,000 |
| Office | L.S. | 1 | | 240 | 560 | 800 |
| Sub Total | | | | 21,204 | 21,519 | 42,723 |
| Engineering Study | | | | 1,060 | 1,076 | 2,136 |
| Contingency | | | | 3,181 | 3,227 | 6,408 |
| Sub Total | | | | 4,241 | 4,303 | 8,544 |
| G. Total | | | | 25,445 | 25,822 | 51,267 |
| Port Area (Construction Cost) | | | | 20,490 | 17,493 | 37,983 |
| 〃 (E/S, Cont.) | | | | 4,098 | 3,498 | 7,596 |
| Total | | | | 24,588 | 20,991 | 45,579 |
| Industrial Area (Construction Cost) | | | | 714 | 4,026 | 4,740 |
| 〃 (E/S, Cont.) | | | | 143 | 805 | 948 |
| Total | | | | 857 | 4,831 | 5,688 |

F/C : Foreign Currency L/C : Local Currency E/S : Engineering Service

### 3.3 Port Administration and Management

From the results of considerations about the character of Kuala Perlis Port, it was proposed to establish a Port Management Body to administer and manage the fishing port and the commercial port together.

The organization chart of the proposed Port Management Body is shown in Fig. 6.

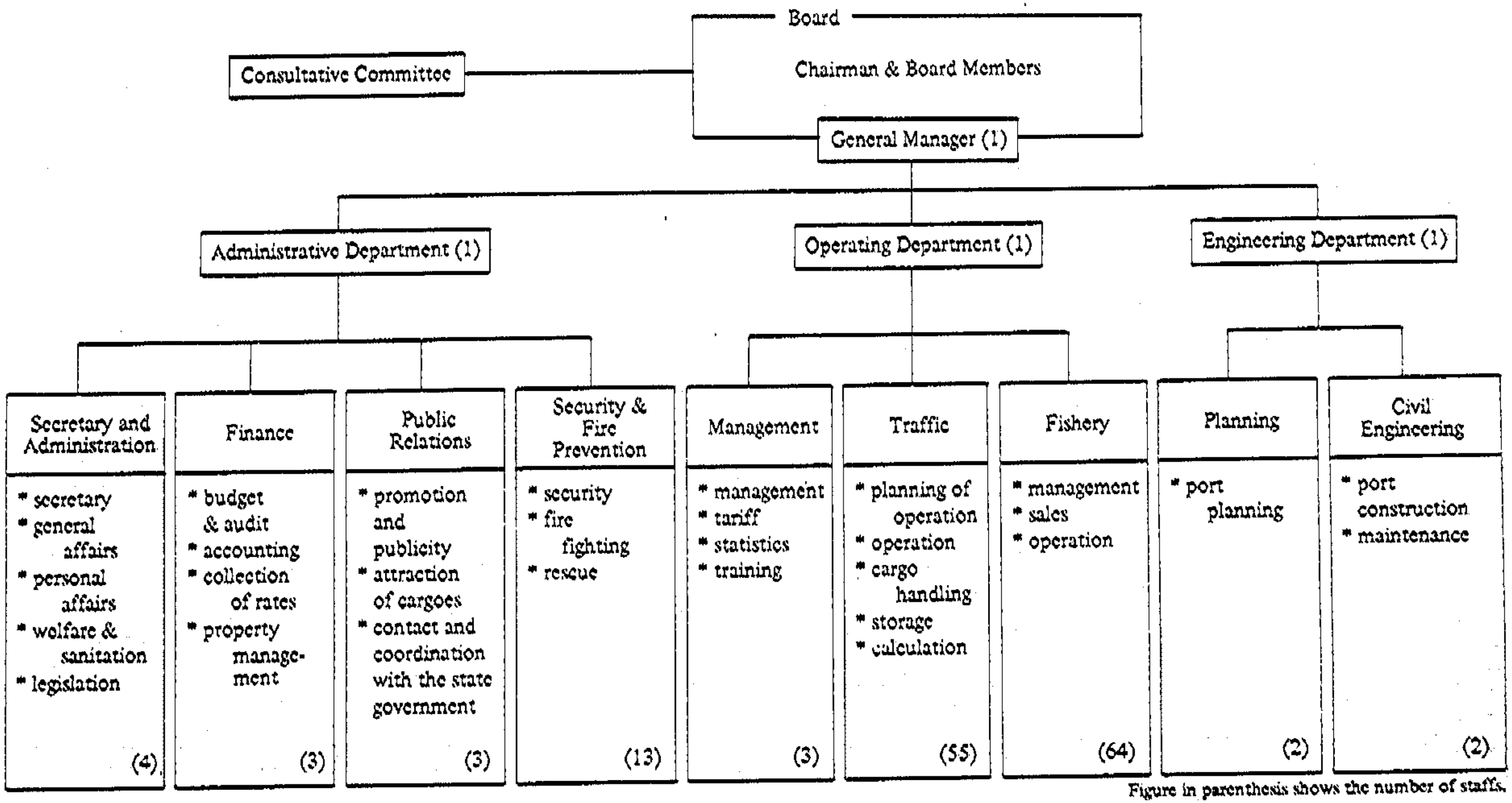



Figure in parenthesis shows the number of staffs.

Fig. 6 Organization Chart of Port Management Body

## 3.4 The Economic Analysis

### (1) The Methods

The method of the economic analysis is as follows:

① Market pricing is generally employed to evaluate all the costs and the benefits.

② The alternative to which the plan is compared is the "WITHOUT" case, or the case without any investment.

③ The economic returns are evaluated through an internal rate of return (I.R.R.).

④ Calculation of the I.R.R. is carried out over the 29 years starting from 1985, the first year of the investment.
The average service life of the facilities/equipment is 25 years.

### (2) The Benefits

The following benefits of this plan are quantitatively analyzed:

① Reduction of transportation cost for port cargoes.

② Benefit of increase of fish handling volume.

③ Improvement in the freshness of fish through increasing the supply of ice and through technical innovation.

④ Benefits due to ship repair facilities.

⑤ Creation of added asset value through reclamation for the industrial estate.

⑥ Increasing employment oppotunities.

### (3) The Cost

The costs of the plan are as follows:

① Construction cost (including equipment cost)

② Operation and maintenance costs

### (4) The Economic Evaluation

Economic analysis of the short term development plan shows that the economic internal rate of return (I.R.R.) is 9.9%. Considering social benefits that are not analyzed quantitatively, it can be concluded that this project is feasible.

## 3.5 The Financial Analysis

### (1) Premises

① The Kuala Perlis Port Management Body will be established at the same time as the short term development plan is finished.

② The foreign currency portion of the development investment funds is made up of long-term loans (Interest: 4.0% per annum, Term of Loan: 25 years) and the local currency portion is made up of governmental funds.

③ The accounting procedure of the Port Management Body will be made by "the self-supporting accounting system".

④ The port charges will be fixed at the level of competing ports.

(2) Revenue

The revenue consists of the following items:

① Port Dues
② Wharfage
③ Wharf Handling Charge
④ Storage Charge
⑤ Ship Repair Facilities Charge
⑥ Miscellaneous
⑦ Sales of Reclaimed Land

The revenue is calculated at M$8,812,000 in 1990, based on the cargo, fish handling, and ship traffic estimations, excluding the sales of reclaimed land.

(3) Expenditure

The expenditure consists of the following items:

① Personnel Cost
② General Administration Costs
③ Labour Costs
④ Maintenance and Operation Costs
⑤ Maintenance Dredging Cost
⑥ Raw Material Costs of Fuel-supply and Water-supply
⑦ Miscellaneous Costs
⑧ Depreciation
⑨ Interest on Loans
⑩ Tax

The annual expenditure is estimated at M$6,067,000 and the annual depreciation amount is M$1,108,000 in 1990.

(4) Comments

The financial internal rate of return (F.I.R.R.) is 4.1% in case of the maximum maintenance dredging volume and it will be possible to meet ordinary operating costs, to renew the facilities and to repay debts. We may, therefore, conclude that the Port Management Body will be financially self-supporting.

# OUTLINE OF THE STUDY

## Outline of the Study

### (1) Background

Kuala Perlis Port is located near the northwestern border of Perlis State in the northern part of the Peninsula Malaysia. Perlis State is at present one of the least developed states in the nation. Its 1980 average per capita GDP was only 60% of the national average of M$1,836.

One of the measures planned by the Malaysian government to improve these economic conditions is a regional development project to be centered around Kuala Perlis Port. As a result, it is hoped that living standards in the state are both raised and stabilized.

Kuala Perlis Port is situated at the mouth of the Perlis River. It functions as both a commercial port and a fishing port. In its role of fishing port, it is the largest in Perlis State, while it is a medium scale fishing port in the region of West Malaysia. It is the base port for approximately 2,351 fishermen, and accounts for a large portion of the 40,300 tons Perlis State fish catch (year 1982).

As a commercial port, it ranks as only a minor Malaysian port, carrying out the operation of a ferry terminal with routes that link the port with Langkawi to the west and functioning as an import/export port for trade by small ships with Thailand. The trade volume with Thailand in year 1982 amounted to approximately 55,000 tons. Langkawi Island and the area surrounding the port have mining and manufacturing industries such as cement and sugar refining. Development of industrial tracts in these areas is now in progress. In conjunction with this industrial development, it is expected that expansion of the port's commercial function will result in accelerated local and regional development. Expansion of the fishing port and ferry functions should also have positive effects.

Sanglang Port, located about 17 km south of Perlis Port is regarded as Perlis Port's competition. The present survey aims at comparing the two ports in terms of their feasibility for development as the representative port for Perlis State. The merits of both ports are also compared in terms of economics and natural conditions.

Under these circumstances, the Government of Malaysia has requested the Government of Japan to conduct a study on the Perlis Port Development Project. The Japan International Cooperation Agency organized a preliminary study team and dispached it to Malaysia in March 1983, followed in July 1983 by the full scale Study Team.

### (2) Objectives

In order to promote regional development and enhance living standards in Perlis State by means of port development, geographic and socio-economic evaluations of Kuala Perlis and Kuala Sanglang are conducted.

The study aims at formulating the Master Plan for the Perlis Port Development Project with the target year around 2000 as well as at conducting a feasibility study on the Short Term Development Plan.

(3) Major Study Items

The main items of the study are as follows:

1) Master Plan

i) To formulate basic concept for the development of the Project

ii) To forecast port traffic including commodity, passenger traffic and the annual landing of fish up to the year 2000

iii) To formulate land/water area utilization plan

iv) To formulate basic layout plan of major port facilities

v) To formulate basic layout plan of the relevant infrastructure such as access roads

vi) To make rough cost estimation for the plan

2) Short Term Development Plan

i) To forecast port traffic including commodity/passenger and the annual landing of fish up to the target year

ii) To formulate the short term development plan

iii) To make preliminary design, implementation plan and cost estimation of the port facilities

vi) To conduct economic analysis of the short term development plan

v) To conduct financial analysis of the short term development plan

(4) Participants in the Study

Study Team

| | | |
|---|---|---|
| Project Manager | Mr. Masao OHNO | The Overseas Coastal Area Development Institute of Japan |
| Port Planning | Mr. Hajime EGUCHI | 〃 |
| Fishery Facility Planning | Mr. Shigeo KOBAYASHI | 〃 |
| Structural Design | Mr. Mikio UEMATSU | 〃 |
| Construction and Cost Estimation | Mr. Takashi ADACHI | 〃 |
| Demand Forecast, Economic and Financial Analysis | Dr. Takeo SHIMAZAKI | 〃 |
| Natural Condition Analysis | Mr. Yutaka OCHI | 〃 |
| Natural Condition Survey | Mr. Yoshihiro HATTORI | 〃 |
| 〃 | Mr. Noriyuki YAMAMOTO | 〃 |
| Coordination | Mr. Takao KAIBARA | Japan International Cooperation Agency |
| 〃 | Mr. Akihiro MATSUMOTO | 〃 |

### (5) Organizations Visited by the Study Team

The Study Team has visited the following cities, organizations and authorities.

| City | Organization or Authority |
|---|---|
| KUALA LUMPUR | Economic Planning Unit |
| | Public Works Department |
| | Ministry of Transport |
| | Malayan Railway (KTM) |
| | Standard Industrial Research Institute of Malaysia |
| | MAJUIKAN (Malaysia Fisheries Development Authority) |
| | Ministry of Agriculture, Fisheries Dept. |
| | Tourist Development Corporation |
| | Drainage and Irrigation Dept. |
| | Meteorological Department |
| | Ministry of Defense, Department of Navy |
| | Malaysia International Shipping Corporation Berhad |
| PERLIS | Perlis State |
| | State Economic Planning Unit |
| | Public Works Department |
| | State Economic Development Corporation |
| | Marine Department |
| | District Surveyor Kangar |
| | MAJUIKAN |
| | Housing and Local Government |
| | Cement Industries of Malaysia Berhad |
| | Drainage and Irrigation Department |
| | Agricultural Dept. |
| | FELDA (Federal Land Development Authority) Sugarcane Factory |
| | Kilang Ais Majuikan |
| | Town and Country Planning Department |
| | Land Office |
| | Muda Agricultural Development Authority (MADA) |
| | Federal Agricultural Marketing Authority (FAMA) |
| | National Electricity Board |
| | Majlis Amanah Rakyat (MARA) |
| | Register and Inspector Motor Vehicle |
| | Meteorogical Department |
| | Kangar Syarikat Perdagangan Pergabungan Sdn Bhd |
| KEDAH | Marine Department |
| | Malaysian Industrial Development Authority (MIDA) |
| | National Paddy and Rice Authority |
| | Public Works Department |

| | |
|---|---|
| | Meteorological Department |
| | MAJUIKAN |
| | Ministry of Agriculture, Fisheries Dept. |
| | Geological Department |
| | MADA |
| PENANG | Penang Port Commission |
| | Marine Department |
| | Meteorological Daprtment |
| | Fisheries Research Institute |
| | Fisheris Department |
| KELANG | Kelang Port Authority |
| | Marine Department |

# CHAPTER 1

# THE PRESENT CONDITION AND FUTURE SITUATION OF THE PROJECT AREA

# 1. The Present Condition and Future Situation of the Project Area

## 1.1 The Present Condition of the Project Area

### 1.1.1 The Outline of Natural Conditions

Perlis State is situated at latitude 6°15' to 40' north of Peninsular Malaysia, which faces Malacca Strait on the west and is surrounded by Thailand on the north-west and north-east international border and Kedah State on the south-east border. The area of Perlis State is 81,053 ha (200,200 acres) which corresponds to the smallest state in Malaysia. As shown in Fig. 1.1.1., Kuala Perlis is located at the northern tip of the Perlis coast and close to the state capital of Kangar, while Kuala Sanglang is situated at the state border of Kedah at the southern end of the Perlis coast. Topographic charts of Kuala Perlis and Kuala Sanglang are illustrated in Fig. 1.1.2 and 3.

Atmospheric condition of Perlis State shows a typically tropical climate characterized by the distinct dry season and the rainy season, as well as high atmospheric temperature and humidity. Tropical depressions hardly come and squalls called Sumatras occur frequently in the rainy season. The seasonal wind are roughly classified into north-east monsoons and south-west monsoons, greatly contributing toward the climatic conditions of this area.

The topographic feature of Perlis State is comparatively flat and the alluvial plain is extensively spreaded facing Malacca Strait, where the portion elevated less than 61 meters (200 feet) high occupies about 80% of the total area as shown in Fig. 1.1.1. Mountain area along the north-east border of Thailand consists of steep range of about 500 meter high, presenting unique karst topography. The Perlis River originates from among these mountains and hills in north-west region. Tributaries of the Perlis River system covering most of Perlis State gather at Kanger and reach Malacca Strait at Kuala Perlis, meandering remarkably.

The coast from Kuala Perlis to Kuala Sanglang extends for about 20 km, forming a simple coastline with shallow nearshore zone of very gentle gradient. An extensive tidal flat becomes revealed during low tide because of a big tidal range. Material of beach consists of marine clay which is agitated easily and transported far along the coast by waves and currents. This kind of fine material creates a problem in maintaining a navigation channel for a port located at such a shallow coastal area. Beach erosion problem is also serious in most of the Perlis coast so that rock banks for shore protection are being constructed in recent years. As waves orienting to the Perlis coast are sheltered by Langkawi Island of Kedah and Terutao Island and other small islands of Thailand, the coast is free from strong swells propagation from Andaman Sea. Waves of relatively small wave height which are generated in Malacca Strait are supposed to be predominant rather than the swells.

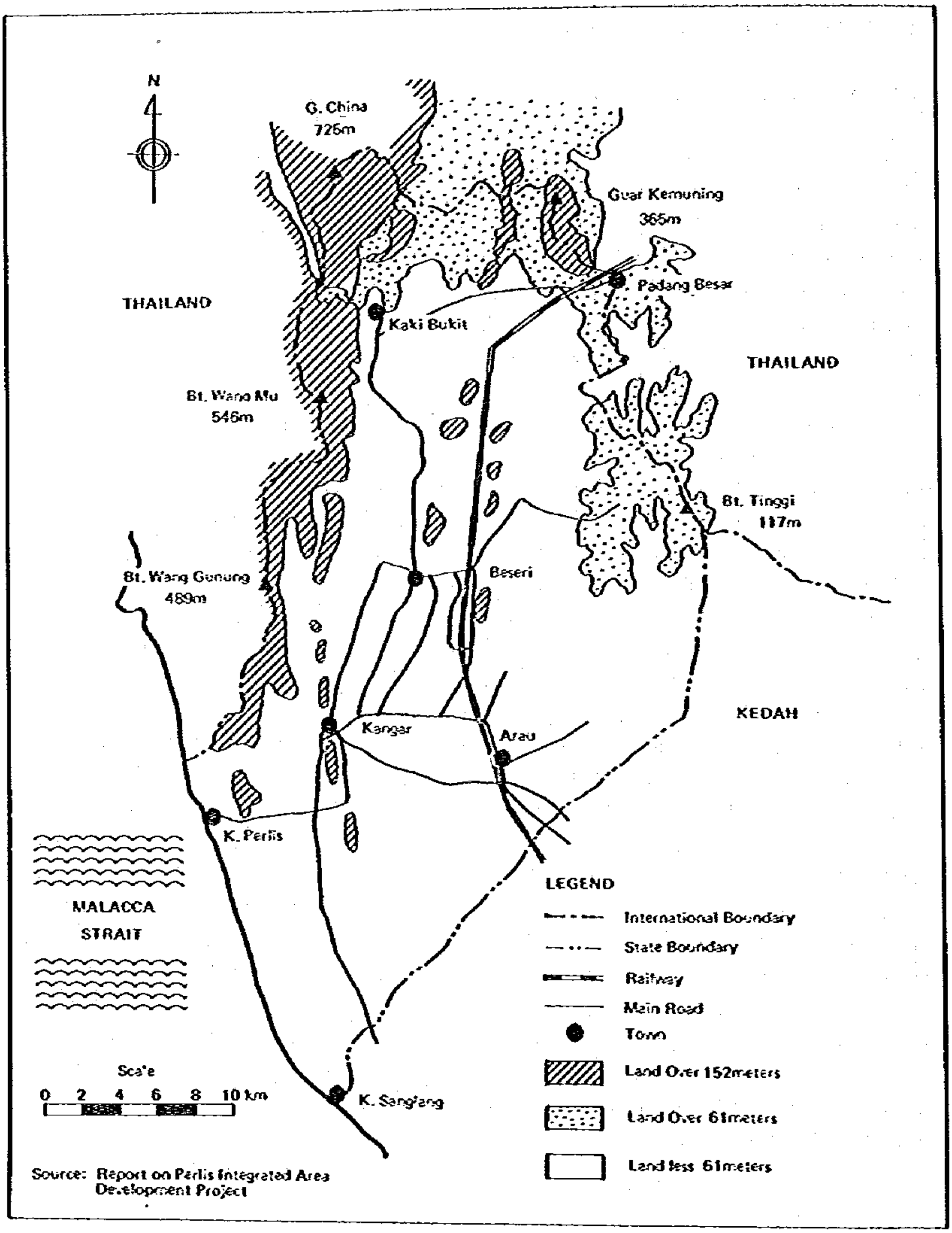



Fig. 1.1.1 Topographic Features, Perlis

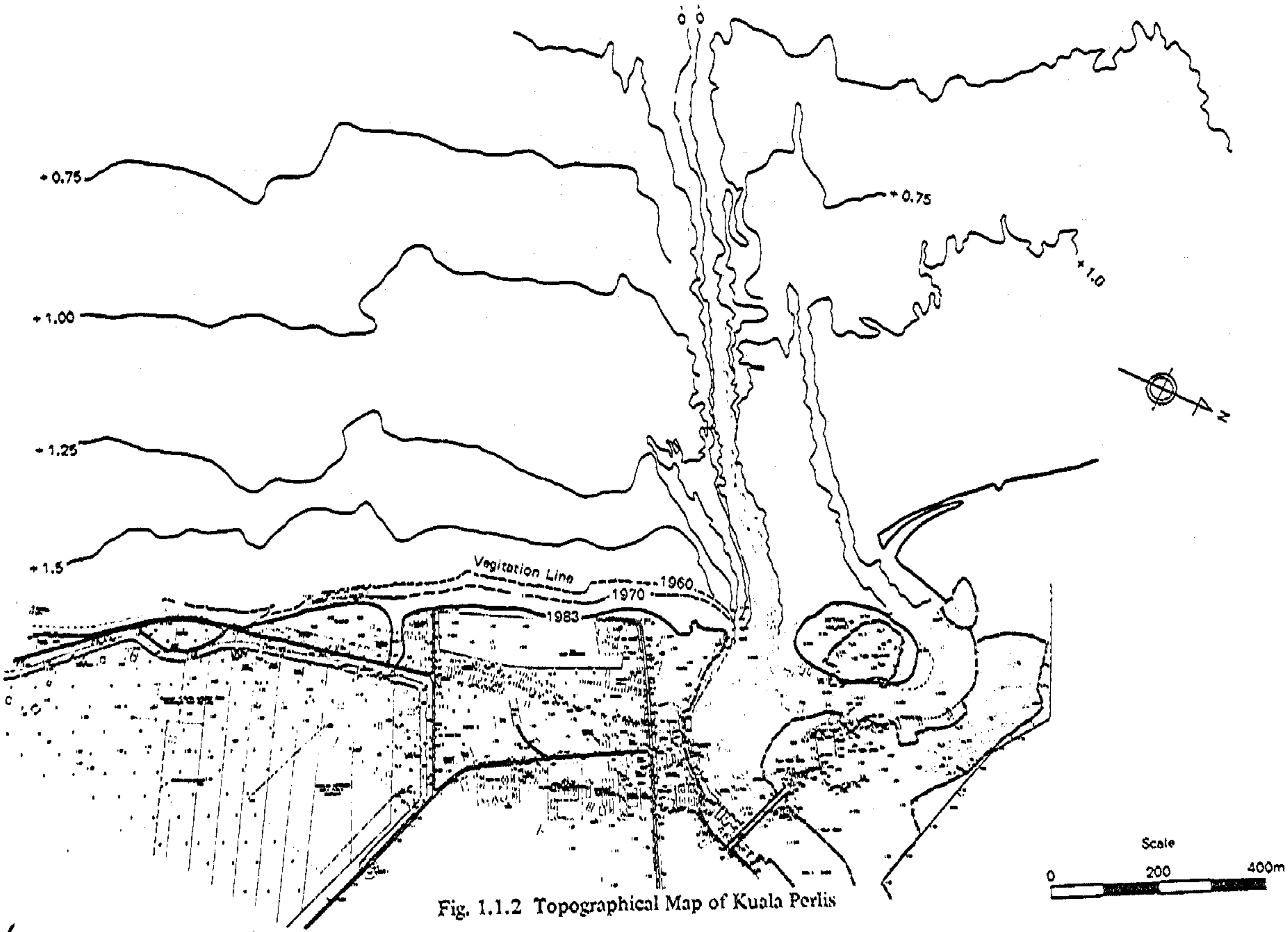



Fig. 1.1.2 Topographical Map of Kuala Perlis

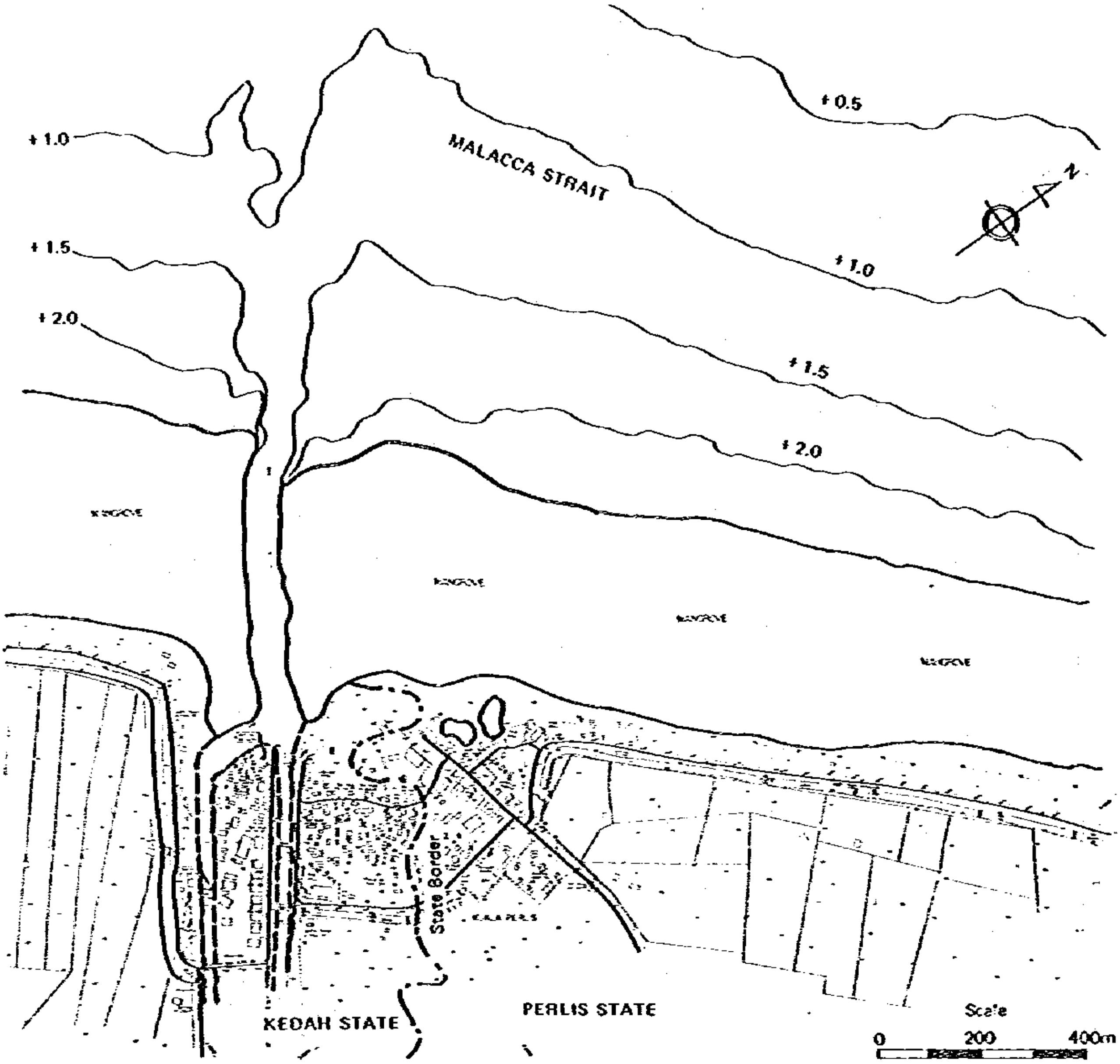



Fig. 1.1.3 Topographical Map of Kuala Sanglang

### 1.1.2 The Social and Economic Conditions

#### (1) Population

Between 1970 and 1980, the population of Perlis State grew from 121,062 to 147,726, equivalent to an annual growth of 2.01%, which is lower than that of the Malaysian National rate of 2.56%. During the same period, the percentage of the Perlis population against the Malaysian population decreased from 1.16% to 1.10%[1].

The Population of Perlis State by Mukim (Parish) is shown in Table 1.1.1.

The age distribution of the population of Perlis State in 1980 shows that children aged 0 ~ 14 represent 35.9%, persons aged 15 ~ 64 represent 59.6% and elderly persons aged 64 and over represent 4.5%, which means that Perlis State has a slightly older age structure than Malaysia as a whole, as shown in Table 1.1.2.

Between 1970 and 1980, the ethnic composition of Perlis State remained almost unchanged with 80% Malays, 16% Chinese and 3% Indians, as shown in Table 1.1.3. In Perlis State, the percentage of Malays is larger than in the case of Peninsular Malaysia.

Population density of Perlis State is shown in Table 1.1.4. Population density of Perlis State is 2 ~ 5 times as large as that of Peninsular Malaysia or Malaysia, but it is about one-third as large as that of urbanized districts such as Penang State. The high population density of Perlis State is due to the flat topographic features of the land, rather than urbanization.

Lifetime migration patterns are shown in Table 1.1.5. In Perlis state, 16,300 persons immigrated and 13,200 persons emigrated in 1970, which resulted in a net increase of 3,100 persons, while in 1980, 23,700 persons immigrated and 26,800 persons emigrated, resulting in a net decrease of 3,100 persons. Only two of the 14 states showed such a net emigration pattern in 1980 as compared with 1970. They were Perlis and Trengganu, net receivers of population in 1970 but net losers in 1980. In 1980, Perlis State had 3,000 emigrants to Kuala Lumpur, 2,900 emigrants to Selangor State, 3,400 emigrants to Pahang State. On the other hand, Kadah State had net decrease of 19,800 migrants in 1970, 20,900 migrants in 1980 and Penang State had a net decrease of about 20,000 persons in both 1970 and 1980. In Peninsular Malaysia, there is a strong stream of migration that flows into Kuala Lumpur, Selangor State and Pahang State. Thus, lifetime migration in Perlis State is in a comparative state of equilibration.

The number of unemployed persons among the labour force aged 15 ~ 64 in Perlis State in 1980 was 4,300, for a 7.8% unemployment rate. The unemployment rate of Peninsular Malaysia was 6.1% in 1980. Perlis States unemployment rate is quite high, next to the 8.7% of Trengganu State and the 8.1% of Kelantan State.

The characteristics of the population of Perlis State are summarized as follows;

① Malays make up about 80% of the population.

② Average annual growth rate is about 2%.

③ Lifetime migration is not large, but in recent years, emigration is increasing.

④ The unemployment rate is high.

## Table 1.1.1 Population of Perlis State by Mukim

| Mukim (Parish) | Population of Perlis State | | Growth Rate 1970–1980 (%) |
|---|---|---|---|
| | 1970 | 1980 | |
| Abi | 1,793 | 1,927 | 0.72 |
| Arau | 9,280 | 10,459 | 1.20 |
| Beseri | 5,860 | 7,004 | 1.80 |
| Chuping | 5,639 | 8,407 | 4.07 |
| Jejawi | 3,350 | 3,771 | 1.19 |
| Kayang | 8,465 | 9,589 | 1.25 |
| Kechor | 4,642 | 5,947 | 2.51 |
| Kuala Perlis | 9,908 | 11,490 | 1.49 |
| Kurong Anai | 8,582 | 9,855 | 1.39 |
| Kurong Batang | 1,670 | 2,113 | 2.38 |
| Ngolang | 2,175 | 2,426 | 1.10 |
| Orau | 1,726 | 1,900 | 0.97 |
| Padang Pauh | 2,870 | 3,102 | 1.10 |
| Padang Siding | 2,403 | 4,962 | 7.52 |
| Paya | 3,519 | 4,133 | 1.62 |
| Sanglang | 13,941 | 14,823 | 0.62 |
| Sena | 7,447 | 9,988 | 2.98 |
| Seriap | 3,521 | 4,521 | 2.53 |
| Sungai Adam | 1,107 | 1,294 | 1.57 |
| Titi Tinggi | 9,318 | 12,391 | 2.89 |
| Utan Aji | 9,503 | 12,370 | 2.67 |
| Wang Bintong | 4,362 | 5,254 | 1.88 |
| TOTAL | 120,991 | 147,726 | 2.02 |

The estimate is based on the 1980 Census of mukim population, adjusted for the partial mukims in the study area by frequency and density of settlements.

Source: KPM Khidmat Sdn. Bhd., "Perlis Integrated Area Development Project", 1983.3.

## Table 1.1.2 Age Distribution – 1980 Census

| Perlis State | | |
|---|---|---|
| Age Group | Total | Percentage (%) |
| 0 – 14 | 53,034 | 35.9 |
| 15 – 64 | 88,045 | 59.6 |
| 64 + | 6,647 | 4.5 |

| Malaysia State | | |
|---|---|---|
| Age Group | Total | Percentage (%) |
| 0 – 14 | 5,307,057 | 39.5 |
| 15 – 64 | 7,631,414 | 56.8 |
| 64 + | 497,117 | 3.7 |

Source: Perlis State Development Corporation, "Salient Investment Information, Perlis, Malaysia".

## Table 1.1.3 Ethnic Composition of the Population

(%)

| | Perlis State | | Peninsular Malaysia |
|---|---|---|---|
| | 1970 | 1980 | 1980 |
| Malays | 79.0 | 78.3 | 55.3 |
| Chinese | 16.4 | 16.0 | 33.8 |
| Indians | 2.1 | 2.9 | 10.2 |
| Others | 2.5 | 2.8 | 0.6 |
| Total | 100.0 | 100.0 | 100.0 |

Source: Khoo Teik Huat, "General Report of the Population Census, 1980", Department of Statistics, Malaysia.

## Table 1.1.4 Population Density

(person/Km²)

| | 1970 | 1980 |
|---|---|---|
| Perlis State | 152 | 182 |
| Penang State | 751 | 872 |
| Peninsular Malaysia | 67 | 83 |
| Malaysia | 32 | 40 |

Source: Khoo Teik Huat, "General Report of the Population Census, 1980", Department of Statistics, Malaysia.

## Table 1.1.5 Lifetime Immigrants, Emigrants and Net Migrants

| | Immigrants (thousands) | | Emigrants (thousands) | | Net Migrants (thousands) | | Net Migration Rate (%) | |
|---|---|---|---|---|---|---|---|---|
| | 1970 | 1980 | 1970 | 1980 | 1970 | 1980 | 1970 | 1980 |
| Perlis State | 16.3 | 23.7 | 13.2 | 26.8 | 3.1 | -3.1 | 2.6 | -2.2 |
| Kedah State | 78.6 | 90.8 | 103.8 | 198.0 | -25.2 | -107.2 | -2.6 | -10.5 |
| Penang State | 91.3 | 127.3 | 111.1 | 148.2 | -19.8 | -20.9 | -2.5 | -2.4 |
| Kuala Lumpur | | 420.5 | | 123.4 | | 297.1 | | 39.0 |

Source: Khoo Teik Huat, "General Report of the Population Census, 1980", Department of Statistics, Malaysia.

(2) Level of Production

Summaries of GDP and the per capita GDP growth by state between 1971 and 1980 are shown in Table 1.1.6, which shows the progress achieved in raising the levels of economic activity and the income of the population of each state. Classifying states by the level of per capita GDP, Kuala Lumpur and Selangor State are high-income states, the 8 states such as Johor, Melaka and so on are middle-income states, and the 4 states of Kadah/Perlis, Kelantan and Trengganu are low-income states. The per capita GDP of Kedah/Perlis in 1971 was M$728.3, 62% of the national average, third from the bottom, next to Kalantan State and Trengganu State. Although the per capita GDP of Kadah/Perlis increased during the period 1972 ~ 1980 by an average annual growth rate of 4.7%, the growth rate was lower than the national average. Therefore, in 1980 the per capita GDP of Perlis State was M$1,094 (in 1970 prices), 60% of the national average, second from the bottom, next to Kelantan State.

The poverty incidence in Perlis State has decreased from 73.9% in 1970 to 64.1% in 1980 as shown in Table 1.1.7, but Perlis State still shows the highest poverty incidence in Peninsular Malaysia.

Table 1.1.6 Summary of GDP and per capita GDP, Growth by State 1971 – 1980
(M$ million in 1970 prices)

| 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 | 2,153 | 3,176 | 4.4 |
| Middle-income | | | | | | |
| Johor ........................... | 1,476 | 2,941 | 8.0 | 1,084 | 1,726 | 5.3 |
| Melaka ........................ | 373 | 708 | 7.4 | 877 | 1,469 | 5.9 |
| Negri Sembilan ............ | 583 | 1,090 | 7.2 | 1,145 | 1,817 | 5.3 |
| Pahang ........................ | 647 | 1,218 | 7.3 | 1,170 | 1,486 | 2.7 |
| Perak ........................... | 1,927 | 2,967 | 4.9 | 1,167 | 1,583 | 3.5 |
| Pulau Pinang .............. | 850 | 2,286 | 11.6 | 1,035 | 2,357 | 9.6 |
| Sabah ........................... | 905 | 2,028 | 9.4 | 1,303 | 1,847 | 4.0 |
| Sarawak ....................... | 920 | 1,816 | 7.9 | 915 | 1,382 | 4.7 |
| Low-income | | | | | | |
| Kedah/Perlis ................ | 828 | 1,463 | 6.5 | 728 | 1,101 | 4.7 |
| Kelantan ..................... | 413 | 786 | 7.4 | 564 | 842 | 4.6 |
| Trengganu ................... | 268 | 759 | 12.3 | 615 | 1,316 | 8.8 |
| Malaysia ...................... | 13,016 | 26,188 | 8.1 | 1,172 | 1,836 | 5.1 |

Source: "Fourth Malaysia Plan, 1981 – 1985," 1981

Table 1.1.7 Poverty Incidence (%), 1970 – 1982

| STATE | 1970 | 1982 |
|---|---|---|
| Johor | 45.7 | 31.2 |
| Kedah | 63.2 | 63.2 |
| Kelantan | 76.1 | 54.1 |
| Melaka | 44.9 | 37.7 |
| Negri Sembilan | 44.8 | 31.9 |
| Pahang | 43.2 | 43.9 |
| Perak | 48.6 | 48.5 |
| Perlis | 73.9 | 64.1 |
| Pulau Pinang | 43.7 | 36.4 |
| Sabah | – | – |
| Sarawak | – | – |
| Selangor | 29.2 | 22.8 |
| Trengganu | 68.9 | 55.6 |
| Wilayah Persekutuan | – | 9.9 |
| Malaysia | – | – |
| Peninsular Malaysia | 49.3 | 39.4 |

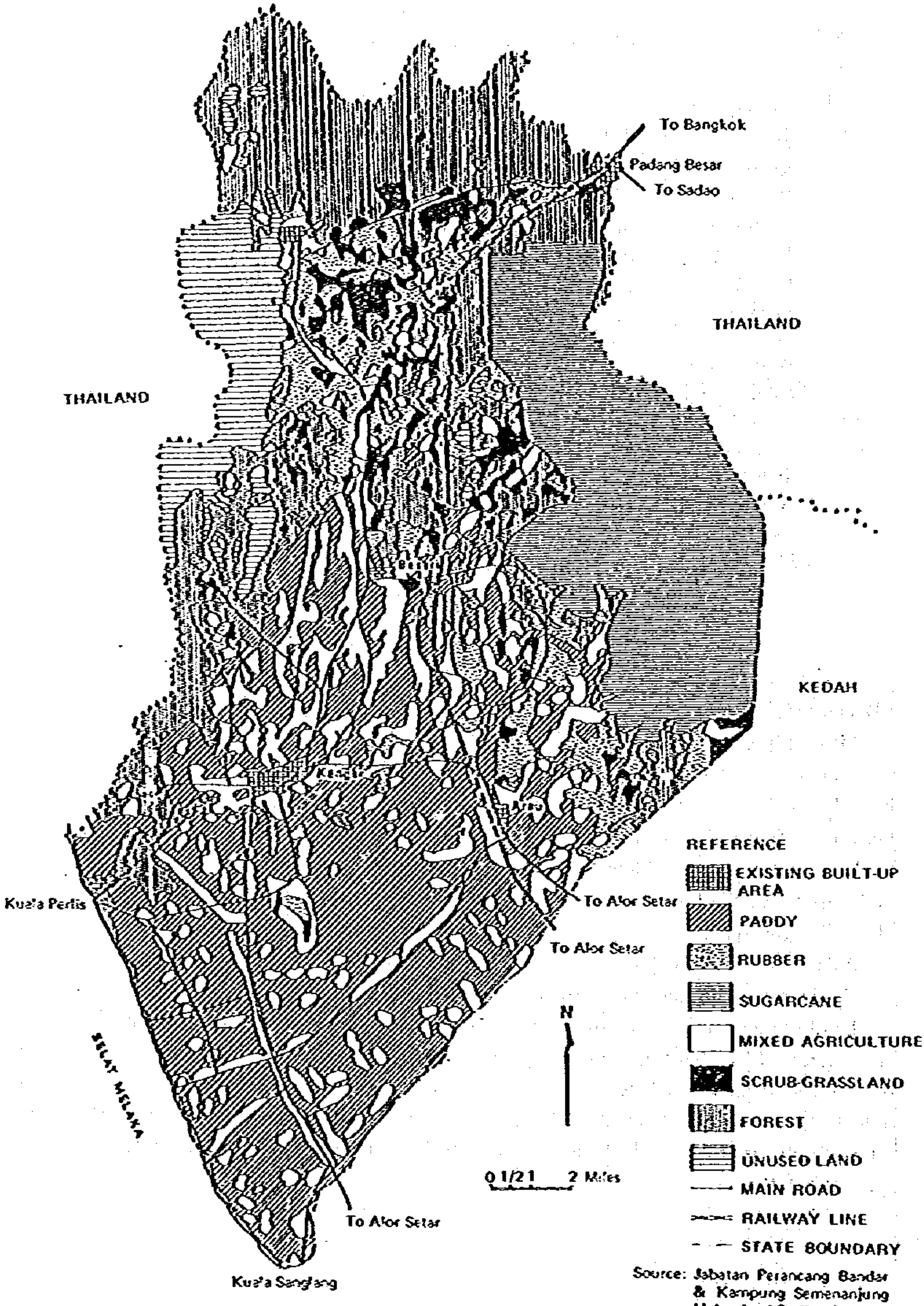
*Source: PES and Regional Economics Section.*

**(3) Land Use**

Major topographic features of Perlis State are shown in Fig. 1.1.1. The greater part consists of a lowlying alluvial plain with an elevation less than 60 m. On the north and north-eastern boundaries are hills with elevations greater than 61 m, that consist of sand stone or mud stone. On the western and north-western boundaries are steep, rugged limestone mountains. The present land use pattern in the State is based on these topographic features, as shown in Fig. 1.1.4. Paddy fields in the lowlying alluvial plain making up the western part of the State are a part of Malaysia's granary.

As the elevation is a little higher in the western part, rubber trees and sugarcane are cultivated. The mountains along the boundaries with Thailand are forested.

Land use and its changes are shown in Table 1.1.8. Between 1976 and 1980, the cultivated area increased by about 3,000 ha, but there was little change in overall land use area. In 1980, the cultivated area accounted for about 60%, forest for about 30%, and town/village area for only 0.9%. Compared with the 31.5% figure for cultivated area in Peninsular Malaysia, the ratio of cultivated area in Perlis State is very high, which shows that Perlis State is an advanced agricultural district.




Source: Jabatan Perancang Bandar & Kampung Semenanjung Malaysia, "Perlis, A study on Regional Planning and Development," 1975.4.

Fig. 1.1.4 Existing Land Use, Perlis State

### Table 1.1.8 Land Use, Perlis State

(a) 1976

| | Area (ha) | (%) |
|---|---|---|
| Culivated | 45,627 | 56.8 |
| Paddy | 26,172 | 32.8 |
| Rubber | 7,195 | 9.0 |
| Coconut | 1,360 | 1.7 |
| Sugarcane | 8,040 | 10.0 |
| Tobacco | 294 | 0.4 |
| Other Crops | 2,366 | 2.9 |
| Forest Reserves | 7,387 | 9.2 |
| Scrub Forest | 12,012 | 15.0 |
| Grass Land | 3,640 | 4.6 |
| Mining | 760 | 0.9 |
| Others | 10,898 | 13.5 |
| Total | 80,326 | 100.0 |

Source: "Laporan, Badan Petugas Pembangunan Perindustrian, Negeri Perlis," 1981.4.

(b) 1980

| | Area (ha) | (%) |
|---|---|---|
| Cultivated | 48,560 | 60.6 |
| Paddy | 25,859 | 32.3 |
| Sugarcane | 8,042 | 10.0 |
| Rubber | 5,298 | 6.6 |
| Coconut | 1,441 | 1.8 |
| Fruits | 1,417 | 1.8 |
| Vegetables | 1,022 | 1.3 |
| Others | 5,478 | 6.8 |
| Forest Reserves | 11,206 | 14.0 |
| Scrub Forest | 13,294 | 16.6 |
| Grass Land | 3,267 | 4.1 |
| Town/Village | 691 | 0.9 |
| Mining | 56 | 0.1 |
| Others | 3,014 | 3.7 |
| Total | 80,090 | 100.0 |

Source: "Taklimat Perancangan dan Pembangunan," Negeri Perlis, Ogos 1981.

### Table 1.1.9 Availability of Cultivatable Land in Malaysia, 1979

(in million hectares)

| Land Surface | Peninsular Malaysia | Sabah and Sarawak | Total |
|---|---|---|---|
| Area of land surface | 13.0 (100.0%) | 19.6 (100.0%) | 32.6 (100.0%) |
| Cultivable land | 6.4 (49.2%) | 8.8 (44.9%) | 15.2 (46.6%) |
| Area under cultivation | 4.1 (31.5%) | 0.5 ( 2.6%) | 4.6 (14.1%) |
| Area available for new cultivation | 2.3 (17.7%) | 8.3 (42.3%) | 10.6 (32.5%) |

Source: E.K. Fish & H. Osman-Rani, "The Political Economy of Malaysia", 1982.

### (4) Industrial Structure

The gross domestic product (GDP) for Perlis State is shown in Table 1.1.10, which shows that the agricultural, forestry and fishing sectors accounted for 57.5% in 1971, but decreased sharply to 44.2% in 1980. On the other hand, the manufacturing sector accounted for 4.7% in 1971, but increased greatly to 9.3%. The wholesale and retail trade, hotels and restaurants sector accounts for about 3%, as there was little change between 1971 and 1980. The goverment service sector increased from 10.1% in 1971 to 24.4% in 1980. The change of GDP by industry shows that the industrial structure of Perlis State has advanced so as to decrease the share of agriculture, forestry and fishing and increase the share of manufacturing, but the share of agriculture, forestry and fishing still accounted for almost half in 1980.

The changes in estimated employment in Perlis State are shown in Table 1.1.11. Between 1970 and 1976, the share of agriculture, forestry and fishing decreased from 72.2% to 67.5%, while the share of manufacturing increased from 2.7% to 4.0% and the share of the commercial sector increased from 6.6% to 9.1%.

The 1980 census shows that the above tendency was strengthened as agriculture, forestry and fishery decreased to 56.9%, manufacturing increased to 5.3% and services to 11.6%. Comparing rates with the national averages, Perlis States percentages of agriculture, forestry and fishing, manufacturing and services are respectively 141%, 41% and 83% of the national ones, showing that the State is specialized in agriculture, forestry and fishing and backward in manufacturing.[3)]

Table 1.1.10 Gross Domestic Product by Industry, Perlis State
(M$ million in 1970 prices)

| Sector | Kedah, Perlis[1)] (1971) | | Perlis State (1980) | |
|---|---|---|---|---|
| | GDP | (%) | GDP | (%) |
| Agriculture, forestry and fishing | 476 | 57.5 | 76 | 44.2 |
| Mining and quarrying | 10 | 1.2 | 0.5 | 0.3 |
| Manufacturing | 39 | 4.7 | 16 | 9.3 |
| Construction | 26 | 3.1 | 2 | 1.2 |
| Utilities | 6 | 0.7 | 3 | 1.7 |
| Transport, storage and communications | 29 | 3.5 | 3 | 1.7 |
| Wholesale and retail trade, hotels and restaurants | 26 | 3.1 | 5 | 2.9 |
| Finance, insurance, real estate and business services | 98 | 11.8 | 18 | 10.5 |
| Government services | 84 | 10.1 | 42 | 24.4 |
| Other services | 12 | 1.8 | 2 | 1.2 |
| Total | 806 | | 167.5 | |
| GDP | 828 | 100.0 | 172 | 100.0 |

Source: "Fourth Malaysia Plan, 1981-1985", 1981.

Note: 1) Kedah and Perlis are two district state but are shown together here because in much of the available statistical data the two states are combined.

Table 1.1.11 Employment Estimates by Sector, Perlis State

| Sector | 1970[1] | | 1976[2] | |
|---|---|---|---|---|
| | Estimated Employment (person) | (%) | Estimated Employment (person) | (%) |
| Agriculture, forestry and fishing | 32,778 | 72.2 | 34,420 | 67.5 |
| Mining and quarrying | 318 | 0.7 | 510 | 1.0 |
| Manufacturing | 1,226 | 2.7 | 2,040 | 4.0 |
| Construction | 363 | 0.8 | 1,020 | 2.0 |
| Utilities | 137 | 0.3 | 153 | 0.3 |
| Transport, storage and communication | 772 | 1.7 | 1,224 | 2.4 |
| Wholesale and retail trade, hotels and restaurants | 2,996 | 6.6 | 4,640 | 9.1 |
| Finance, insurance, real estate and business services | | | 255 | 0.5 |
| Government services | 4,450 | 9.8 | 5,609 | 11.0 |
| Other services | 2,360 | 5.2 | 1,122 | 2.2 |
| Total | 45,400 | 100.0 | 50,993 | 100.0 |

Source: 1) "Population Census of Malaysia, 1970."
2) SEPU Perlis

(5) Standard of Living

Indicators for the standard of living in Perlis State are shown in Table 1.1.12. The number of registered doctors per 10,000 population in Perlis State was 1.6 in 1981, lower than the national average of 2.6, but public acute care hospital beds per 1,000 population was 2.7, higher than the national average of 1.6.

Primary school and secondary school teachers, per 100,000 population in Perlis State was 503 and 490 respectively in 1982, higher than the national averages of 472 and 354.

The infant mortality and toddler mortality rates in Perlis State were 23.5 and 1.5 respectively in 1981, almost the same as the averages of Peninsular Malaysia of 21.0 and 1.8.

Between 1970 and 1980, the literacy rate in Perlis State increased from 59.7% in 1970 to 72.3% in 1980.

As to indicators for residential circumstances, the percentage of living quarters with piped water in Perlis State was 43.3% in 1980, lower than the national average of 65.0%, but the percentage of living quarters with electricity was 67.9%, higher than the national average of 64.3%. The percentage of living quarters with a toilet system was 8.4% in 1980, lower by far than the national average.

Between 1970 and 1982, motorcars/motorcycles registered per 1,000 population in Perlis State increased rapidly from 37 to 179.5, which is estimated as being almost the same as the national average.

Television licenses per 1,000 population in Perlis State increased to 82.1 in 1982, which is almost the same as the national average of 86.9.

Summarizing the above, some of the indicators for the standard of living in Perlis State are higher than the national average and generally speaking most are almost the same level as the national average. The standard of living in Perlis State is not always low but close to the national average. According to the statistical data, the per capita GDP is low and the poverty incidence is high in Perlis State, but it seems that these data do not accurately show the poverty of the population.

### Table 1.1.12 Indicators for the Standard of Living

| | Perlis State | | | | Peninsular Malaysia | | | | Malaysia | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1970 | 1980 | 1981 | 1982 | 1970 | 1980 | 1981 | 1982 | 1970 | 1980 | 1981 | 1982 |
| Registered doctor per 10,000 population | 1.3 | | 1.6 | | | | | | 2.0 | | 2.6 | |
| Public acute care hospital beds per 1000 population | 2.1 | | 2.7 | | | | | | 1.7 | | 1.6 | |
| Primary school teachers per 100,000 population | 547 | | | 503 | | | | | 516 | | | 472 |
| Secondary school teachers per 100,000 population | 236 | | | 490 | | | | | 208 | | | 354 |
| Infant mortality rates | 35.5 | | 23.5 | | | | 21.0 | | 40.7 | | | |
| Toddler mortality rates | 3.3 | | 1.5 | | | | 1.8 | | | | | |
| Literacy rates | 59.7 | 72.3 | | | | | | | 58.0 | | | |
| Percent of living quarters with pipe water | 22.7 | 43.3 | | | | | | | 25.8 | 65.0 | | |
| Percent of living quarters with electricity | 17.0 | 67.9 | | | 43.7 | | | | | 64.3 | | |
| Percent of living quarters with toilet system | 7.6 | 8.4 | | | 18.6 | | | | | 25.8 | | |
| Motorcars/motorcycles registered per 1000 population | 37 | | | 179.5 | | | | | 63.6 | 155 | | |
| Television licenses per 1000 population | 11.7 | | | 82.1 | | | | | 20.7 | | | 86.9 |

Source: Seksyen Ekonomi Wilayah, Unit Perancang Ekonomi, "Reductions in Regional Disparities in Socio-economic Development," 1983.3.7.

(References)


1) Department of Statistics, "Annual Statistical Bulletin Malaysia, 1981", 1982.11.
2) Khoo Teik Huat, "General Report of the Population Census, 1980", Department of Statistics, Malaysia.
3) Seksyen Ekonomi Wilayah, Unit Perancang Ekonomi, "Reduction in Regional Disparities in Socio-economic Development", 1983.3.7.

### 1.1.3 The Present Situation of Infrastructure Development

#### (1) Ports and Fishing Ports (see Fig. 1.1.5)

There are 4 major ports in Peninsular Malaysia, Penang, Kelang, Johnor, and Kuantan. Spread out at distances of 250 – 300 km from each other, their influence covers the peninsula.

Perlis State is serviced by Pinang Port, about 100 km to the south. In the state itself there is only the small port of Kuala Perlis, about 2 km from the border of Thailand. Kuala Perlis, besides being a fishing port, serves as a passenger ship terminal for boats going to Langkawi Island (Kedah State) and as a trading port for the small ships going back and forth to Thailand. However the shallow waterway and poor arrangement of port facilities, including the berths, hinders smooth operations.

Although there are other fishing ports to the south at Kurong Tengar, Sungai Berembang, Sungai Baharu, and Kuala Sanglang, most of the fishermen and fishing boats gather around Kuala Perlis Port.

#### (2) Roads (see Fig. 1.1.5 and Fig. 1.1.6)

Federal road No. 1 (Asia Highway No. 2) runs north from Johor, passes through the western half Perlis State and ends at Padang Besar on the Thai border, where it connects with a Thai highway. Two more federal roads branch off this highway and connect to Kuala Perlis and Kuala Sanglang. These and all other trunk roads in Perlis State have been developed to connect with the state capital at Kangar. A comparatively closely knit network of state roads, most of which are paved and well maintained, connects the state's villages to each other.

#### (3) Railroads (see Fig. 1.1.5 and Fig. 1.1.6)

A north/south railroad, traversing the peninsula from Johor to Thailand, runs roughly through the center of Perlis State. However as it is a single-track narrow gauge line (1 m), operating infrequently and with obsolete facilities, it can not compair with other forms of transportation, such as cars, etc. Although in general the railroads in Perlis are not heavily used either by passengers, or for cargo, there are feeder lines to the cement factories which are used to carry gypsum from Thailand and to transport cement products to other states.

#### (4) Power (see Fig. 1.1.7)

Electricity generated at the Penang thermal power plant is transmitted by cable to the Bukit Keteri substation (132 kv) where it is relayed to the Kangar substation. From Kangar a power network distributes this electricity around the state. Most of it is consumed by the cement factories. It is necessary to establish a future demand/supply reinforcing program based on study of the types of industries that will be introduced to Perlis State.

There is also a plan to supply power by undersea cable to cement factories on Langkawi Island which are expected to start operation in mid '84.

#### (5) Water Resources (see Fig. 1.1.8)

The present city water supply is mostly ground water pumped out at Arau and is far from sufficient.

Trunk canals have been developed in the MUDA project area covering the southern half of the state, but in the middle of the state development lags.

The construction of a dam upstream on the Perlis River is being considered, in order to solve the water shortage problem. However, as the ground is flat, construction of a dam to secure sufficient water will be difficult.

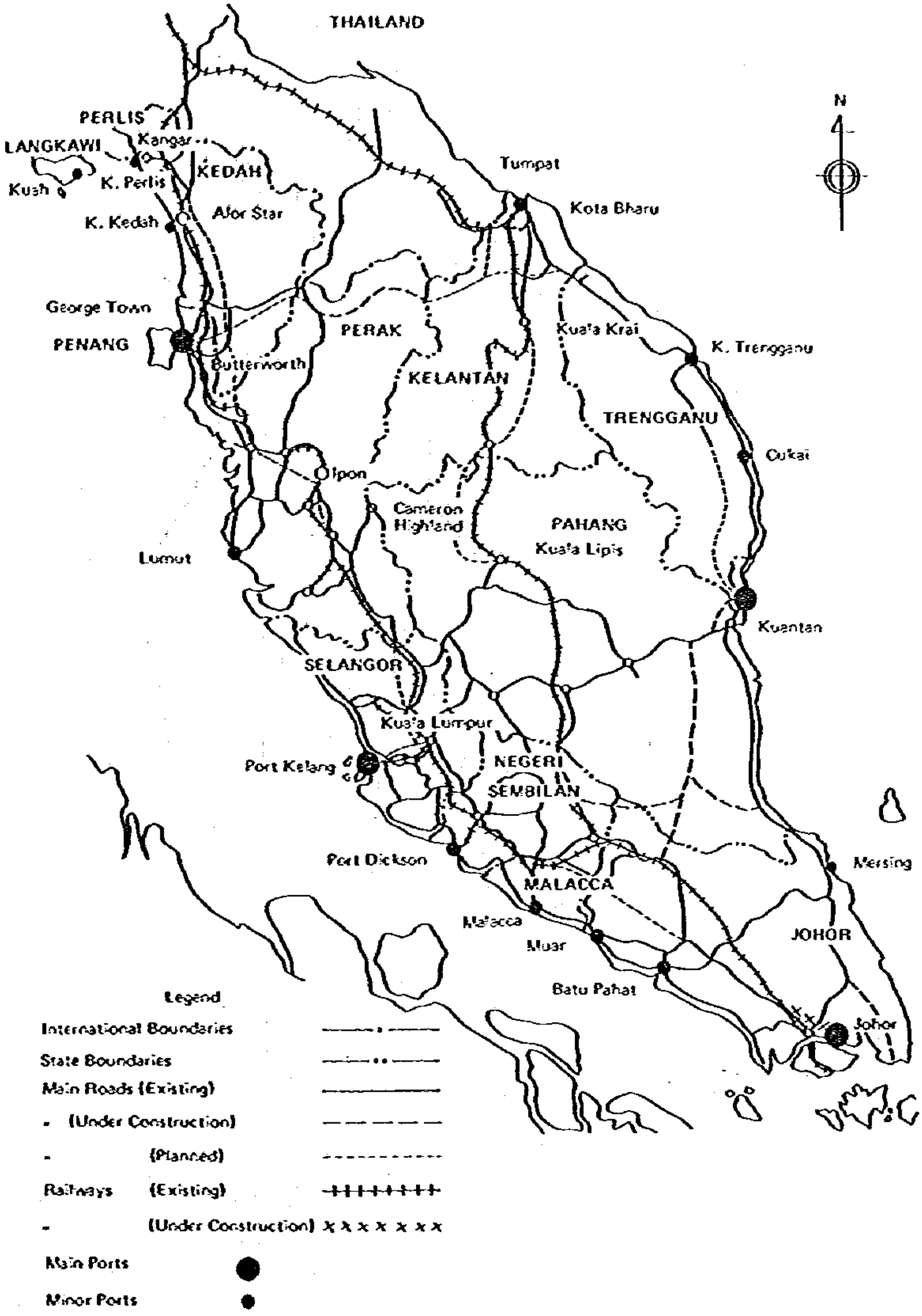



Fig. 1.1.5 Location of Ports and Network of Roads and Railways in Peninsular Malaysia

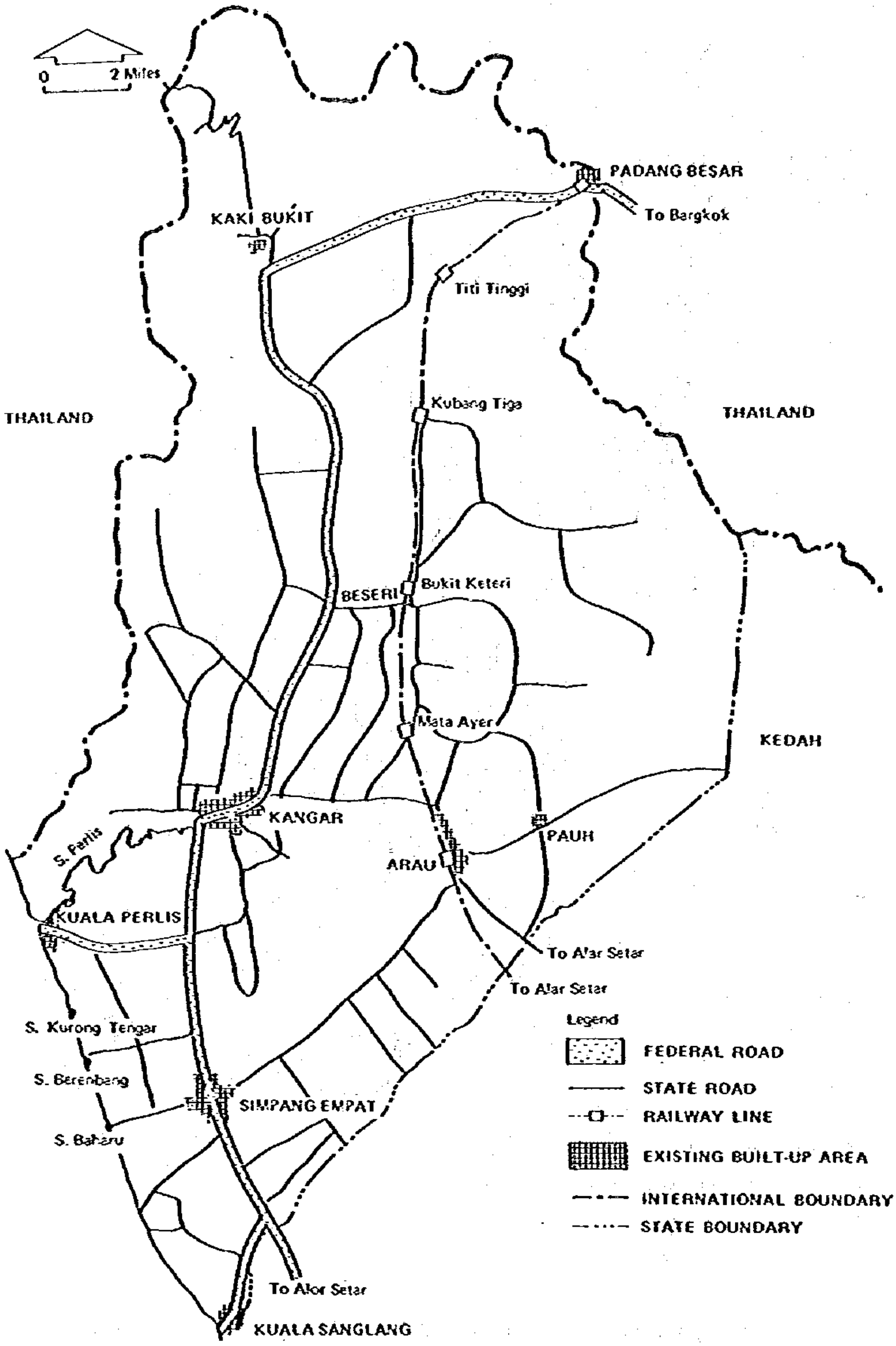



Fig. 1.1.6 Existing Road and Railway Network in Perlis State

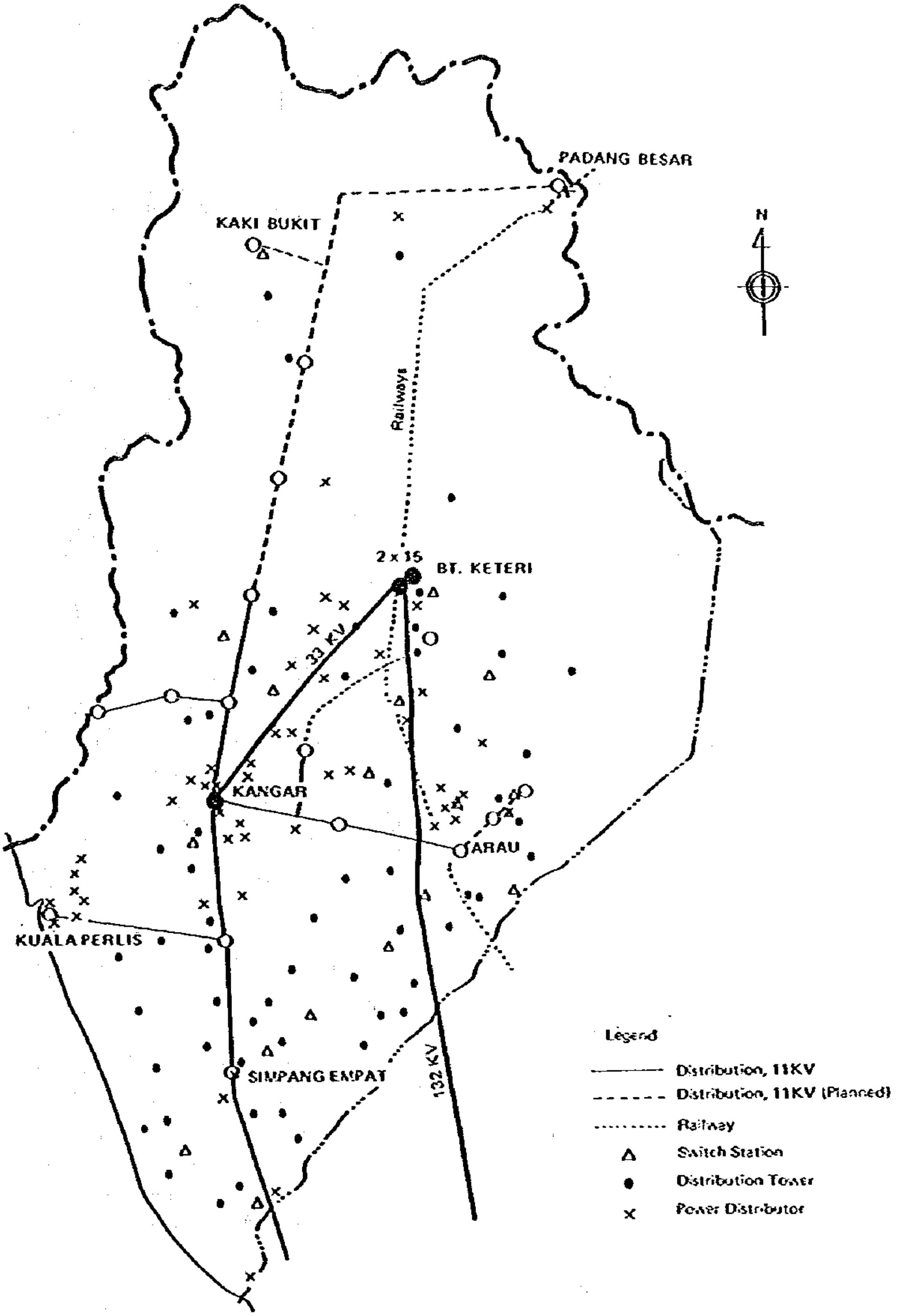



Fig. 1.1.7 Electricity

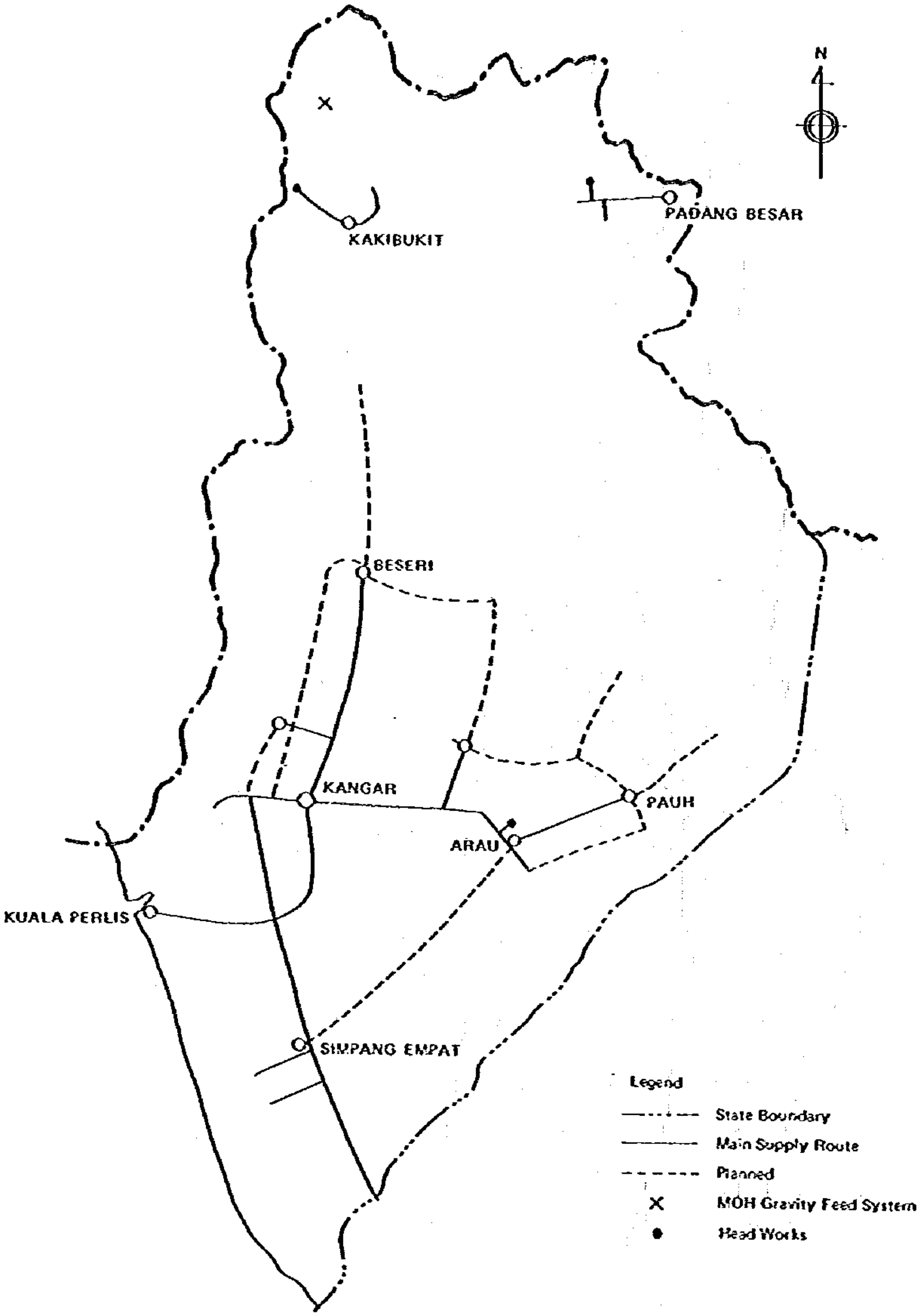



Fig. 1.1.8 Water Supply

## 1.2 The Present Conditions and Problems of the Proposed Port Development Sites

### 1.2.1 The Natural Conditions

#### (1) Meteorological Conditions

1) Air Temperature and Humidity

The meteorological condition of Perlis State which is located in northern area of Peninsular Malaysia shows a typically tropical climate which has relatively uniform air temperature throughout a year with high humidity and distinctly seasonal rainfall.

Monthly air temperature and humidty for 24 hours measured at Chuping Principal Meteorological Station, Perlis are tabulated on Table 1.2.1 and 2. Air temperature of February and March which correspond to dry season is relatively higher than that of other months. However, mean highest daily air temperature and mean lowest daily air temperature are approximately uniform, which are 32.9°C and 23.4°C respectively, air temperature differential between daytime and nighttime is 9.5°C. Characteristics of monthly humidity show the same trend as that of air temperature. Relative humidity in Perlis State is high throughout a year, that is 83.1% of annual mean humidity, although humidity in dry season is relatively lower than in other seasons.

2) Rainfall

Precipitation varies apparently in dry season from late of October to March and rainy season from May or June to September. Rainfall amount in dry season corresponding to north-east monsoon, particularly in January and February is extremely small. Fig. 1.2.1 illustrates monthly rainfall records in Kangar, Perlis during 1951 to 1980. Precipitation in January and February is only 30 mm/month and in some of included years there was no rainfall of a month recorded in statistics. In rainy season, monthly precipitation occurs more than 200 mm/month. The monthly rainfall variation has two peaks in June and September which correspond to inter-monsoonal transition period between north-west monsoon period and south-west monsoon period, which are 198.9 mm/month and 288.8 m/month respectively.

The spatial variation of annual rainfall is shown in Fig. 1.2.2. Obviously, from a distinct isohyet pattern, mean annual rainfall in Perlis State is relatively low in north-easterly hill area and increases in a southerly direction to a maximum value of about 2,200 mm/month at Kuala Sanglang. Along the edge of the Nakwan Range located on north-westerly boundary of Thailand, annual rainfall reaches more than 2,000 mm/month. A rainfall characteristic of Perlis is that rainfall occurs severely in certain small region and sometimes daily rainfall exceeds 200 mm/day. Annual mean rainfall of Perlis State is around 2,000 mm/year which means relatively small precipitation area in Peninsular Malaysia.

3) Wind

The wind of Perlis State is characterized prominently by two monsoons. The north-east monsoon occurs during the months of late of October to March and the south-west monsoon occurs during May or June to September. Meteorological station in Perlis State exists merely in Chuping which is located in forest far from coastal area and does not have sufficient data due to the short observation period. Therefore, wind velocity and direction statistics from 1968 to 1977 measured at Alor Setar Meteorological Station, Kedah is adopted for analysis. Fig. 1.2.3 shows the percentage frequency of occurrence and velocity of wind for each season and throughtout a year.

During north-east monsoon season, north-easterly wind is predominant and northerly to easterly wind occupies 68% of whole wind occurrence. Relevant to wind velocity, breeze less than the velocity of 3.3 m/sec is prominent and the occurrence of wind velocity ranged from 3.4 to 5.4 m/sec is only 1.3%. During south-west monsoon season, westerly wind is prevailing and wind direction of the velocity more than 1.6 m/sec distributes from north-west to south-west. During two inter-monsoon seasons, westerly wind is also relatively predominant.

Fig. 1.2.4 illustrates the frequency of mean hourly wind velocity at Alor Setar Meteorological Station, Kedah from 1968 to 1982. The maximum hourly wind velocity for 15 years is 10.1 m/sec recorded on September 15, 1978 and May 30, 1980. The wind velocity range less than 5 m/sec occupies 99.5% of the observation period. Conclusionally, the wind condition of Perlis State is supposed to be very calm from the wind statistics at Alor Setar.

Wind observation at Kuala Perlis was conducted by JICA during August and September, 1983 which correspond to south-west monsoon season. As a result of observation data, prevailing wind direction varies from SSW to NNW and average of wind velocity is less than 4m/sec. During observation period, maximum wind velocity of 17.0 m/sec and 9.0 m/sec are recorded during storm.

## (2) Sea Conditions

### 1) Tide

There is no tide observation station in Perlis State and tide table at Koi Noi Island, Thailand is utilized for tide forecast.

Tide observation of JICA was conducted from August 8 to September 8, 1983 with a tide gauge installed at the river mouth of the Perlis River. Tidal harmonic analysis was performed using a computer with observation data of tide level. The 4-major components of tide and the mean sea level are obtained as follows, referring to another observation data at Langkawi Island, Kedah made by Sato Kogyo Co., Ltd., Japan.

| | | |
|---|---|---|
| o Mean seal level: | +167.0 cm above observation datum | |
| o The 4-major tide components; | Height | Kappa |
| Principal Lunar, $M_2$: | 74.7 cm | 331.90° |
| Principal Solar, $S_2$: | 44.9 cm | 8.60° |
| Lunisolor Diurnal, $K_1$: | 16.2 cm | 339.50° |
| Principal Lunar Diurnal, $O_1$: | 6.6 cm | 295.10° |
| o Accumulation of 4-components, $Z_0$: | 142.4 cm | |

And the tidal level are obtained as follows based on the above mentioned 4-major tide components. Tide levels are obtained as follows and also shown in Fig. 1.2.5.

| | |
|---|---|
| o Indian spring high water level: (Design highest water level) | D.L. + 2.84 m |
| o Mean spring high water level: | D.L. + 2.62 m |
| o Mean neap high water level: | D.L. + 1.72 m |
| o Mean sea level: | D.L. + 1.42 m |
| o Mean neap low water level: | D.L. + 1.12 m |
| o Mean spring low water level: | D.L. + 0.22 m |
| o Indian spring low water level: (Design lowest water level) | D.L. ± 0.0 m |

2) Waves

Wind wave and swell statistics reported by ships navigating in Malacca Strait of latitude 0° to 7° north for 6 years from 1976 to 1981 is summarized in Table 1.2.3 on swells propagating from Andaman Sea and wind waves generated in Malacca Strait.

Relevant to swell, average wave height is about 1 meter and period is 6 to 7 seconds. Maximum swell, 4 meter wave height and 14 second wave period, appears in the Table 1.2.3. Wind waves reported in Malacca Strait is very small due to the short wind fetch restricted by Sumatera and no strong wind occurring in this area. Therefore, the average dimensions of wind waves are 2 second wave period and around 0.7 meter wave height. Maximum wind waves generated in this area is reported as 8 second wave period and 3 meter wave height.

Coastline of Perlis State is located in a wave sheltered area of Langkawi Island, Kedah, Terutao Island and many islands in Thailand, so that swells and wind waves intruded from Andaman Sea do not suffer a coastline of Perlis State so much rather than wind waves which are generated in Malacca Strait and induced south-westerly to southerly. However, waves invading to the Perlis coast is supposed to be small because of the limited wind fetch by Sumatera and severe wave attenuation caused by wave breaking and bottom friction on very gentle bathymetry in shallow water region.

Regarding wave observation conducted by JICA with DW-III Wave Meter installed 4 km offshore of Kuala Perlis, the maximum significant wave during the period of August 31 to September 10, 1983 was recorded as 0.57 meters in wave height and 6.7 seconds in wave period. Visual observation of induced waves is also carried out by JICA from August 14 to September 9, 1983. The maximum significant wave obtained by visual observation is reported as 0.84 meter in wave height under the northerly wind of 5.0 – 6.0 m/sec. However, the visual observation is liable to give a excessive number and the northerly wind can not generate such a wave theoretically. It is supposed that the actual wave would be smaller than the observed wave.

As a result of SMB wave forecasting method, significant wave height and wave period are obtained as 1.8 meters and 4.8 seconds respectively in accordance with 300 km wind fetch and the modelized wind occurrence pattern derived from wind statistics. The wind pattern presumed consists of three phases, that is, first phase of wind accreting period (6 hour wind duration and 9.3 m/sec wind speed), second phase of maximum wind period (2 hour duration and 13.6 m/sec) and third phase of wind settling period (6 hour duration and 9.3 m/sec), in which the offshore wind speed of 9.3 and 13.6 m/sec are converted from the inland wind velocity of 6.5 and 9.5 m/sec respectively. The wind condition utilized for wave forecasting is very severe, so that the predicted wave is said to be very conservative for the proposed area.

To evaluate the wave refraction effect, the refraction coefficients at Kuala Perlis and Kuala Sanglang and the wave refraction diagrams off the Perlis coast are computed for the representative wind waves and swells. Fig. 1.2.6 (a) and (b) show the wave ray distribution of the 4.8 second forecasted wave period intruded from SW and WSW directions. The refraction coefficients computed for the waves of 4.8 and 8.0 second period are tabulated on Table 1.2.5.

The obtained wave refraction coefficients vary depending on wave period and wave direction. Regarding the predominant wind wave direction of the Perlis coast, the refraction coefficients of SW and SSW wave direction are 0.89 and 0.94 at Kuala Perlis, 1.00 and 1.00 at Kuala Sanglang. Therefore, the wave height induced to Kuala Perlis is expected to be reduced by about 10% of deep water wave height. For Kuala Sanglang, the wave refraction is not effective, so that the induced wind waves of the predominant direction are not attenuated significantly by wave refraction.

Wave attenuation due to bottom friction would be expected on the Perlis coast, in a case of that waves propagate for long distant on very gentle sea-bottom. For example, attenuation degree is estimated with the method proposed by Bretschneider and Reid*) on a condition that the friction coefficient is 0.01, the sea-bottom slope 1/1,600 in Kuala Perlis and 1/400 in Kuala Sanglang. Following conditions are established for computation. The wave propagation distance is 8,000 meters in Kuala Perlis and 2,000 meters in Kuala Sanglang which are determined by 7 meter offshore water depth and 2 meter nearshore water depth. Assumed wave height estimated by wave forecasting is 1.8 meters and wave period is 4.8 seconds. From the computation result, wave height in nearshore region is computed as 46% of Kuala Perlis and 77% of Kuala Sanglang in comparison with the offshore wave height. It means that the wave height reduced by the bottom friction is less than half of induced wave height at Kuala Perlis. However, a friction coefficient generally depends on actual wave condition and bottom condition of a site. The friction coefficient 0.01 proposed by Bretschneider, however, is relatively small in comparison with the number measured at Japanese coasts and generally a number of friction coefficient is recommended to be about 0.01 to 0.02 for wave forecasting, so that the wave attenuation rate due to bottom friction proposed here is supposed to be conservative.

Therefore, a design significant wave height in Kuala Perlis is said to be around 1.0 meter in wave height and 4.8 seconds in wave period, considering the forecasted wave under the modelized wind pattern, the wave observation data, the wave refraction analysis and the wave attenuation due to the bottom friction. Since forecasted wave dimensions are varied depending on tide level, during lower tide the propagated wave height would be reduced even more by the effect of wave breaking.

3) Current

Ocean current in Malacca Strait, shown in Figure 1.2.7 (a) and (b), flows northerly from

*) Bretschneider, C.L. and Reid, R.O.: Modification of Wave Height due to Bottom Friction, Percolation and Refraction, U.S. Army Corps of Engineers, Beach Erosion Board, Tech. Memo. No. 45, 1954

Singapore to Andaman Sea along Sumatera predominantly throughout a year. However, during north-east monsoon season, ocean current changes its direction off the Perlis coast and southerly current appears seasonally along Malay Peninsular.

Tidal current along the Perlis coast is supposed to be complicated due to adjacent islands, bathymertry and seasonal ocean current variation. There are no observation data of current in Perlis State except a temporal measurement for submarine electric cable construction project between Kuala Perlis and Langkawi Island conducted by National Electric Board, Malaysia. Maximum current speed observed in the survey is approximately 1 knot and mostly less than 0.5 knot. Current direction depending on tide level shows that southerly component is predominant during high tide and northerly component is predominant during low tide.

Tidal current observation at Kuala Perlis and Kuala Sanglang was conducted by JICA in August and September, 1983. Fig. 1.2.8(a) to (c) illustlate tidal current condition observed at Kuala Perlis from August 4 to 9, 1983. These figures indicate that predominant direction of tidal current is SSE, of which current speed is relatively large, that is 0.6 knot, in comparison with current speed of other directions. Maximum current speed recorded in the field survey is 1.0 knot during high tide.

A tidal current harmonic analysis is carried out based on above mentioned current observation data and tidal current ellipses are shown in Fig. 1.2.9. Tidal ellipses of tropic and spring tide are synthesized with tidal current components calculated by harmonic analysis. Tidal current is circulating clockwise so that the current during ebb tide flows landward in SSE direction and the current during flood tide flows seaward in NNW direction. The constant current is relatively small, of which vector orients to approximately south-east direction.

## (3) River Conditions

### 1) River Network

River network of Perlis State shown in Fig. 1.2.10 constitutes the Perlis river and irrigation canals in MADA area. The Perlis river system has many complicated branch rivers which are originated from mountain and hill area of Thailand international boundary and distribute in most of the state area. Main tributaries gather at Kangar into the Perlis River which orients to Kuala Perlis with forming very meandering path. MADA irrigation area located south of the Perlis River containing two main canals, such as Arau Canal and New Sanglang Drain, and well organized branch channels connected to main canals. Water supply for the irrigation area is provided from Kedan State via Arau Canal and New Sanglang Drain.

### 2) Flood

Flooding in Perlis State occurs more or less during the months of July to December. Flooding appears to be caused by heavy rainfalls of several day duration over the northern areas. Additionally, very gentle river gradient due to majority of flat alluvium lowland, extensive tidal area to reach beyond Kangar and meandering river feature with insufficient cross section for river discharge. Flood records in recent 10 years are tabulated in Table 1.2.4. Flooding occurs occasionally in September. The flood prone areas in Perlis State lie in the flat alluvial plain of southern and central regions as shown in Fig. 1.2.10. Flooding in Perlis State is characterized by extensive areas of shallow and gradual increase of flood water level which remained high for 13 days in the most severe case before settlement of flood, so that it is not so destructive to give a severe damage to houses and other structures.

(4) Soil Conditions

The soil investigation was carried out by JICA at 7 points in the Kuala Perlis area and 4 points in the Kuala Sanglang area. And the investigation of the sea bed material was carried out in the surrounding area. In this section, a summary of investigation results is presented.

Some of the subsoil profiles are shown in Fig. 1.2.11 (a), (b) and 12. The summary of the soil testing results is shown in Fig. 1.2.13 and 14. A top down description of the subsoil stratification is given below. In the Kuala Perlis area, the first layer is very soft marine clay, the second is stiff to very stiff clay, and the third is limestone or highly weathered shale. In Kuala Sanglang area, the first layer is very soft marine clay, the second is medium to stiff clay, and the third is weatherd shale. The stratification of subsoil in Kuala Perlis is little more complicated than that in Kuala Sanglang, because the Kuala Perlis area is located in the southern part of Setul Limestone Formation.

Considering the overall results from the whole investigated area, weathered shale or limestone lies at the depth of -12 to -24 meters below ground level in Kuala Perlis, and -15 to -28 meters below ground level in Kuala Sanglang.

The natural moisture content (Wn) of very soft marine clay constituting the top soil layer is 80 to 150% (Kuala Perlis; 80 to 120%, Kuala Sanglang; 80 to 150%), and this marine clay has a very high compressibility. Concerning the strength of this marine clay of which N-value is 0 and the cohesion is very low, however the strength increases according to the depth of stratum. If facilities are constructed without taking any measures against the high compressibility and lack of stability of the marine clay, there would likely create problems of subsidance, sliding and so forth.

The water content (Wn) of the second layer varies 10 to 40% (Kuala Perlis; 10 to 40%, Kuala Sanglang; 20 to 40%), the compressibility is not high, and N-value is 5 to 30 (Kuala Perlis; $N \geqq 10$). Thus, it is supposed to be stable enough to built light structures.

According to the results of the soil investigation, it is most important to take steps to prevent mishaps due to the very soft marine clay.

(5) Characteristics of the Coast

Coastline of Perlis State extends linearly from north to south in about 20 km. Langkawi Island, Kedah, Tarutao Island and small islands off Kuala Perlis affect remarkably the sea condition along the Perlis coast. Siltation caused by river sediment discharge and littoral drift under the influence of waves and currents has been a big problem for maintaining navigation channels. On the other hand, beach erosion is a recent problem, where most of the Perlis coast except the vicinity coast of Kuala Sanglang has experienced a severe beach erosion and rock embankment to protect the land has been constructed. Beachline adjacent to Kuala Sanglang has moved 500 meters seaward in recent 10 years, where mangrove trees are propagating. In general, a cause of beach erosion is a decrease of sediment supply from river due to construction of dam or interruption of littoral drift due to construction of large scaled coastal structures such as breakwater, training wall and jetty. However, none such structures could be found out along the Perlis coast. Very minor cause would be supposed that beach retaining effect of vegitation was eliminated by felling mangrove forest.

Recent beach line transformation of the coasts adjacent to Kuala Perlis and Kuala Sanglang are illustrated in Fig. 1.2.15 and 16. Beach line of Kuala Perlis had recessed 60 meters of most severe point for 6 years of 1964 to 1970. Up to now, beach erosion is still ongoing and the road along the coast of Kuala Perlis has been damaged severely and some part of the road is destroyed completely. The coast of Kuala Sanglang is also used to experience a serious beach erosion, that is, 100 meter beach line recession during the year of 1954 to 1964. Since 1970, the recession of beach line stopped and the beachline in the vicinity of river mouth at Kuala Sanglang commenced to advance seaward. At the same time of1970, New Sanglang Drain was constructed connecting to the Sanglang River. It is supposed to be some impact to change a sedimentation system of this area and promote deposition of sediment which is transported from the northern coast of Kuala Sanglang.

(6) Siltation of the Navitation Channel

Siltation of the navigation channel is generally caused by deposition of river sediment and of sea-bed material suspended and transported by waves and tidal currents.

The Perlis State waterway network consists of the Perlis River and its tributaries covering three forths of the state area and the MADA irrigation system of which main canals are the Arau Canal and the New Sanglang Drain.

However, sediment volume carried by these rivers is supposed to be small as the catchment area of Perlis is relatively small, and the agricultural area and forest vegitation sufficiently reduces land erosion. For example, the water depth of the berthing area around the ferry jetties at Kuala Perlis is well maintained naturally without any dredging works.

The results of field observation and suspended sediment measurements conducted by JICA implied that shoaling of the navigation channel is caused by sediment transport due to waves and tidal currents rather than by sediment discharge from the river. The sea-bed material off the Perlis coast is silty clay and is easily suspended by waves and transported by tidal currents. In addition, the extensive sedimentation area of the very gentle bottom slope increases the amount of sediment transported by the breaking waves and currents.

Most of the Perlis State coastline, excepting around Kuala Sanglang, is experiencing beach erosion. In Kuala Sanglang, the beach line has moved seaward by 500 meters in the last 10 years due to sediment accumulation. Therefore, the general pattern of littoral sand drift system in the Perlis coast is supposed that it originates at the mouth of the Perlis River and is deposited around Kuala Sanglang.

It is very difficult to evaluate theoretically the shoaling rate of the navigation channel as generally it depends on many combined factors such as geography, currents, tides, sand drift, channel depth and soil condition, so that it would be better to assess it from the actual field data of maintenance dredging at site. At Kuala Perlis, maintenance dredging for a small area was conducted in 1969 and 1970. Unfortunately, the records of the bathymetric surveys before and after dredging are so poor that it is not possible to estimate a siltation rate.

In order to predict the shoaling rate at Kuala Perlis, the dredging records at Satun of Thailand are adopted. Satun Port located about 20 km north of Kuala Perlis has similar natural conditions, such as composition of coast soil, wave conditions affected by Langkawi Island and the other islands and so on. Maintenance dredging of the approach channel, which has a -3.5 meter water depth and is 17 km long, is carried out periodically with bathymetry survey along the channel. As a result of calculation from the bathymetric change between 1982 and 1983, the annual siltation rate is obtained as approximately 60 cm/year. The siltation rate for Kuala Perlis is presumed to be greather than this number as the wave conditions along the Perlis coast are more severe than at Satun, where the channel is well protected against waves, being in a bay and sheltered by islands.

## Table 1.2.1 Mean Hourly Values of Tempcature (°C)

Year: 1981

| Hour / Month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | Mean | Mean Max. | Mean Min. | Range |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 24.0 | 23.8 | 23.6 | 23.4 | 23.2 | 23.0 | 22.9 | 23.8 | 26.0 | 28.0 | 29.5 | 30.7 | 31.3 | 31.8 | 31.6 | 31.2 | 30.1 | 28.4 | 26.7 | 25.5 | 24.9 | 24.6 | 24.3 | 24.1 | 26.5 | 33.1 | 22.7 | 10.4 |
| February | 24.6 | 24.4 | 24.0 | 23.8 | 23.6 | 23.6 | 23.5 | 24.3 | 27.1 | 29.4 | 31.0 | 32.4 | 33.5 | 34.0 | 33.4 | 32.4 | 30.9 | 29.4 | 27.8 | 26.6 | 26.0 | 25.5 | 25.1 | 24.8 | 27.5 | 35.3 | 23.3 | 12.0 |
| March | 25.2 | 24.9 | 24.7 | 24.4 | 24.2 | 24.1 | 24.0 | 25.2 | 27.9 | 29.9 | 31.7 | 33.1 | 33.9 | 34.4 | 34.5 | 33.7 | 32.2 | 30.3 | 28.7 | 27.5 | 26.8 | 26.3 | 26.0 | 25.6 | 28.3 | 35.9 | 23.8 | 12.1 |
| April | 24.9 | 24.7 | 24.5 | 24.5 | 24.3 | 24.3 | 24.4 | 25.6 | 27.8 | 29.3 | 30.5 | 31.4 | 31.9 | 31.9 | 31.2 | 30.6 | 29.1 | 28.3 | 27.0 | 26.3 | 25.9 | 25.6 | 25.3 | 25.1 | 27.3 | 33.5 | 24.0 | 9.5 |
| May | 25.1 | 25.0 | 24.7 | 24.6 | 24.5 | 24.4 | 24.4 | 25.9 | 28.1 | 29.5 | 30.6 | 31.2 | 31.3 | 31.2 | 30.6 | 29.9 | 29.0 | 27.7 | 26.7 | 26.1 | 25.7 | 25.5 | 25.3 | 25.2 | 27.2 | 33.0 | 24.1 | 8.9 |
| June | 25.1 | 24.8 | 24.7 | 24.5 | 24.2 | 24.0 | 24.1 | 25.5 | 27.6 | 29.0 | 30.1 | 30.7 | 31.1 | 31.0 | 30.9 | 30.7 | 30.2 | 29.2 | 27.7 | 26.8 | 26.3 | 25.9 | 25.6 | 25.3 | 27.3 | 32.5 | 23.8 | 8.7 |
| July | 24.7 | 24.4 | 24.1 | 24.0 | 23.7 | 23.5 | 23.6 | 24.9 | 27.2 | 28.6 | 29.7 | 30.5 | 30.9 | 30.9 | 30.9 | 30.3 | 29.7 | 28.7 | 27.2 | 26.3 | 25.8 | 25.5 | 25.2 | 24.9 | 26.9 | 32.4 | 23.3 | 9.1 |
| August | 24.5 | 24.3 | 24.1 | 23.9 | 23.7 | 23.6 | 23.7 | 25.2 | 27.6 | 29.2 | 30.2 | 30.9 | 31.4 | 31.5 | 31.4 | 31.0 | 30.3 | 29.2 | 27.4 | 26.3 | 25.8 | 25.4 | 25.0 | 24.7 | 27.1 | 32.9 | 23.3 | 9.6 |
| September | 24.6 | 24.4 | 24.3 | 24.1 | 24.0 | 23.8 | 24.0 | 25.3 | 27.4 | 28.8 | 30.0 | 30.8 | 30.6 | 30.3 | 30.1 | 29.7 | 28.5 | 27.4 | 26.3 | 25.7 | 25.3 | 25.1 | 24.9 | 24.7 | 26.7 | 32.3 | 23.6 | 8.7 |
| October | 24.4 | 24.2 | 24.0 | 23.8 | 23.6 | 23.5 | 23.6 | 25.4 | 27.7 | 29.2 | 30.1 | 30.6 | 30.7 | 30.5 | 29.9 | 29.3 | 28.5 | 27.5 | 26.3 | 25.7 | 25.3 | 25.0 | 24.8 | 24.6 | 26.6 | 32.5 | 23.3 | 9.2 |
| November | 24.0 | 23.9 | 23.8 | 23.7 | 23.5 | 23.4 | 23.5 | 24.7 | 26.3 | 27.5 | 28.5 | 28.8 | 29.0 | 29.1 | 28.9 | 28.2 | 27.3 | 26.3 | 25.4 | 25.0 | 24.8 | 24.5 | 24.3 | 24.2 | 25.8 | 30.9 | 23.2 | 7.7 |
| December | 23.7 | 23.6 | 23.5 | 23.4 | 23.3 | 23.2 | 23.2 | 24.1 | 25.8 | 27.1 | 28.2 | 29.0 | 29.3 | 29.3 | 29.0 | 28.7 | 27.9 | 26.5 | 25.3 | 24.7 | 24.4 | 24.1 | 24.0 | 23.9 | 25.6 | 30.7 | 22.9 | 7.8 |
| Mean | 24.6 | 24.4 | 24.2 | 24.0 | 23.8 | 23.7 | 23.7 | 25.0 | 27.2 | 28.8 | 30.0 | 30.8 | 31.2 | 31.3 | 31.0 | 30.5 | 29.5 | 28.2 | 26.9 | 26.0 | 25.6 | 25.2 | 25.0 | 24.8 | 26.9 | 32.9 | 23.4 | 9.5 |

Chuping Station, Perlis
Source: Meteorological Dept.

## Table 1.2.2. Mean Hourly Values of Relative Humidity (%)

Year: 1981

| Hour / Month | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | Mean | Mean ax. | Mean Min. | Range |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| January | 87.2 | 87.6 | 88.3 | 88.8 | 88.7 | 88.7 | 88.7 | 85.6 | 77.3 | 68.5 | 61.7 | 56.6 | 54.3 | 52.5 | 53.3 | 55.0 | 59.3 | 65.4 | 72.8 | 79.6 | 83.2 | 84.5 | 86.0 | 86.6 | 75.0 | 91.2 | 51.1 | 40.1 |
| February | 89.3 | 89.8 | 90.9 | 91.0 | 91.6 | 91.7 | 92.2 | 89.7 | 78.1 | 67.2 | 60.3 | 54.0 | 50.2 | 49.5 | 52.1 | 55.9 | 63.5 | 69.5 | 75.1 | 79.9 | 83.5 | 85.7 | 87.0 | 88.2 | 76.1 | 93.7 | 47.9 | 45.8 |
| March | 88.3 | 89.5 | 90.3 | 90.7 | 91.4 | 91.7 | 91.5 | 87.6 | 75.5 | 66.8 | 58.0 | 53.3 | 49.0 | 47.9 | 48.6 | 53.0 | 59.9 | 66.8 | 71.3 | 76.8 | 80.5 | 83.0 | 85.1 | 86.7 | 74.3 | 93.0 | 45.3 | 47.7 |
| April | 95.7 | 96.1 | 96.4 | 96.5 | 96.9 | 97.0 | 97.3 | 94.1 | 84.2 | 77.9 | 72.8 | 69.3 | 67.3 | 67.2 | 70.3 | 73.4 | 79.4 | 82.9 | 86.9 | 89.5 | 91.2 | 92.3 | 93.6 | 94.4 | 85.9 | 98.4 | 62.6 | 35.8 |
| May | 96.8 | 96.8 | 97.7 | 97.5 | 97.9 | 98.3 | 98.6 | 94.6 | 85.1 | 79.2 | 74.1 | 71.5 | 70.6 | 71.3 | 72.8 | 75.7 | 79.9 | 84.8 | 89.6 | 92.2 | 94.0 | 95.1 | 95.6 | 96.0 | 87.7 | 99.1 | 66.1 | 33.0 |
| June | 96.1 | 96.9 | 97.4 | 97.9 | 98.1 | 98.5 | 99.2 | 96.8 | 86.3 | 79.9 | 74.5 | 71.9 | 69.7 | 69.8 | 69.4 | 71.3 | 73.9 | 78.3 | 84.2 | 88.1 | 90.3 | 92.3 | 93.8 | 94.6 | 86.2 | 99.4 | 64.9 | 34.5 |
| July | 95.3 | 96.0 | 96.8 | 97.1 | 97.4 | 98.0 | 98.6 | 95.7 | 85.4 | 79.3 | 74.6 | 69.2 | 67.7 | 67.8 | 67.2 | 69.2 | 72.6 | 77.0 | 84.5 | 88.5 | 90.8 | 91.9 | 93.2 | 94.6 | 85.3 | 98.9 | 63.4 | 35.5 |
| August | 95.5 | 96.0 | 96.5 | 96.9 | 97.3 | 97.6 | 98.2 | 95.7 | 84.0 | 77.4 | 71.9 | 67.1 | 65.7 | 63.8 | 64.7 | 65.9 | 69.2 | 75.2 | 83.8 | 88.5 | 90.3 | 91.6 | 93.3 | 94.5 | 84.2 | 98.8 | 61.5 | 37.3 |
| September | 95.2 | 95.3 | 96.1 | 96.4 | 96.3 | 96.9 | 97.3 | 93.6 | 84.2 | 77.7 | 71.3 | 67.6 | 68.6 | 69.1 | 69.9 | 71.6 | 76.3 | 81.9 | 87.8 | 89.9 | 92.6 | 93.0 | 94.1 | 94.9 | 85.7 | 98.4 | 64.3 | 34.1 |
| October | 95.9 | 96.1 | 96.9 | 97.2 | 97.5 | 97.9 | 98.5 | 93.6 | 83.4 | 75.9 | 70.4 | 69.0 | 67.7 | 68.5 | 70.9 | 73.3 | 76.2 | 81.3 | 87.2 | 90.0 | 92.1 | 93.2 | 94.5 | 95.6 | 85.9 | 98.9 | 62.9 | 36.0 |
| November | 96.2 | 96.4 | 96.5 | 96.7 | 96.9 | 97.3 | 97.6 | 93.5 | 86.6 | 82.1 | 77.6 | 75.8 | 74.7 | 74.3 | 75.0 | 77.6 | 81.6 | 86.4 | 89.8 | 91.8 | 92.7 | 93.7 | 94.5 | 95.3 | 88.4 | 98.2 | 70.0 | 28.2 |
| December | 89.5 | 89.7 | 90.1 | 90.3 | 90.7 | 91.3 | 91.5 | 89.1 | 83.0 | 76.5 | 71.8 | 69.0 | 66.7 | 67.6 | 68.4 | 69.8 | 72.5 | 77.3 | 82.5 | 85.3 | 86.9 | 88.0 | 88.8 | 89.0 | 81.9 | 92.8 | 64.8 | 28.0 |
| Mean | 93.4 | 93.8 | 94.5 | 94.7 | 95.1 | 95.4 | 95.8 | 92.4 | 82.8 | 75.7 | 69.9 | 66.2 | 64.3 | 64.1 | 65.2 | 67.6 | 72.0 | 77.2 | 83.0 | 86.7 | 89.0 | 90.4 | 91.6 | 92.5 | 83.1 | 96.7 | 60.4 | 36.3 |

Chuping Station, Perlis
Source: Meteorological Dept.

Table 1.2.3 Monthly Wind Wave and Swell Condition in Malacca Strait

Year: 1976 - 1981

| MONTH | Wind Wave | | | | Swell | | | |
|---|---|---|---|---|---|---|---|---|
| | Average Period (seconds) | Average Height (meters) | Max. Period (seconds) | Max. Height (meters) | Average Period (seconds) | Average Height (meters) | Max. Period (seconds) | Max. Height (meters) |
| January | 2 | 0.7 | 9 | 3.0 | 6 | 1.0 | 14 | 3.0 |
| February | 2 | 0.7 | 7 | 2.5 | 6 | 1.0 | 14 | 3.5 |
| March | 2 | 0.6 | 9 | 2.0 | 6 | 0.9 | 14 | 3.0 |
| April | 2 | 0.6 | 9 | 1.5 | 6 | 0.9 | 14 | 4.0 |
| May | 2 | 0.7 | 8 | 3.0 | 7 | 1.1 | 14 | 4.0 |
| June | 2 | 0.7 | 7 | 3.0 | 6 | 1.1 | 14 | 4.0 |
| July | 2 | 0.7 | 8 | 2.5 | 7 | 1.1 | 14 | 3.0 |
| August | 2 | 0.7 | 9 | 3.0 | 6 | 1.2 | 14 | 3.5 |
| September | 2 | 0.7 | 8 | 3.0 | 7 | 1.1 | 14 | 3.5 |
| October | 2 | 0.7 | 8 | 3.0 | 7 | 1.0 | 14 | 2.5 |
| November | 2 | 0.7 | 6 | 3.0 | 7 | 1.0 | 14 | 3.0 |
| December | 2 | 0.7 | 8 | 2.5 | 6 | 1.1 | 14 | 3.5 |

Source: Meteorological Dept.

(Region: Lat. 0°N - 7°N, Long. 95°N - 104°E)

Table 1.2.4 Recent Flood Records at Kangar

| No. | Date | Duration (day) | Water Level at Kangar (meters) |
|---|---|---|---|
| 1 | Sept. 1972 | | 2.84 |
| 2 | Dec. 1972 | 7 | 2.64 |
| 3 | Aug. 1973 | 5 | 2.65 |
| 4 | Dec. 1973 | 9 | 2.80 |
| 5 | Sept. 1976 | 13 | 3.11 |
| 6 | Nov. 1976 | 5 | 2.44 |
| 7 | Sept. 1977 | 8 | 2.53 |
| 8 | Nov. 1979 | 4 | 2.70 |
| 9 | Oct. 1980 | 6 | 2.68 |
| 10 | July 1982 | 8 | 3.11 |
| 11 | Sept. 1982 | 5 | 2.58 |

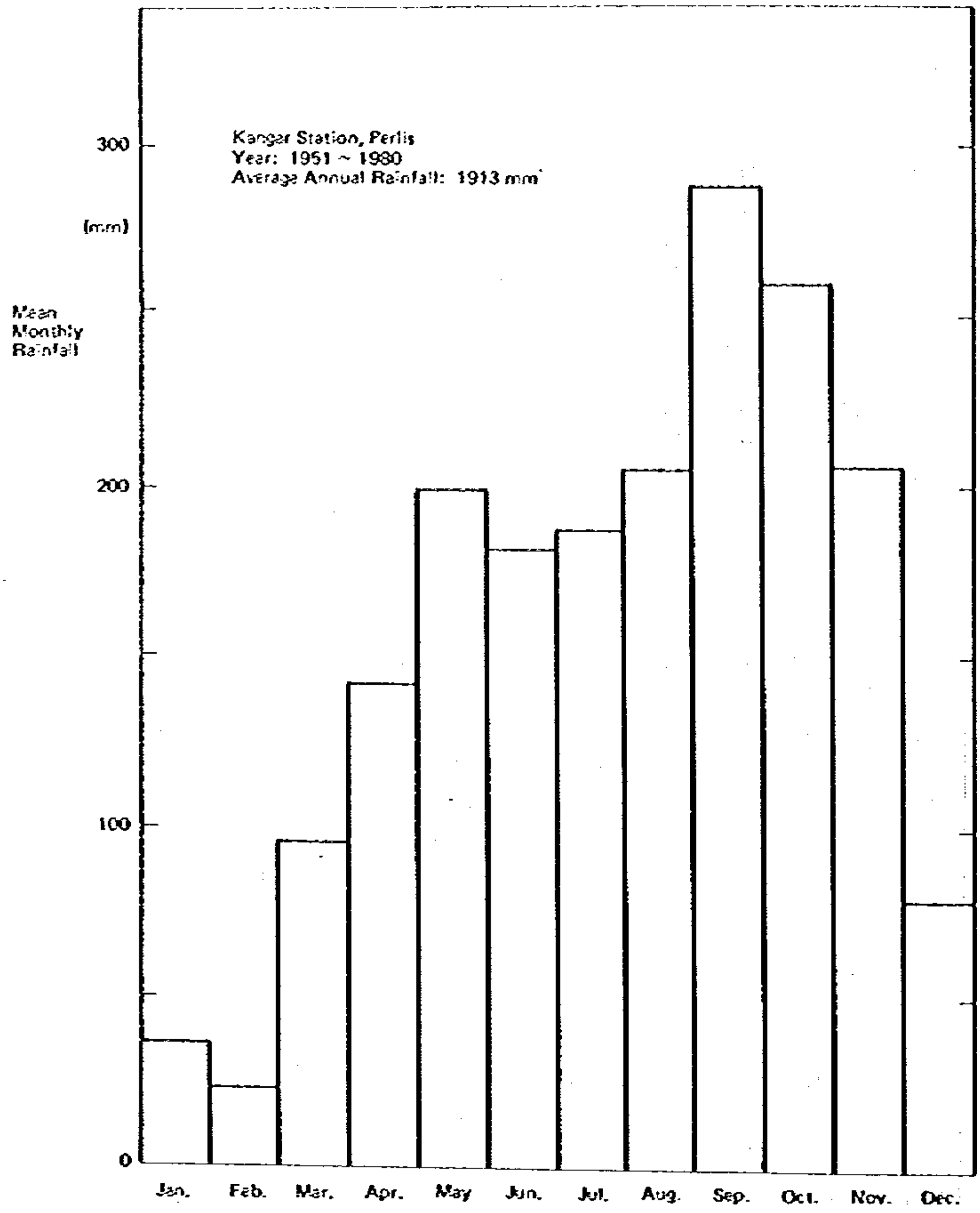
(Elevation at Kangar: around 2.1 meters)

Table 1.2.5 (a) Refraction Coefficient at Kuala Perlis

| Wave Period \ Direction | WSW | SW | SSW | S |
|---|---|---|---|---|
| 4.8 sec | 0.49 | 0.89 | 0.94 | 0.78 |
| 8.0 sec | 0.56 | 0.77 | 0.85 | 0.74 |

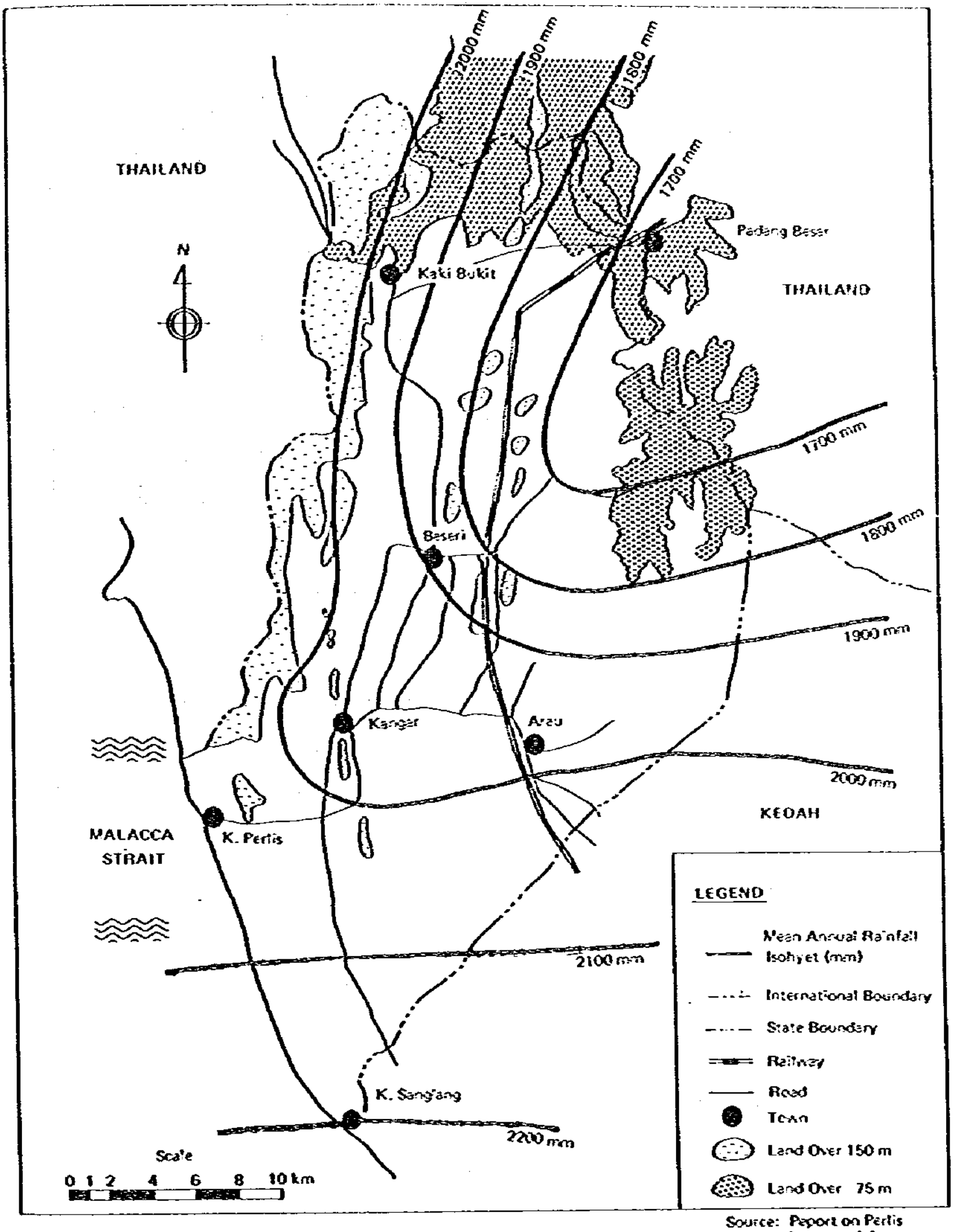
Table 1.2.5 (b) Refraction Coefficient at Kuala Sanglang

| Wave Period \ Direction | WSW | SW | SSW | S |
|---|---|---|---|---|
| 4.8 sec | 0.91 | 1.00 | 1.00 | 0.85 |
| 8.0 sec | 0.63 | 0.85 | 0.82 | 0.67 |




Source: Meteorological Dept.

**Fig. 1.2.1 Average Monthly Rainfall**




Source: Report on Perlis Integrated Area Development Project

**Fig. 1.2.2 Mean Annual Rainfall Isohyets, Perlis**

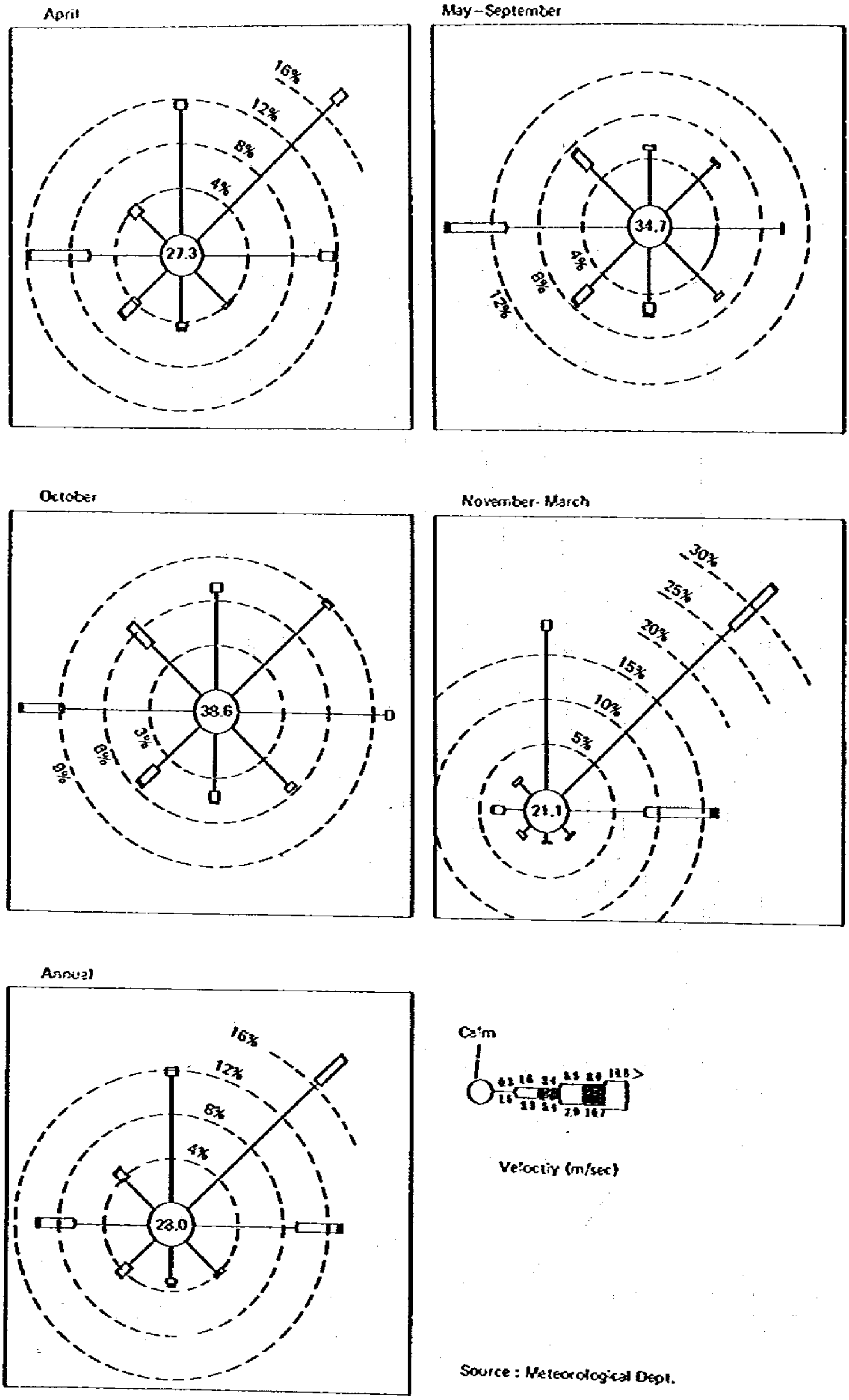



Fig. 1.2.3 Wind Rose Summary at Alor Setar, Kedah, 1968–1977

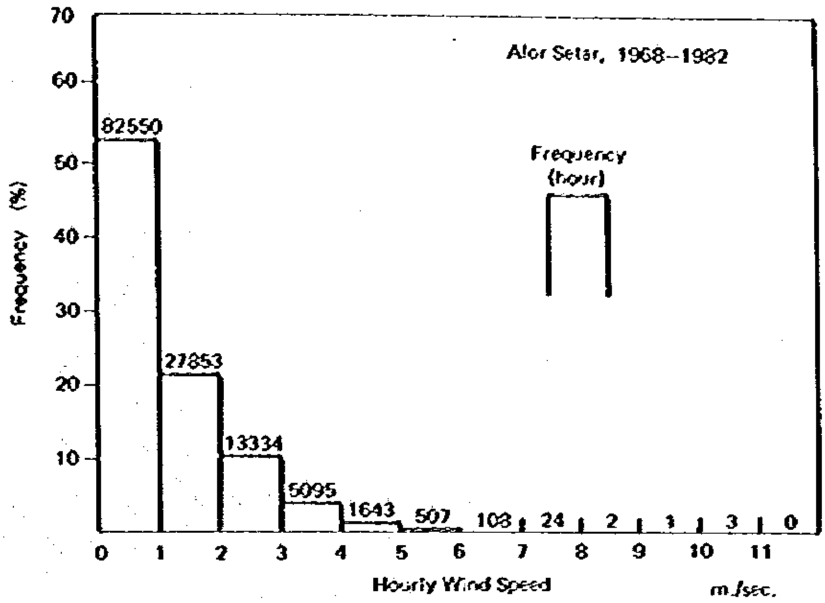



Fig. 1.2.4 Frequency of Mean Hourly Wind Speed

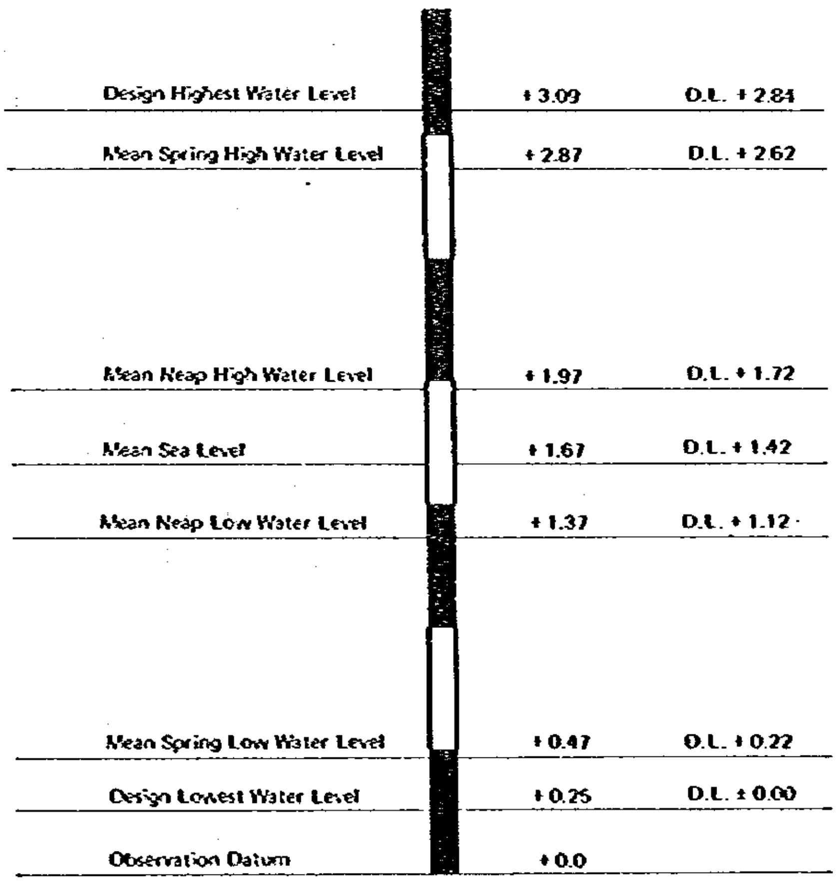



Fig. 1.2.5 Tide Datum

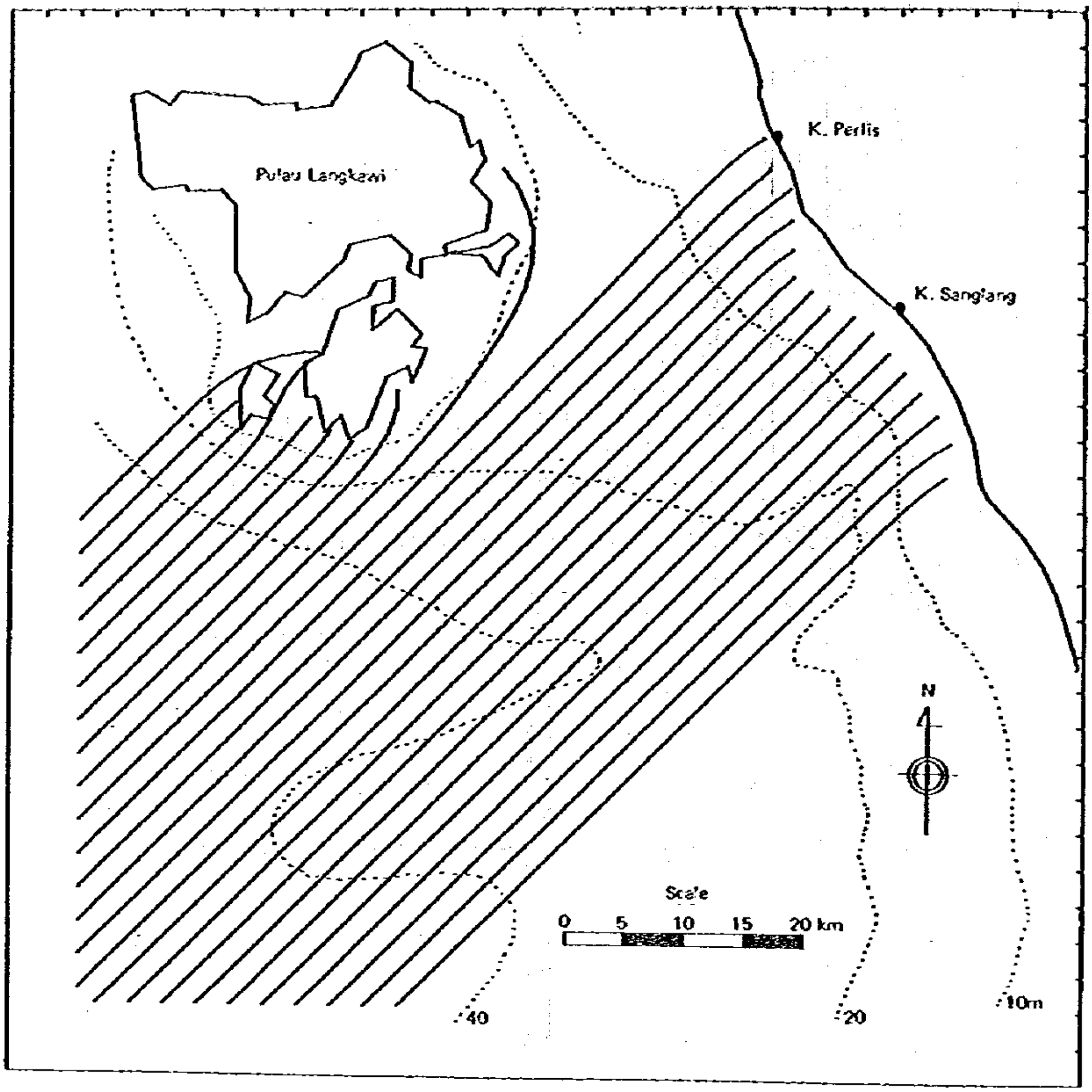



Fig. 1.2.6 (a) Wave Refraction Diagram
(Wave Period: 4.8 seconds
Wave Direction: SW)

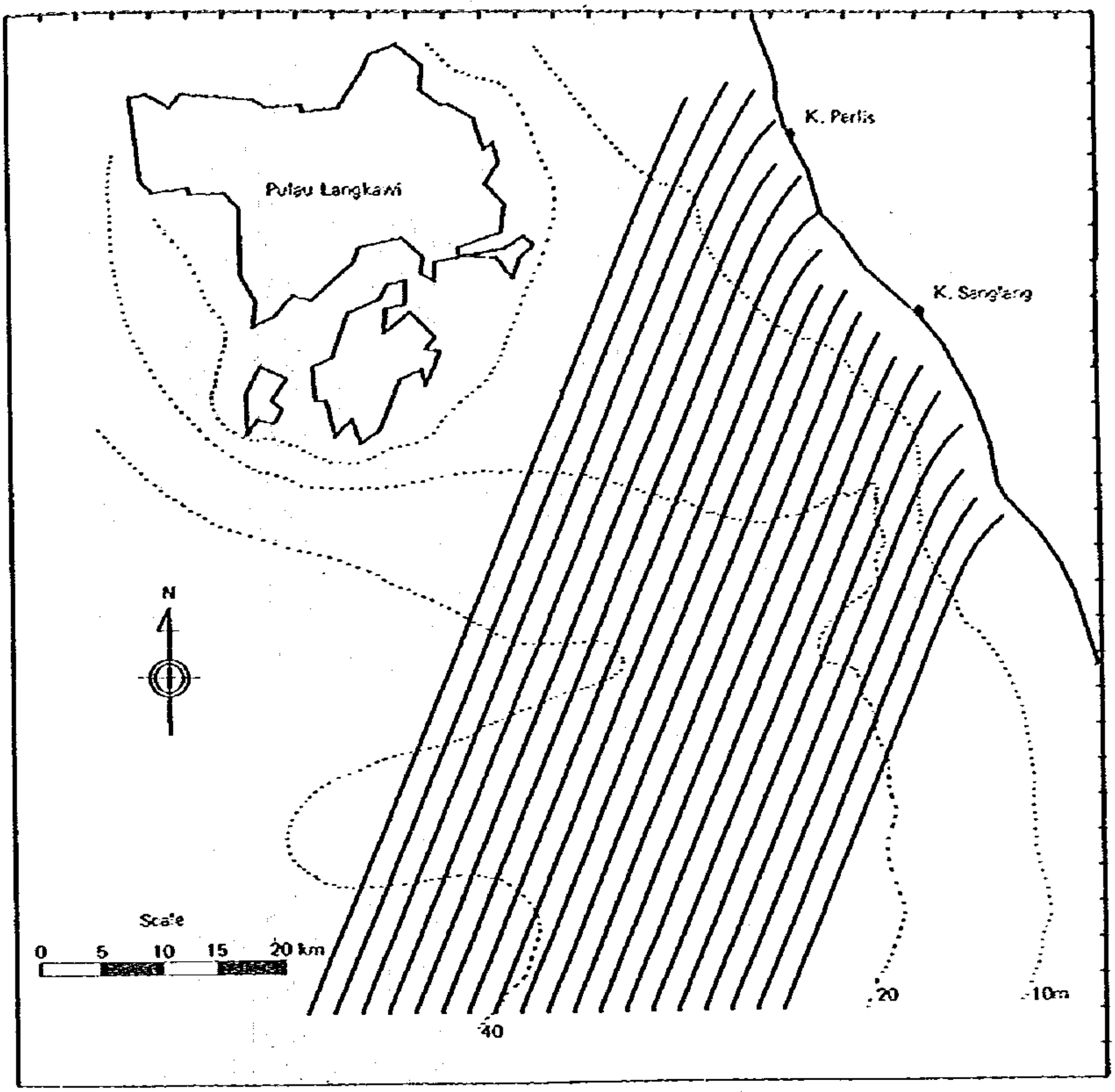
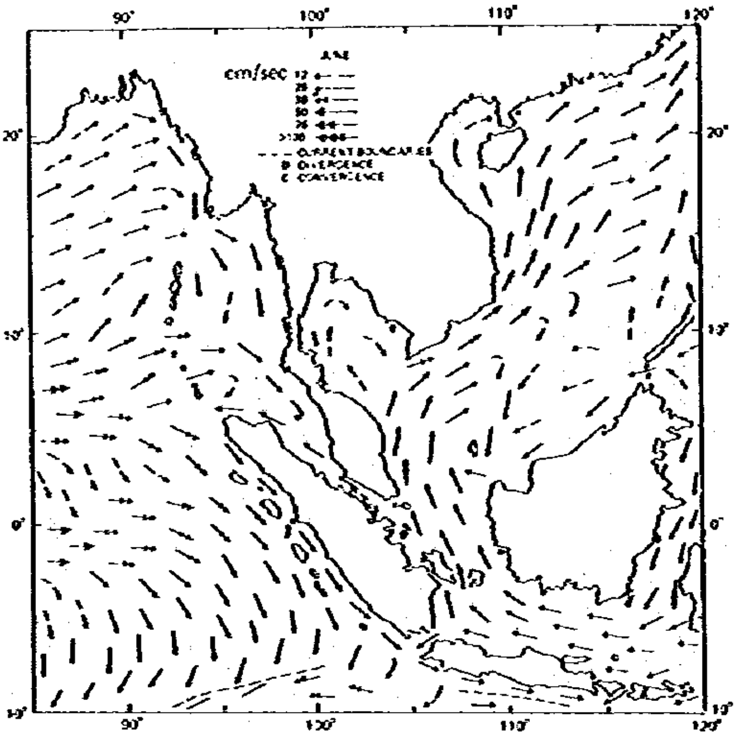
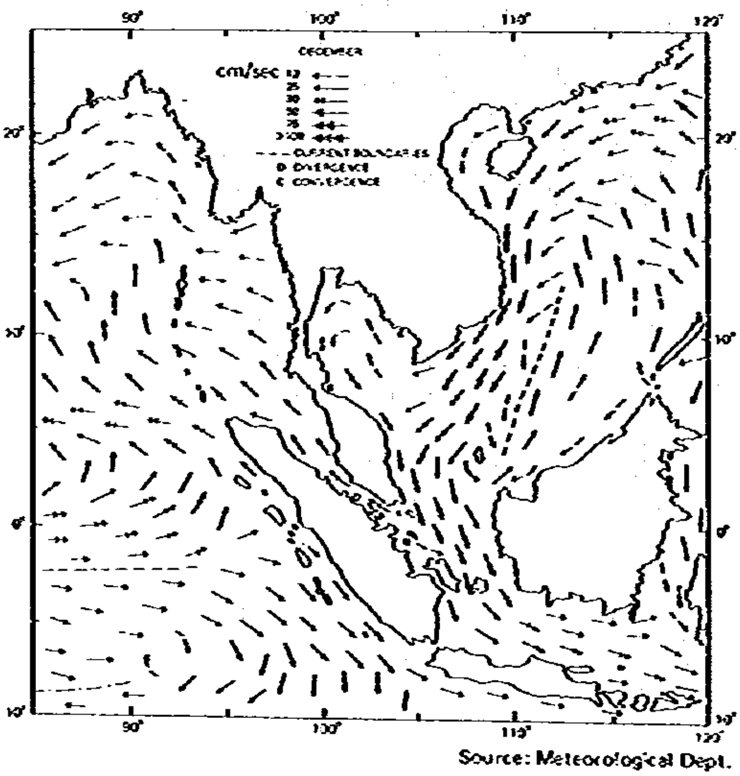



Fig. 1.2.6 (b) Wave Refraction Diagram
(Wave Period: 4.8 seconds
Wave Direction: SSW)

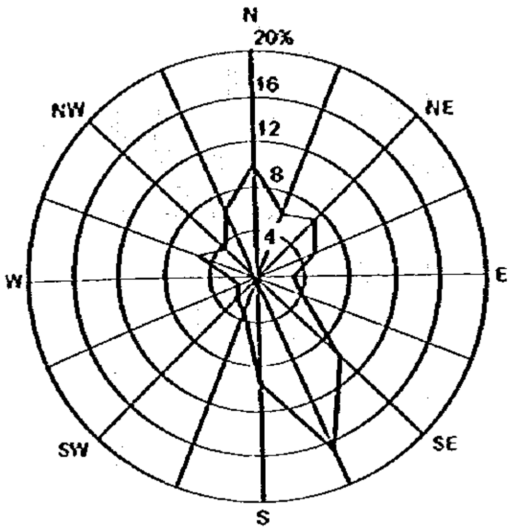



(a) Surface currents in June.

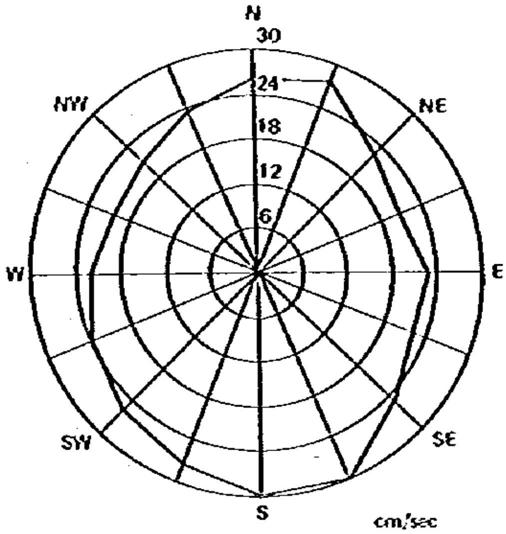



(b) Surface currents in December.

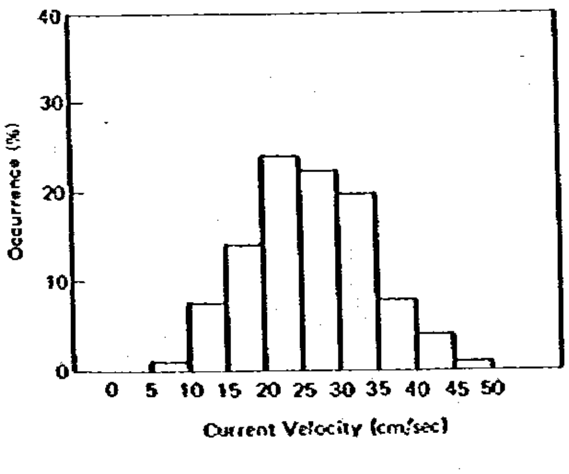
Fig. 1.2.7 Ocean Current Profile




(a) Direction of Tidal Current




(b) Mean Velocity of Tidal Current




(c) Current Velocity Distribution

Fig. 1.2.8 Characteristics of Tidal Current at Kuala Perlis

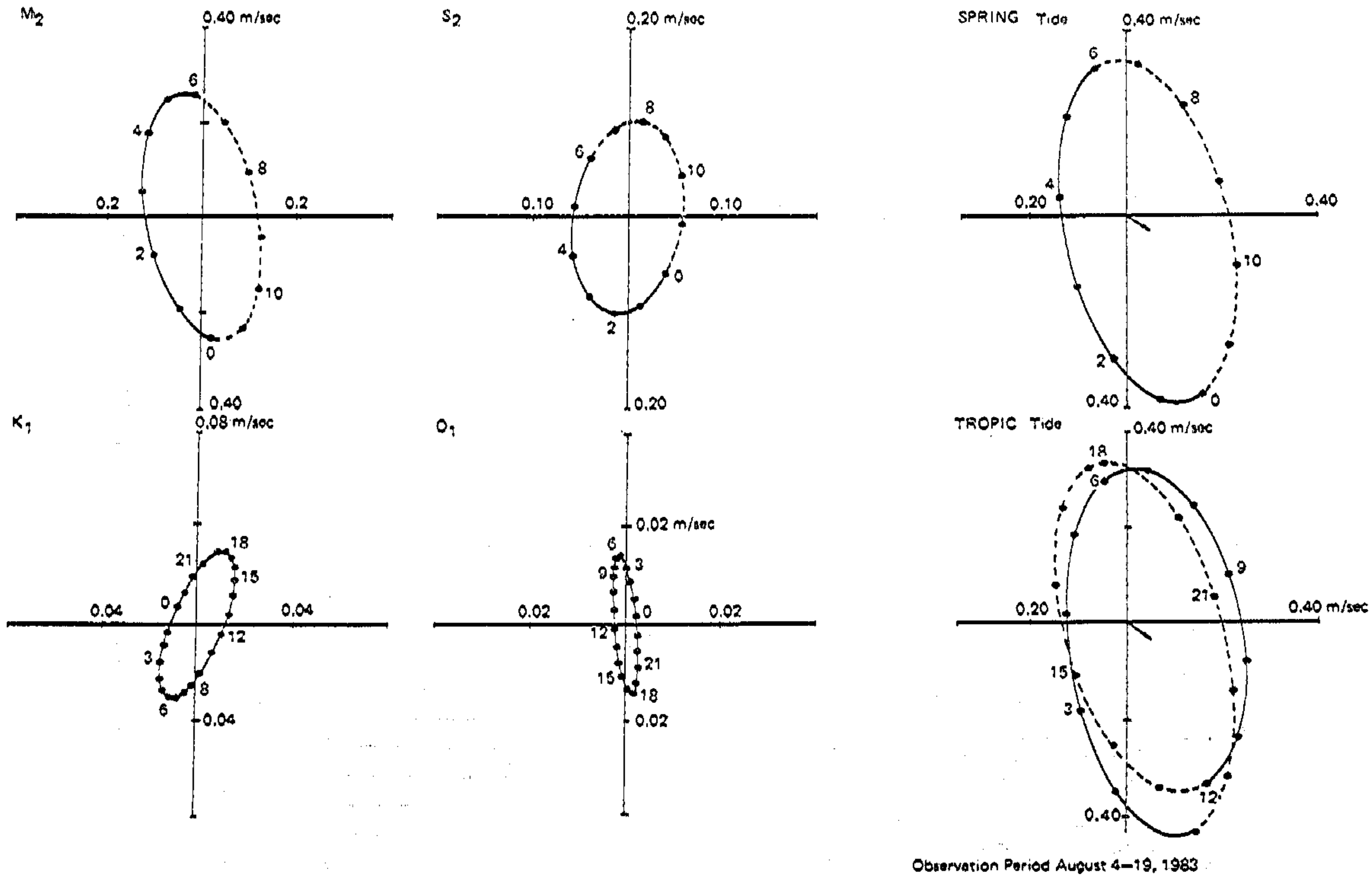
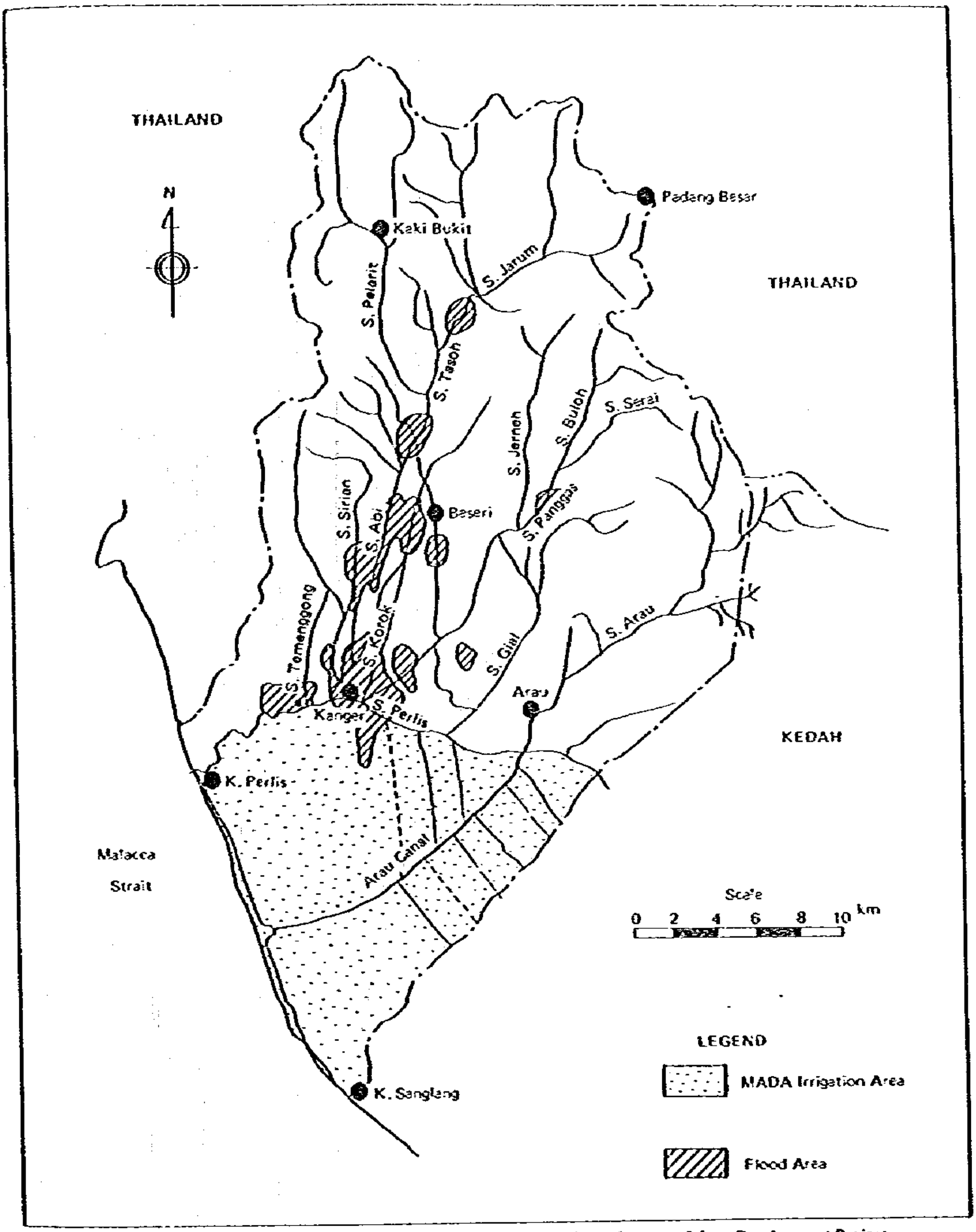



Fig. 1.2.9 Tidal Current Ellipse at Kuala Perlis




Source: Report on Perlis Integrated Area Development Project

Fig. 1.2.10 Drainage Network, Perlis

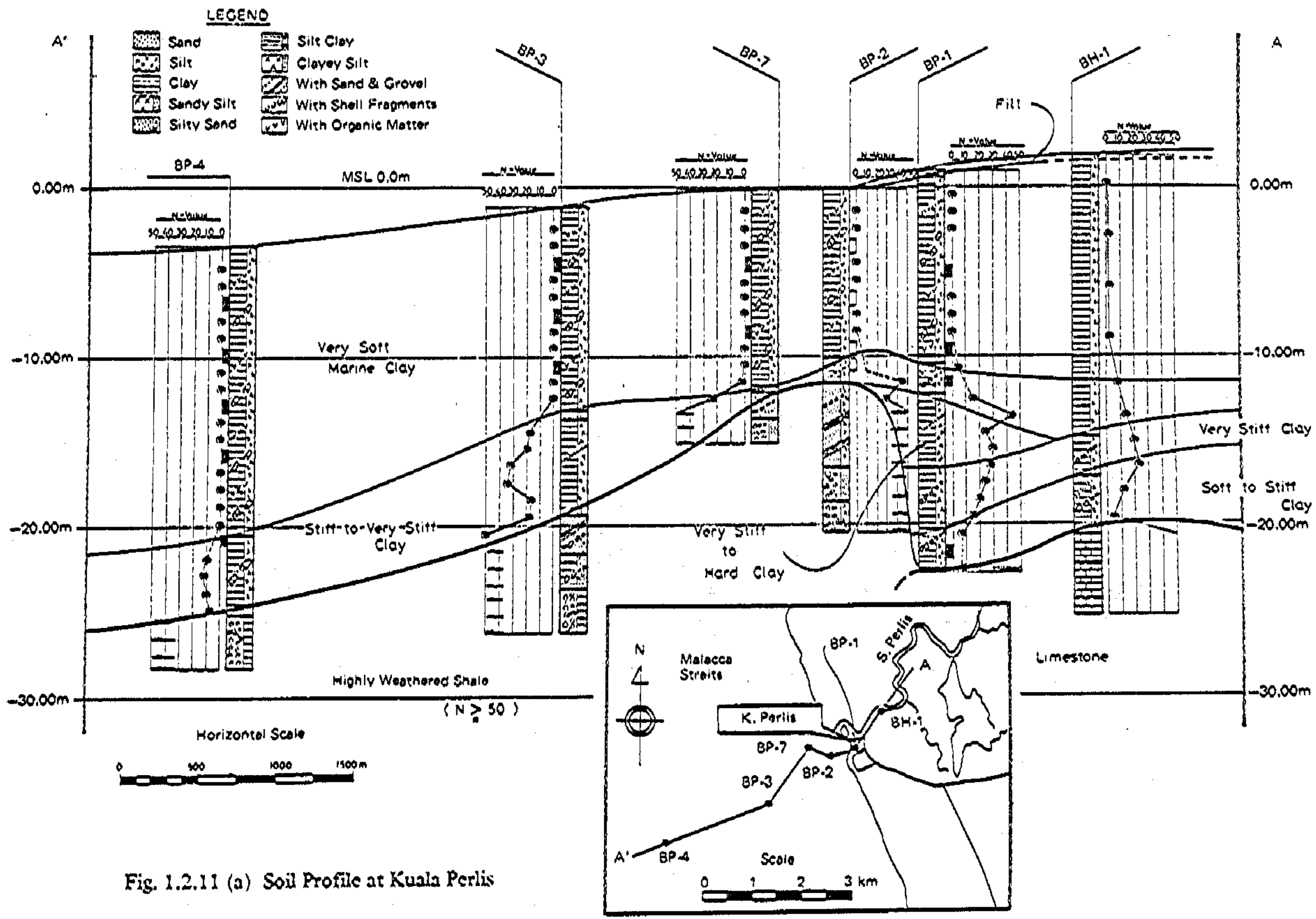



Fig. 1.2.11 (a) Soil Profile at Kuala Perlis

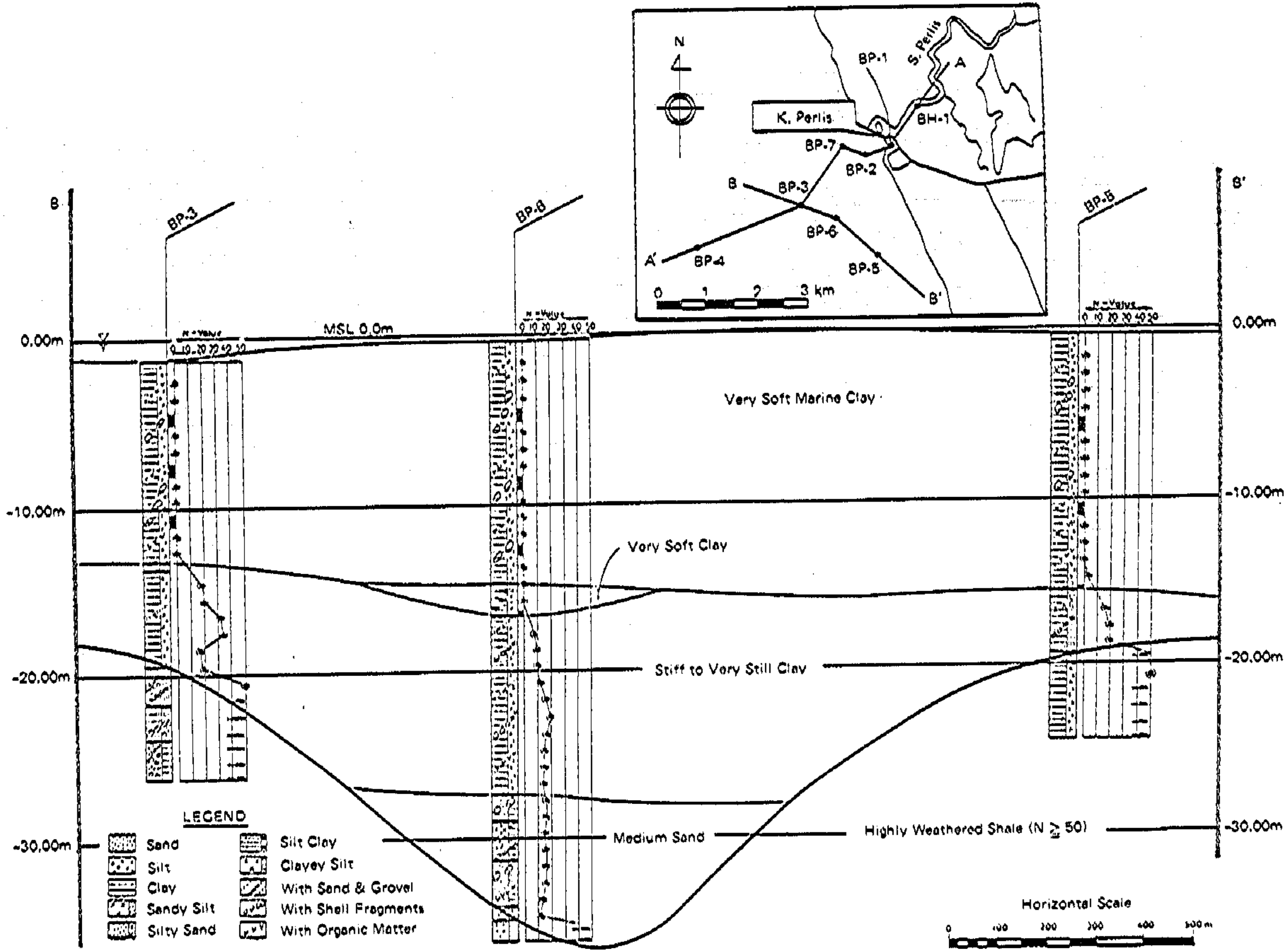


Fig. 1.2.11 (b) Soil Profile at Kuala Perlis

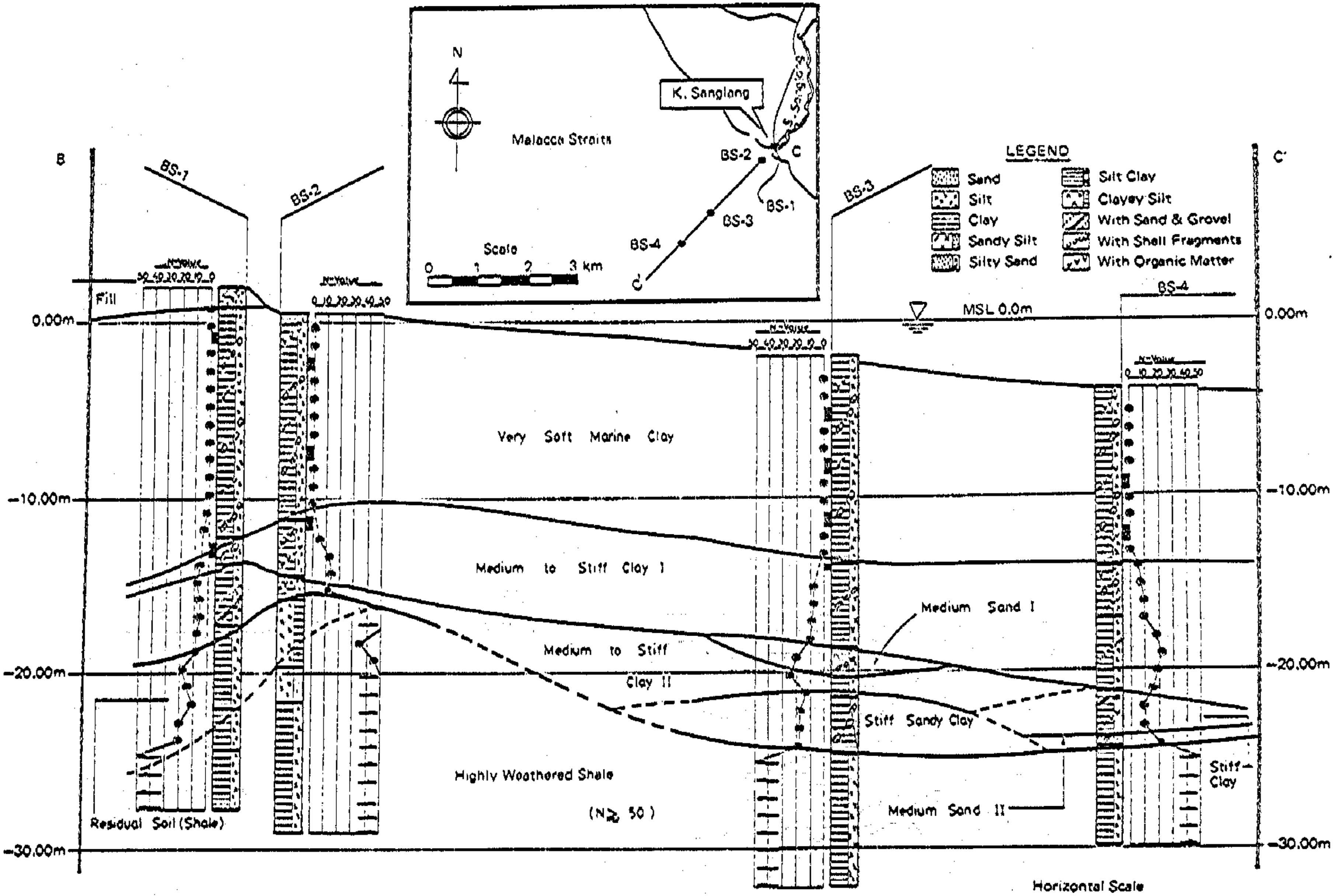



Fig. 1.2.12 Soil Profile at Kuala Sanglang

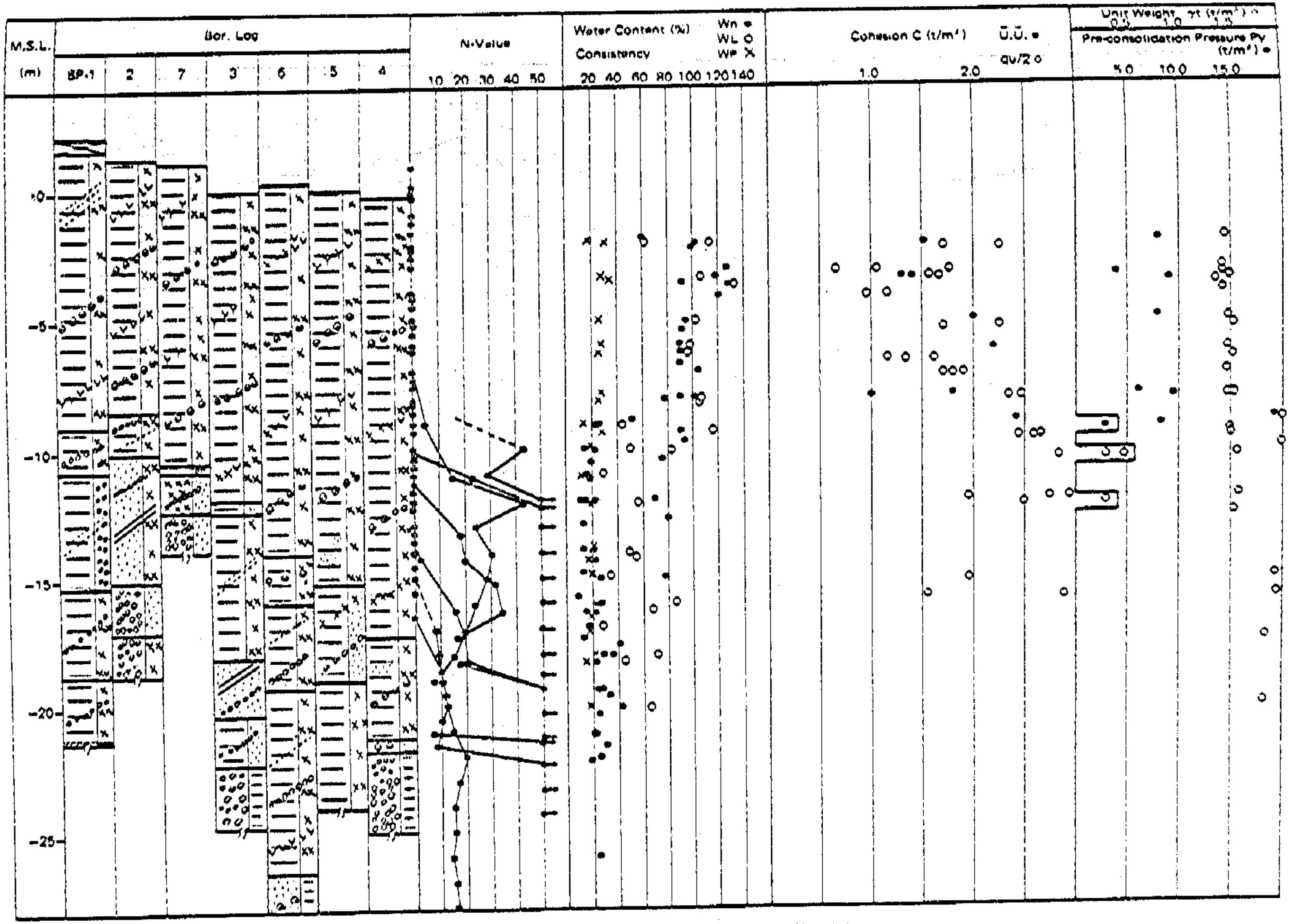



Fig. 1.2.13 Soil Testing Result (Kuala Perlis)

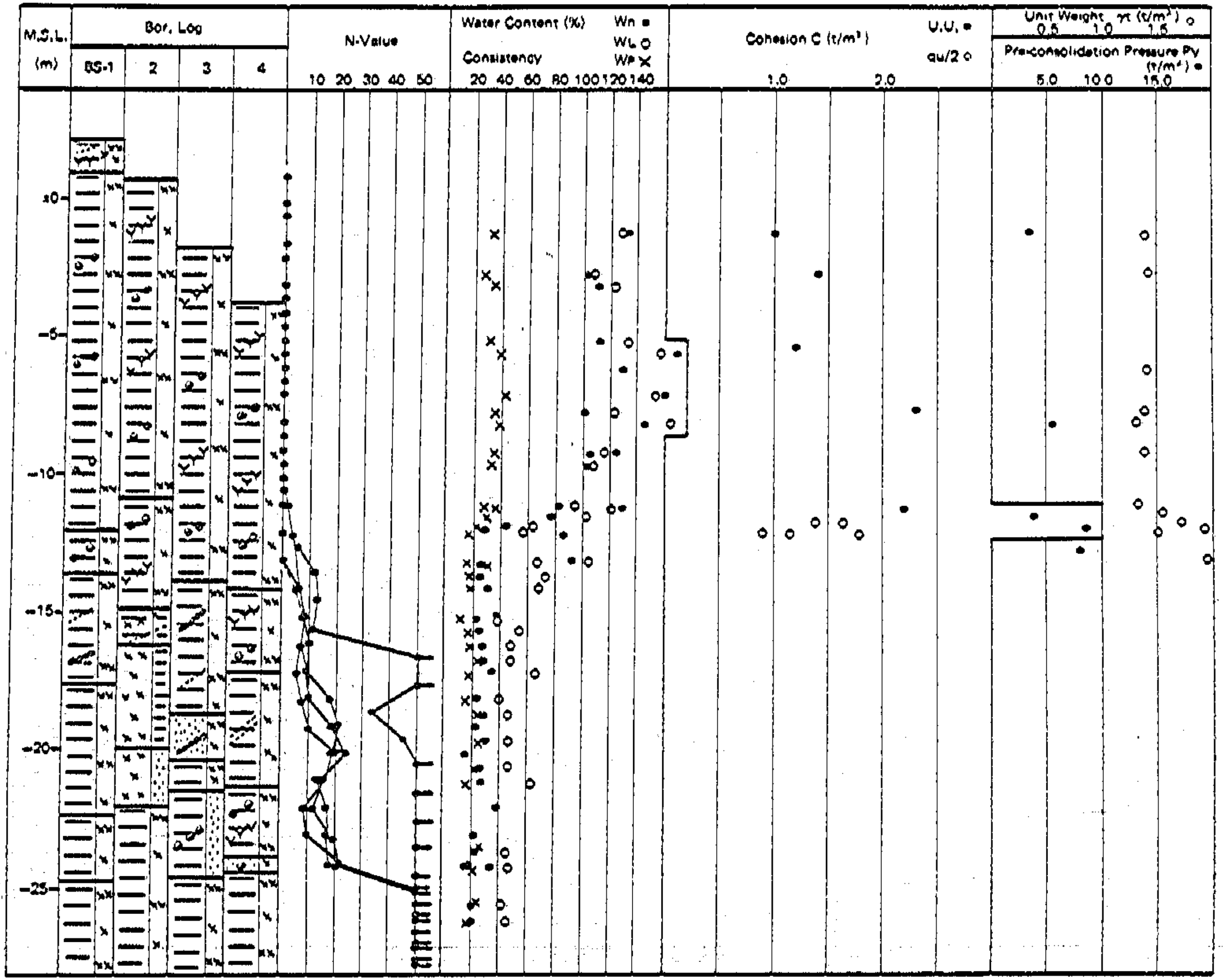
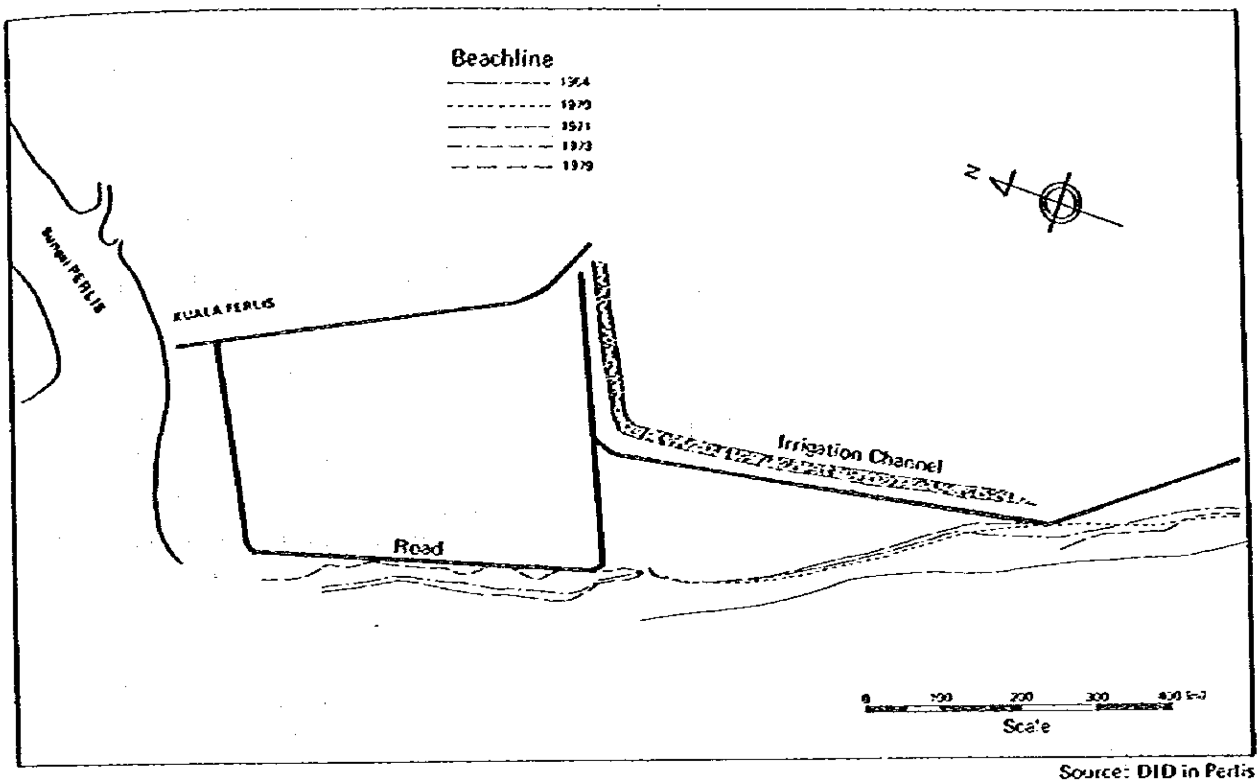
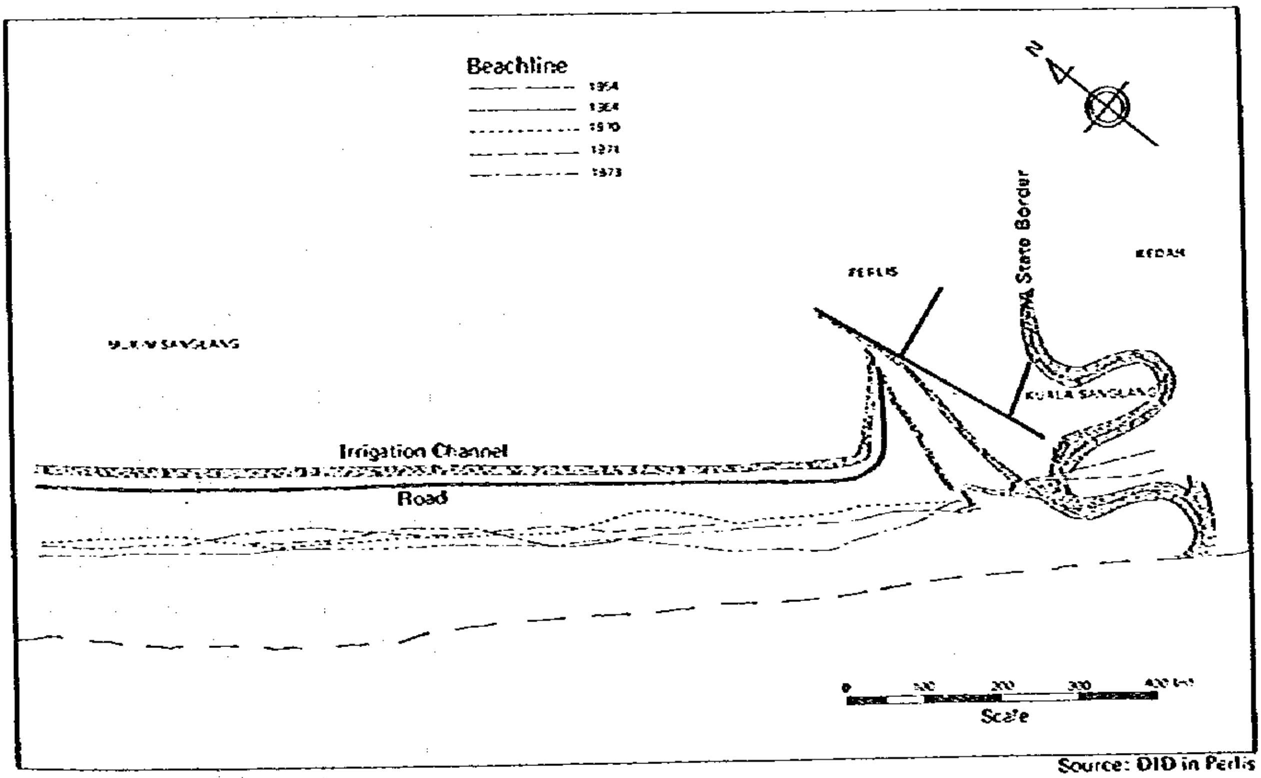



Fig. 1.2.14 Soil Testing Result (Kuala Sanlang)




Source: DID in Perlis

**Fig. 1.2.15 Beachline Transformation adjacent to Kuala Perlis**




Source: DID in Perlis

**Fig. 1.2.16 Beachline Transformation adjacent to Kuala Sanglang**

### 1.2.2 The Present Condition of the Ports

#### (1) Kuala Perlis Port

1) Geographical Conditions

Kuala Perlis Port is located on the northernmost stretch of the west coast of Peninsular Malaysia, about 2 km south from the Thai border and about 10 km southwest from the state capital of Kangar. It is an estuary port built at the mouth of the Perlis River.

The sea area in front of the port is calm, as it is protected from waves by Langkawi Island which lies about 30 km offshore.

The tideland which extends about 2 km from the coast consists of a shoaling beachs with an average slope about 1/1600. This same slope continues out to a water depth of about 5 m.

Both banks of the estuary are congested with small jetties, sheds for marine products and private houses. The town is located behind the left bank (see Fig. 1.2.7, Fig. 1.2.8).

The distances to neighbouring ports are 19 km to Satun Port in Thailand (Temalang district), 37 km to Kuala Kedah Port in Kedah State and 34 km to Kuah Port on Langkawi Island.

2) Port Activity

Kuala Perlis Port has the dual function of a commercial port and a fishing port.

The details of these functions are as follows.

a) Commercial Port Functions

The port functions as a base for the passenger ferry service to Langkawi Island which lies about 30 km to the west and for the passenger traffic with Thailand. It is also a base port for coastal trade with Thailand carried out by small ships.

There are 8 passenger ferries in service (ship type 50 – 130 G/T, max. draft 1.8 m) and passengers for Langkawi Island are increasing annually, having reached 280,000 (round trip) in 1980 (see Table 1.2.6, 1.2.7).

Cargo for Langkawi Islands is divided between portable size, which is shipped on the passenger ferries, and large size cargo such as construction materials and processed foods, which are transported from Kuala Kedah Port in Kedah State.

Passenger transportation to Thailand is carried out by small boats of less than 10 G/T and the number of passengers is given as 160,000 max. according to past statistics but it is estimated to actually be near 300,000 (see Table 1.2.8).

Coastal trade is mostly carried out by small ships of 20 or 30 G/T mostly to and from the community of Satun in South Thailand.

According to customs statistics, the yearly volume of cargo handled at Kuala Perlis Port is around 10,000 tons, about 90% of which is imports and 10% exports. Including cargo not reported, the volume is estimated to actually be about 5 times this figure.

The main articles of trade include timber, fish meal fertilizer and marine products, machine parts, charcoal, and fruits are as imports, and food and light industrial goods, as exports.

b) Fishing Port Functions

Kuala Perlis Port is the largest fishing port in Perlis State but it is about average when considering all of Peninsular Malaysia.

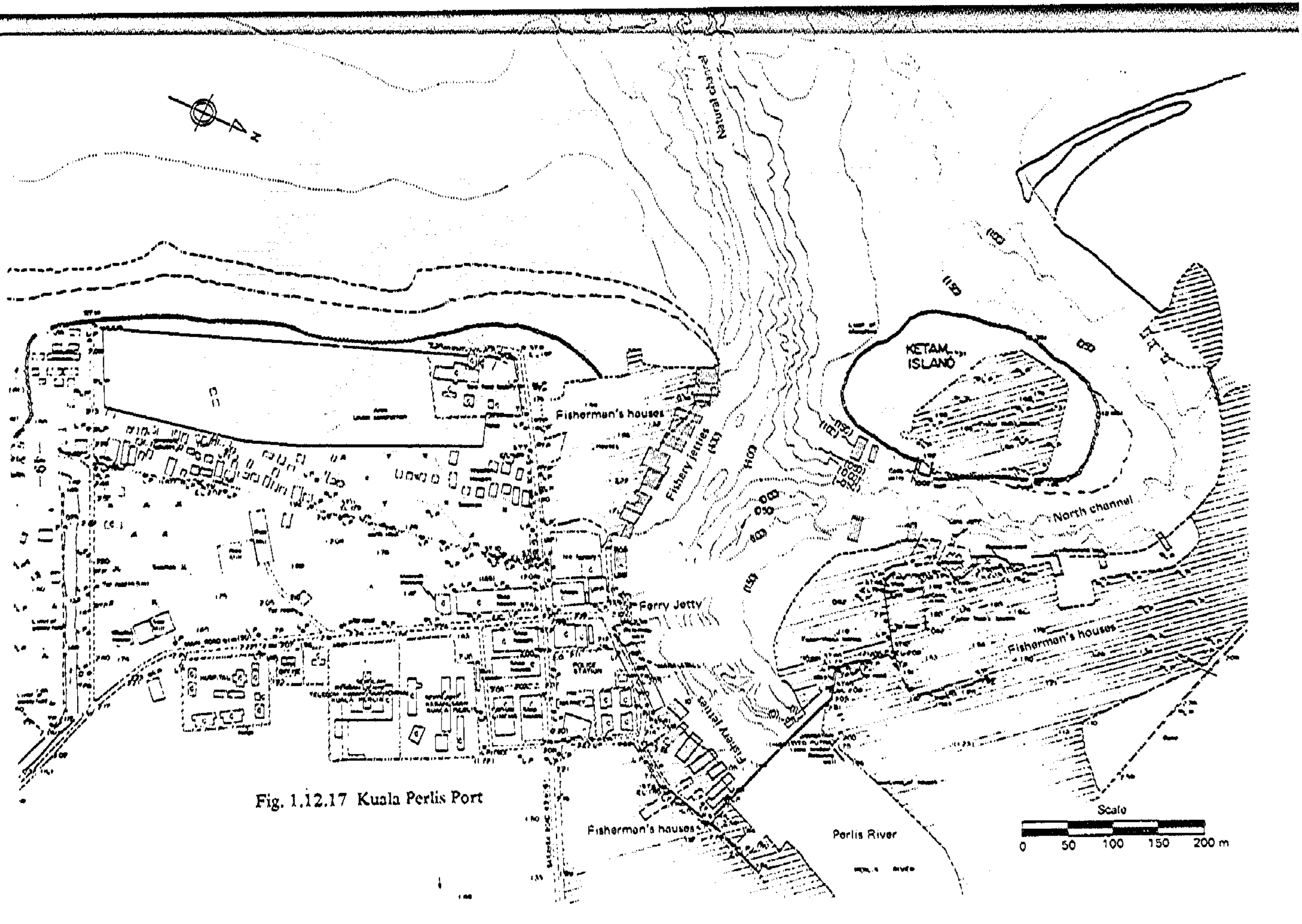



Fig. 1.12.17 Kuala Perlis Port

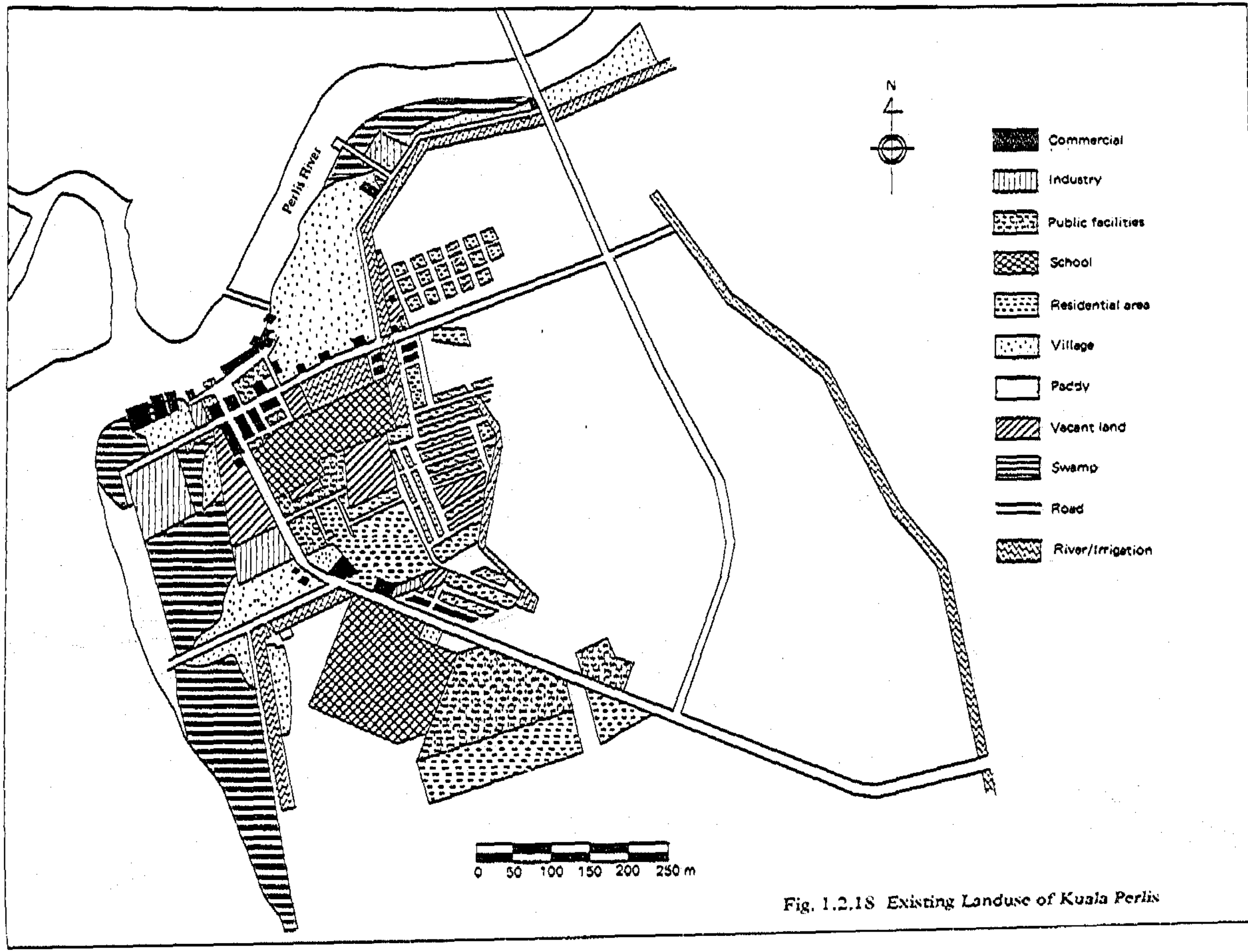



Fig. 1.2.18 Existing Landuse of Kuala Perlis

Table 1.2.6 Ferries in Service Between Kuala Perlis and Langkawi Island

(January 1984)

| Ferry | Tonnage | | Number of Passengers |
|---|---|---|---|
| | Net | Gross | |
| 1. Kijang Mas (Hovercraft) | 38.74 | 50.75 | 84 |
| 2. Pantas Express | 31.69 | 60.59 | 70 |
| 3. Express | 71.98 | 130.00 | 130 |
| 4. Bintang Utara | 79.20 | 122.19 | 96 |
| 5. Pulau Singa | 45.48 | 55.55 | 94 |
| 6. Insan Jaya | 62.00 | 100.00 | 120 |
| 7. Ambar | 52.85 | 81.30 | 90 |
| 8. Kasturi | 26.36 | 45.29 | 60 |

Source: SEDC PERLIS – Research Data January 1984

Table 1.2.7 Number of Ferry Passengers

(Unit: persons/year)

| Year | Kuala Perlis → Langkawi | Langkawi → Kuala Perlis | Total |
|---|---|---|---|
| 1976 | 104,281 | 82,976 | 187,257 |
| 1977 | 121,997 | 86,974 | 208,971 |
| 1978 | 114,006 | 86,322 | 200,328 |
| 1979 | 125,362 | 107,534 | 232,896 |
| 1980 | 140,970 | 135,595 | 276,565 |

Source: SEPU Perlis

Table 1.2.8 Number of Passengers between Thailand and Malaysia

(Unit: Persons/year)

| Year | Inbound | Outbound | Total |
|---|---|---|---|
| 1976 | 51,077 | 59,846 | 110,924 |
| 1977 | 57,245 | 57,233 | 114,478 |
| 1978 | 77,935 | 60,272 | 138,207 |
| 1979 | 75,941 | 78,535 | 154,476 |
| 1980 (–June) | 42,485 | 41,803 | 84,288 |

Source: IMI

Three thousands and three fishermen are registered in Perlis State, and 78%, or 2351 of these, are registered in Kuala Perlis Port.

By race, 823 Malays, 33 Chineses, and 1,495 Thais are registered, this group being characterized by a large number of immigrants from Thailand.

Four hundreds and forty eight boats, or 70% of the 664 boats registered in the state, are based at Kuala Perlis Port.

Most of these have inboard motors and although max. G/T is 70 tons, most are less than 25 tons.

By type, there are 198 trollers, 137 gill netters, 79 seiners and 35 anglers (see Table 1.2.9).

The catch in 1982 was 31,720 tons, of which 92% were catched by seiners and trollers (see Table 1.2.10).

The main catches are horse mackerel, sardine, prawn, and shellfish. Nationwide horse mackerel is taken in the largest numbers, and prawns are highest in value.

Besides these boats registered at Kuala Perlis, a monthly average of 470 Thai fishing boats enter the port (680 at maximum), and produce an annual catch of about 40,000 tons.

Table 1.2.9 shows the number of fishing boats by type and by fishing method at Kuala Perlis Port.

Table 1.2.9 Number of Fishing Boats by Type and by Fishing Method at Kuala Perlis Port

| Type \ Fishing Method | | Trawl | Purse Seine | Gill/Drift Net | Trop Net | Hook and Line | Total |
|---|---|---|---|---|---|---|---|
| In board | < 10 ton | 45 | | 72 | | 11 | 128 |
| | 10 – 25 ton | 134 | | 3 | | 7 | 144 |
| | 26 – 40 ton | 17 | 43 | 3 | | 9 | 72 |
| | 40 ton < | 2 | 33 | | | | 35 |
| | Total | 198 | 76 | 78 | | 27 | 379 |
| Out board | | | 2 | 57 | | 3 | 62 |
| None Powered | | | | 2 | | 5 | 7 |

Source: Annual Fisheries Statistic Kedah/Perlis 1982

Table 1.2.10 Estimate of Marine Products by Fishing Method at Kuala Perlis Port

(in 1982)

| | |
|---|---|
| Trollers | 5,600 Metric Ton |
| Seiners | 23,600 〃 |
| Gill Netters | 330 〃 |
| Anglers | 190 〃 |
| Others (Shellfish) | 2,000 〃 |
| Total | 31,720 Metric Ton |

3) The Present Condition of the Port Facilities

a) Navigation Channel

Natural waterways formed by the flow of the Perlis River are used for the navigation channel at Kuala Perlis Port.

The width of the river at the estuary is about 150 m and a lowtide water depth of about 2 m is maintained. Tideland developed by the accumulation of coastal drift sands, and soil and sand flow from the river, extends from the estuary for about 4 km. The water depth of the navigation channel is about 60 cm at low tides, blocking the traffic of ferries and fishing boats. From 1969 to 1970 the navy carried out dredging of the water route but as these efforts were insufficient, it has returned to its original condition.

However, up to the now the alignment and water depth of the navigation channel have been stable.

b) Berthing Facilities

Closely packed berthing facilities line both banks for about 1 km upstream from the estuary of the Perlis River. The main facilities, such as fish landing jetties for the fishing boats and the ferry jetty are all located along the left bank. On the right bank and along the north channel where fishermen's houses are clustered, the only jetties available are for laying off and preparation of fishing boats (see Fig. 1.2.19).

With regard to berthing facilities for the commercial port, there is only a ferry jetty and a concrete jetty constructed for loading ice.

The fishing port has 16 landing wooden pier type jetties, of which one is a MAJUIKAN facility and the rest are private. At each jetty, a fish sorting area, an ice storage, a refrigerater, water and oil supply facilities, and an office, etc. are installed.

The area of largest jetty is 406 m² and together the 16 jetties total 5,247 m² (see Table 1.2.11).

Table 1.2.11 Berthing Facilities at Kuala Perlis Port

| Facility | Wharf length | Structure | Wharf area | Administration | Remarks |
|---|---|---|---|---|---|
| Commercial Port Facilities | | | | | |
| Ferry Jetty | 32 m | concrete | 390 m² | Marine Department | length 32 m<br>width 12 m |
| Concrete Jetty | 12 m | – ditto – | 74 m² | | length 12 m<br>width 6 m |
| Fishing Port Facilities | | | | | |
| Landing Jetties (Total of 16 Jetties) | 210 m | wood | 5,247 m² | MAJUIKAN, Private | |

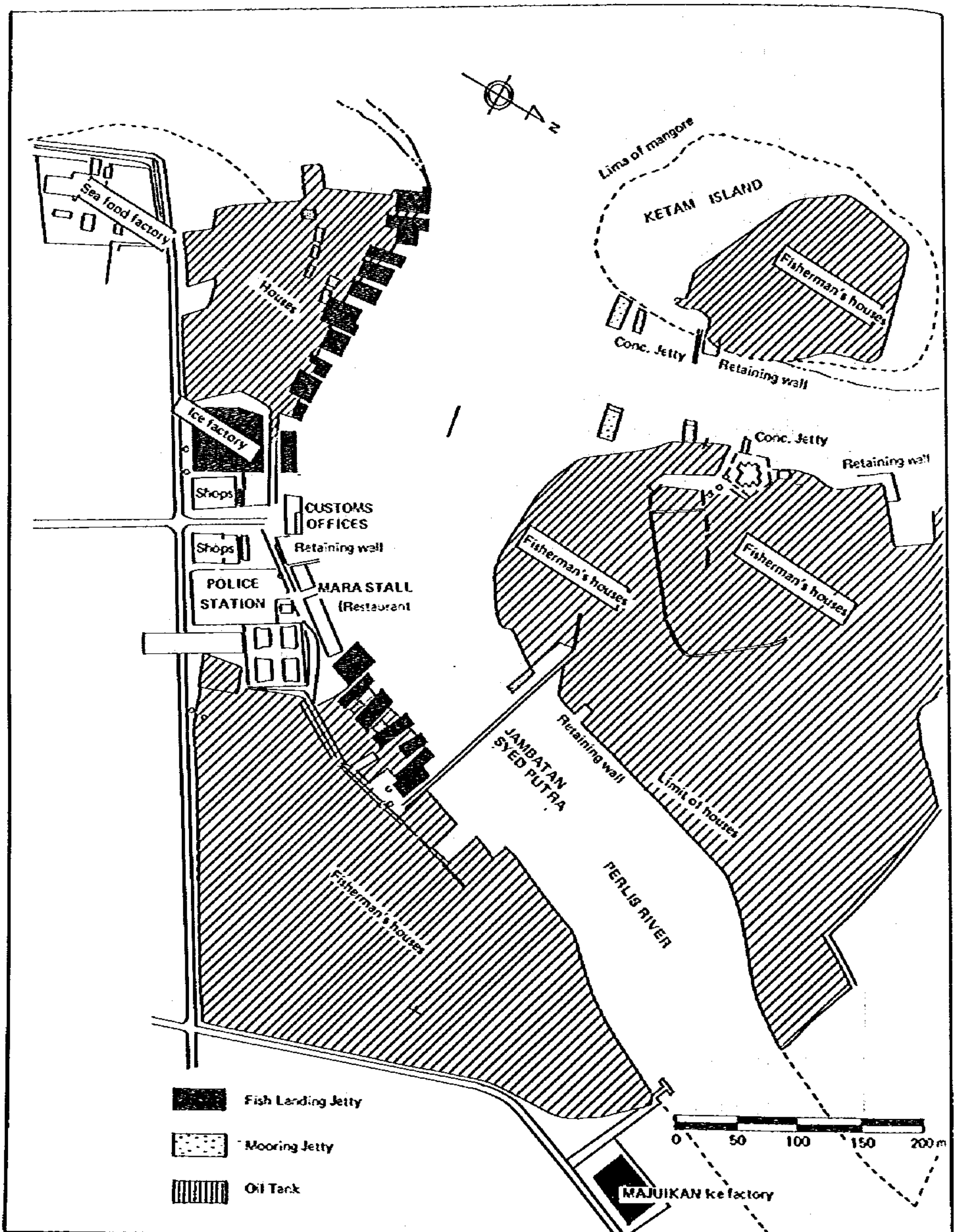



Fig. 1.2.19 Fishery Facilities of Kuala Perlis Port

c) Fishery Related Facilities

i) Ice making plant

| | | Ice making capacity | Size of ice cube | Ice storing capacity |
|---|---|---|---|---|
| Perlis Iceworks LTD (Private Company) | : | 100 tons/day | 10 blocks/ton | 350 tons |
| Kiang Ais MAJUIKAN Perlis (Semi Government) | : | 50 tons/day | 7 blocks/ton | 350 tons |

ii) Refrigerator for ice storing

| | | | |
|---|---|---|---|
| MAJUIKAN Jetty | : | 9 tons capacity | 1 units |
| Private Jetties | : | 5 – 20 tons capacity | 10 units |
| | | Total capacity | 100 tons |

iii) Fish refrigerator (for fesh fish –5°C)

| | | | |
|---|---|---|---|
| Private Jetties | : | 20 tons capacity | 3 units |
| | | 10 tons capacity | 4 units |

iv) Oil supply facilities (Cylindrical horizontal tank 15 tons capacity)
There are 9 units with oil storing capacity 135 tons.
Fishing boats supply oil from private owned jetties.

v) Fish processing plant : Syariakat Top Food (M) Sdn. Bhd.
This has modern facilities for processing and freezing prawns but presently closed due to lack of raw prawns.

(2) Kuala Sanglang Port

1) Geographical Conditions

Kuala Sanglang Port is located in sourthernmost Perlis State, at the month of the Sanglang River which forms the border with Kedah State. The estuary of the Sanglang River has seen great changes in the last 10 years. An irrigation canal was dug along the south side of the Sanglang River which now flows into a second new channel, paralled to the canal, which it joins where they flow into the sea. The mangrove forest has spread offshore for about 500 m from the original coast line due to the depositing of earth and sand in the estuary (see Fig. 1.2.20, 1.2.21).

For this reason, the port facilities located on the Perlis State side of the old Sanglang River were buried and the present port facilities were constructed around the outlet of the new irrigation canal, on the Kedah State side. The sea area outside the port, as at Kuala Perlis Port, is sheltered by Langkawi Island. The tideland extends 2 km offshore. From there the seafloor has an average slope of 1/400, until it reaches a water depth of about 5 m.

The distances to neighbouring ports are 36 km to Satun Port in Thailand, 20 km to Kuala Kedah Port in Kedah State and 43 km to Kuah Port on Langkawi Island.

2) Port Activity

Kuala Sanglang Port functions only as a small scale fishing port.
The number of registered fishermen is 209, only 7% of the Perlis State total.
By race, there are 158 Malays, 5 Chineses and no Thai.

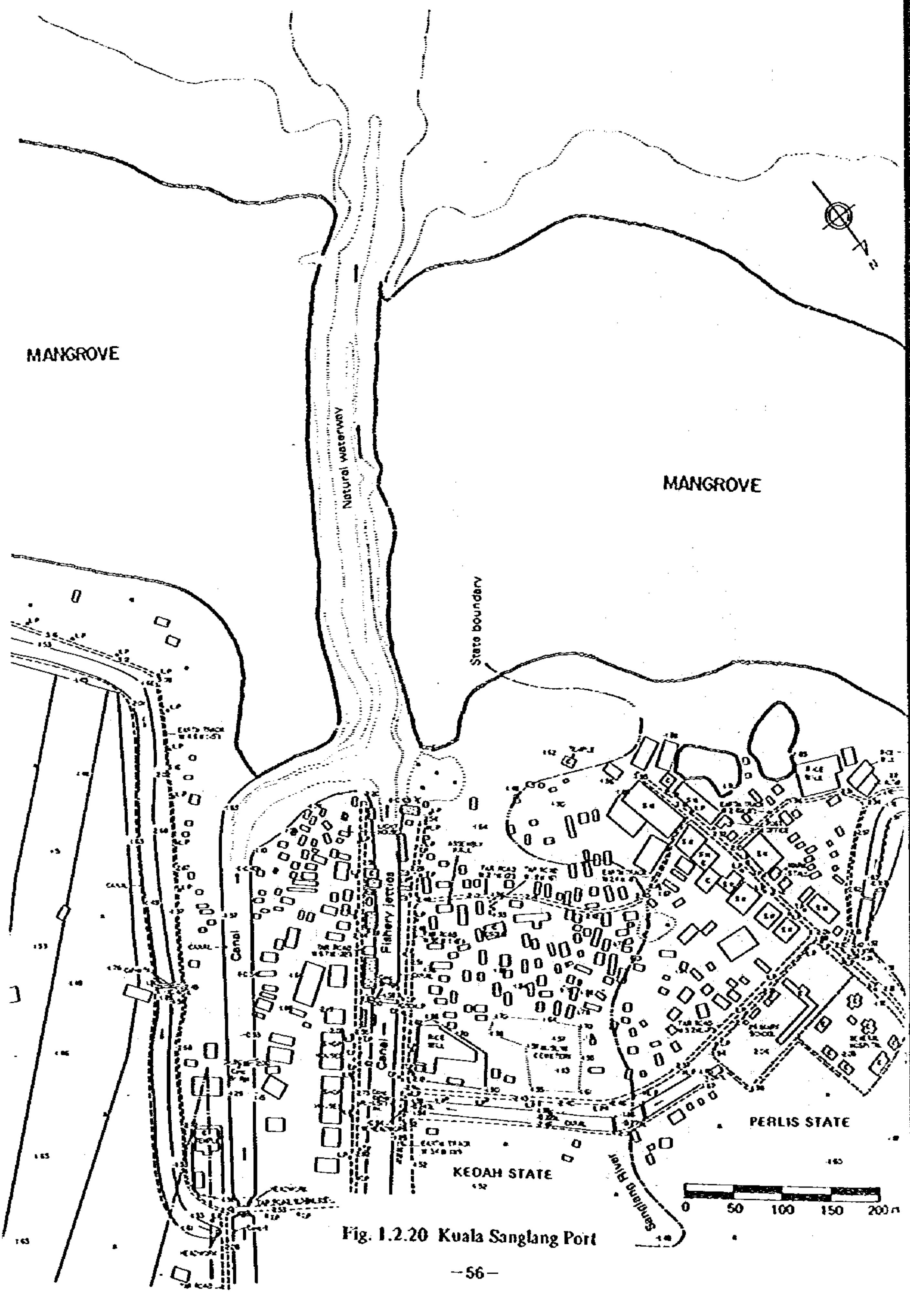


Fig. 1.2.20 Kuala Sanglang Port

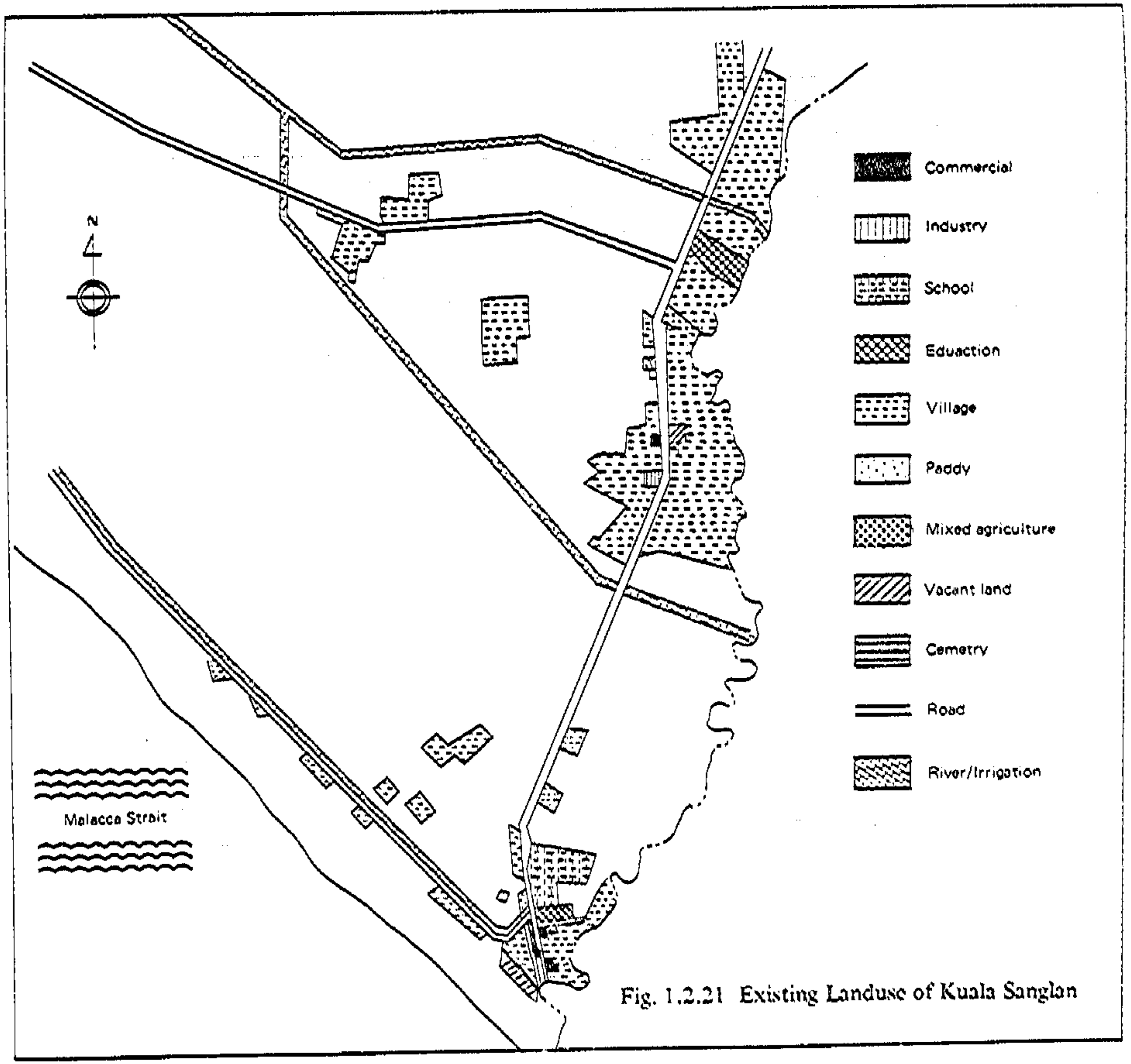



Fig. 1.2.21 Existing Landuse of Kuala Sanglan

The number of registered fishing boats is 74, of which 56 (76%) have inboard motors. All are less than 40 G/T and the majority are trollers (see Table 1.2.12).

The catch in 1982 was 2,955 tons or one eleventh that of Kuala Perlis Port. There is no landing of catches from Thai fishing boats (see Table 1.2.13).

**Table 1.2.12 Number of Fishing Boats by Type and Fishing Method at Kuala Sanglang Port**

(in 1982)

| Type \ Fishing Method | | Trawl | Purse Seine | Gill/Drift Net | Trop Net | Hook and Line | Total |
|---|---|---|---|---|---|---|---|
| In board | < 10 ton | 17 (12) | 1 | 5 | 3 | 4 | 30 (12) |
| | 10 – 25 ton | 19 (12) | 1 | 2 | | | 22 (12) |
| | 26 – 40 ton | 3 | 1 | | | | 4 |
| | 40 ton < | | | | | | |
| | Total | 39 | 3 | 7 | 3 | 4 | 56 (24) |
| Out board | | | | 10 (6) | | 6 (2) | 16 (8) |
| None board | | | | 2 | | | 2 |

Note: ( ) shows fishing boats belonging to Kedah State

**Table 1.2.13 Marine Products by Fishing Method at Kuala Sanglang Port**

(in 1982)

| | |
|---|---|
| Trawlers | 1,800 Metric Ton |
| Seiners | 900 " |
| Gill netters | 35 " |
| Anglers | 20 " |
| Others | 200 " |
| Total | 2,955 Metric Ton |

3) Present Condition of Port Facilities

a) Navigation Channel

A natural waterway, maintained by the force of the water flowing from the irrigation canal, is used for the navigation channel. The outlet of the irrigation canal has become surrounded by mangrove for about 500 m beyond the old shoreline, near where the berthing facilities area. This has been planted during the past 10 years.

The width of the waterway is about 60 m and at low tide water depth is about 20 cm, limiting exit and entry to even a small ship.

b) Berthing Facilities

A total of 12 fish landing jetties, including one owned by MAJUIKAN, exist between the mouth of the north irrigation canal and the concrete bridge 200 m upstream (see Fig. 1.2.22).

Each jetty has a fish sorting area, an ice storage, a warehouse, and an office, but there are no other facilities. The total length of the landing jetties is 110 m and their area is 900 $m^2$.

c) Fishery Related Facilities

The fishery related facilities around Kuala Sanglang Port are as given below.

i) Ice Making Plant: nil

Ice is brought in from Alor Setar or Kuala Perlis

ii) Refrigerator, Ice Storage

The only refrigerator with mechanical equipment is at MAJUIKAN Jetty and the rest are small storage for thermal insulation.

iii) Oil Supply Facilities

| | | |
|---|---|---|
| MAJUIKAN Jetty | : | 1 unit (15 onts) |
| Private | : | 1 unit (15 tons) |

iv) There are no other notable fishery related facilities.

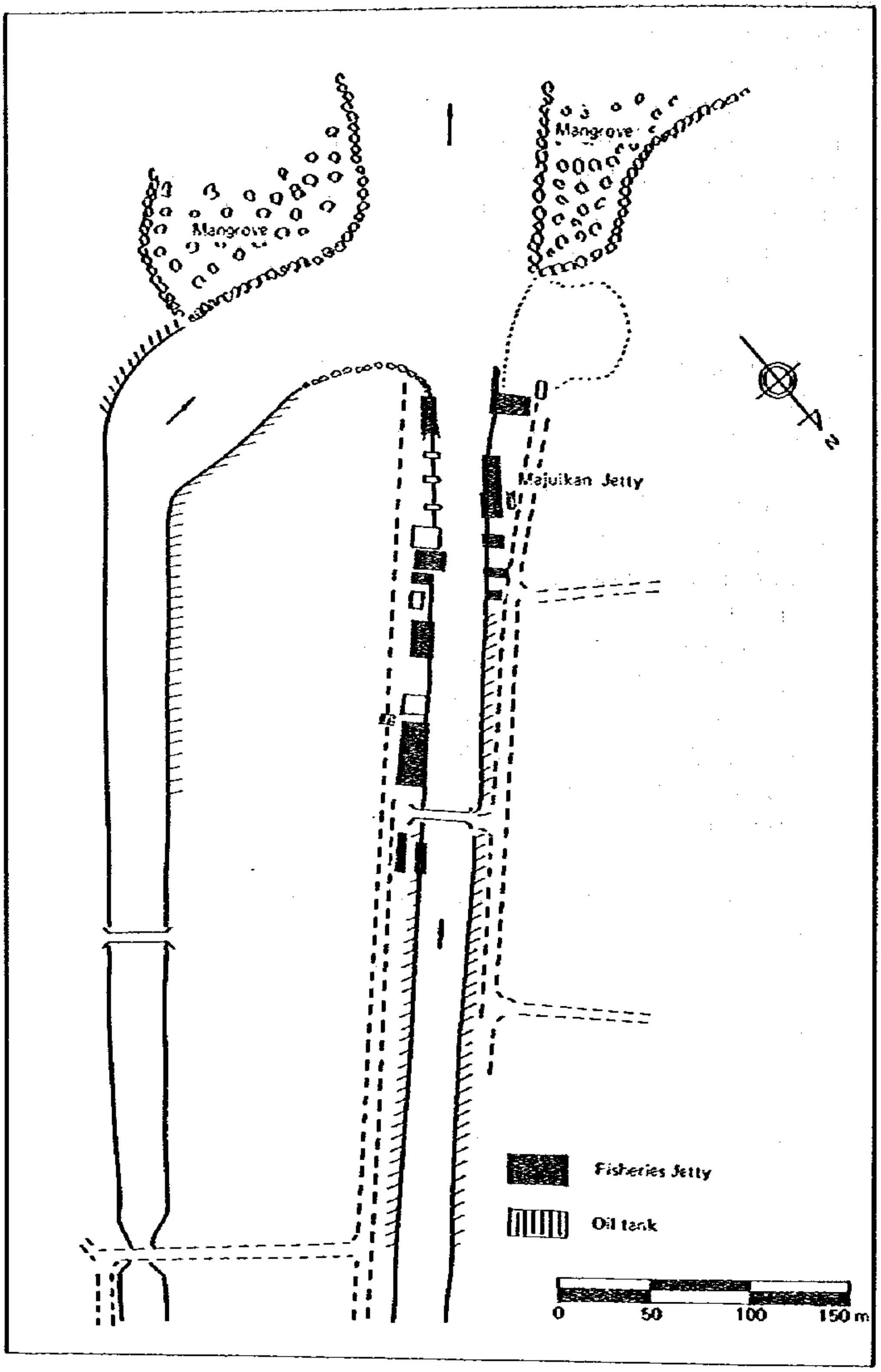



Fig. 1.2.22 Fisheries Facilities of the Kuala Sanglang

### 1.2.3 The Ports' Problems

(1) Kuala Perlis Port

1) Related to the Navigation Channel and the Basin

① Since the port mouth is less than 1 m deep at low tide, ferries and fishing boats must wait for high tide to go in and out. This hinders ferry traffic and restricts operation of the fishing boats.

② Since the basin in front of the wharves is narrow, there will be some difficulties in maneuvering the larger vessels.

2) Related to the Ferry Wharves

① The ferry terminal berth is only 32 m long, enough to berth a single ferry next to the pier. However as the arrivals and departures of ferries are bunched at high tide, this length is insufficient. The ferries must berth side by side and passengers often have to climb over one or two boats when boarding or unboarding, creating a serious safety problem.

Also some inconvenience is felt by passengers because there are no access bridges or floating pier facilities.

② The waiting room at the passenger terminal is small and offers little service to tourists.

③ There are no special facilities for berthing the boats transporting passengers to and from Thailand, so they use the side of the ferry terminal, the side of the restaurant along the river, or the side of the fishing boat jetty making boarding and unboarding dangerous because of the large tidal rage in water level.

3) Related to Wharves for Freighters

① For cargo handling facilities, there is only one concrete jetty which is not used much. Cargoes are transported by fishing boats or small ships and they berth at the fishing boat jetties or the embankment. Loading/unloading work is mostly done by hand.

② Functional facilities such as sheds and warehouses which support the commercial port function are mostly undeveloped.

4) Related to the Fishing Boat Jetties

① Since operation of fishing boats largely depends upon the tide, the boats tend to leave port or return to port all at the same time. Therefore, the present limited capacity of the facilities makes landing and loading operations very congested. The fishery jetties have only short face lines and are not adjacent so that simultaneous loading and unloading of several ships is not possible.

② Due to the large tidal range, operating time cannot be fixed.

③ Because water depth of the jetty is shallow, berthing of fishing boats at low tide is difficult.

④ Because no loading equipment is available, work is all done by hand.

⑤ Since the floors of the fish handling areas are made of wood and obsolete, they are unsanitary and greatly affect the freshness of the fish.

⑥ The areas for selecting, packing, and shipping the fish is narrow. There is no car parking space and trucks are loaded on the road. Since there is no platform and height is uneven, loading is inconvenient and inefficient.

5) Related to Ice Making

① With the increase of fish catches, the supply of ice is getting short. The shortage is covered by bringing in from Alor Setar and sometimes by imports from Satun Port in Thailand.

② In the dry season, the supply of water for making ice runs short and irrigation water must be used.
The result is brown unsanitary ice, the use of which is liable to adversely affect the freshness of the fish.

③ Due to the lack of ice, ice is shipped as soon as it is made and not being properly frozen, melts easily.

6) Related to Fishing Boat Repair Shops

There is a small private engine repair shop but there is no hull repair shop for fishing boats nor repair shop that can handle large mechanical parts.

7) Related to Processing Facilities of Marine Products.

There is a modern prawn processing plant run by Syliakat Top (M) Sdn. Bhd. but operation is presently suspended and it is desired to make effective use of it again.

There are no other fish processing plants nor fish meal plants to process trash fish. Some of the trash fish are landed at the fish meal plant in Thailand.

(2) Kuala Sanglang Port

1) Related to Navigation Channel and Basin

① Because the approaching waterway is very shallow and lowtide water depth is only 20 cm, entrance and departure of large fishing boats is not possible.
Also maneuvering of ships inside the port is difficult.
For this reason, the size of fishing boats is limited and most are trollers or gill netters operating in coastal waters. Large seiners cannot enter the harbor.

② Presently landing jetties are installed on both sides of the canal but when there are many ships in port, or when fishing boats berth on both banks, it is so narrow as to make traffic almost impossible.

2) Related to Fishing Boat Jetties

The present problems caused by wooden landing jetties are the same as those at Kuala Perlis Port.

3) Related to Fishery Facilities

Since there are no fishery related facilities such as refrigerating facilities, or ice making facilities. Not only ice, but also fishery materials and equipment, foods, daily necessities, and supplies must be procured from outside.

For increasing the volume of fish catch in the future, it is indispensable to build larger fishing boats as well as to develop the related facilities.