社会開発調査部報告書

THE STUDY ON
TOKUA AIRPORT DEVELOPMENT PROJECT
IN
PAPUA NEW GUINEA

FINAL REPORT

– MAIN REPORT –

MARCH 1992

JAPAN INTERNATIONAL COOPERATION AGENCY

PREFACE

In response to a request from the Government of Papua New Guinea, the Government of Japan decided to conduct a study on the Development Project of Tokua Airport and entrusted the study to the Japan International Cooperation Agency (JICA).

JICA sent to Papua New Guinea a study team headed by Mr. Shoichiro Maeda of Nippon Koei Co., Ltd. three times between May 1991 and March 1992.

The team held discussions with the officials concerned of the Government of Papua New Guinea, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

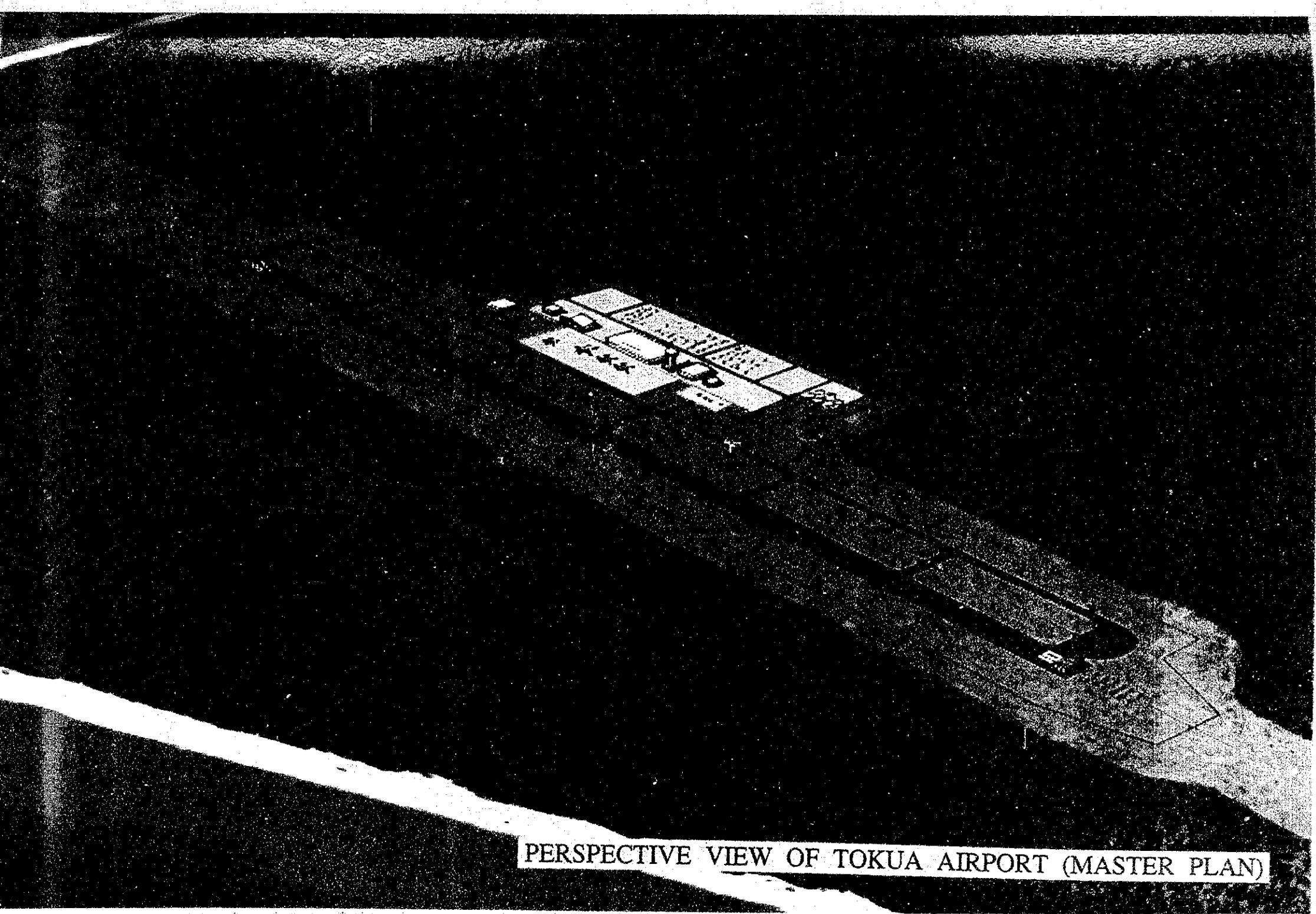
I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

I wish to express my sincere appreciation to the officials concerned of the Government of Papua New Guinea for their close cooperation extended to the team.

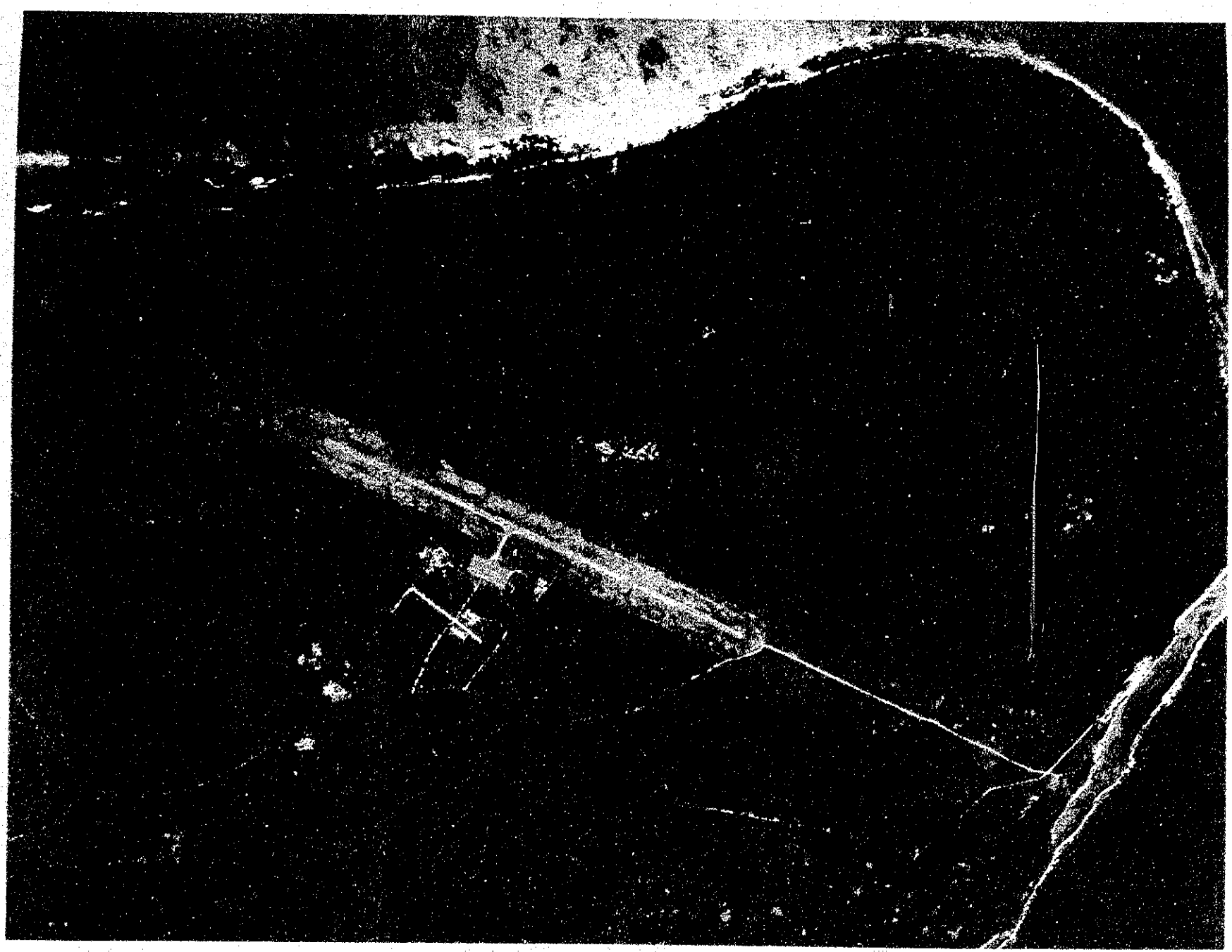
March 1992

Kensuke Yanagiya

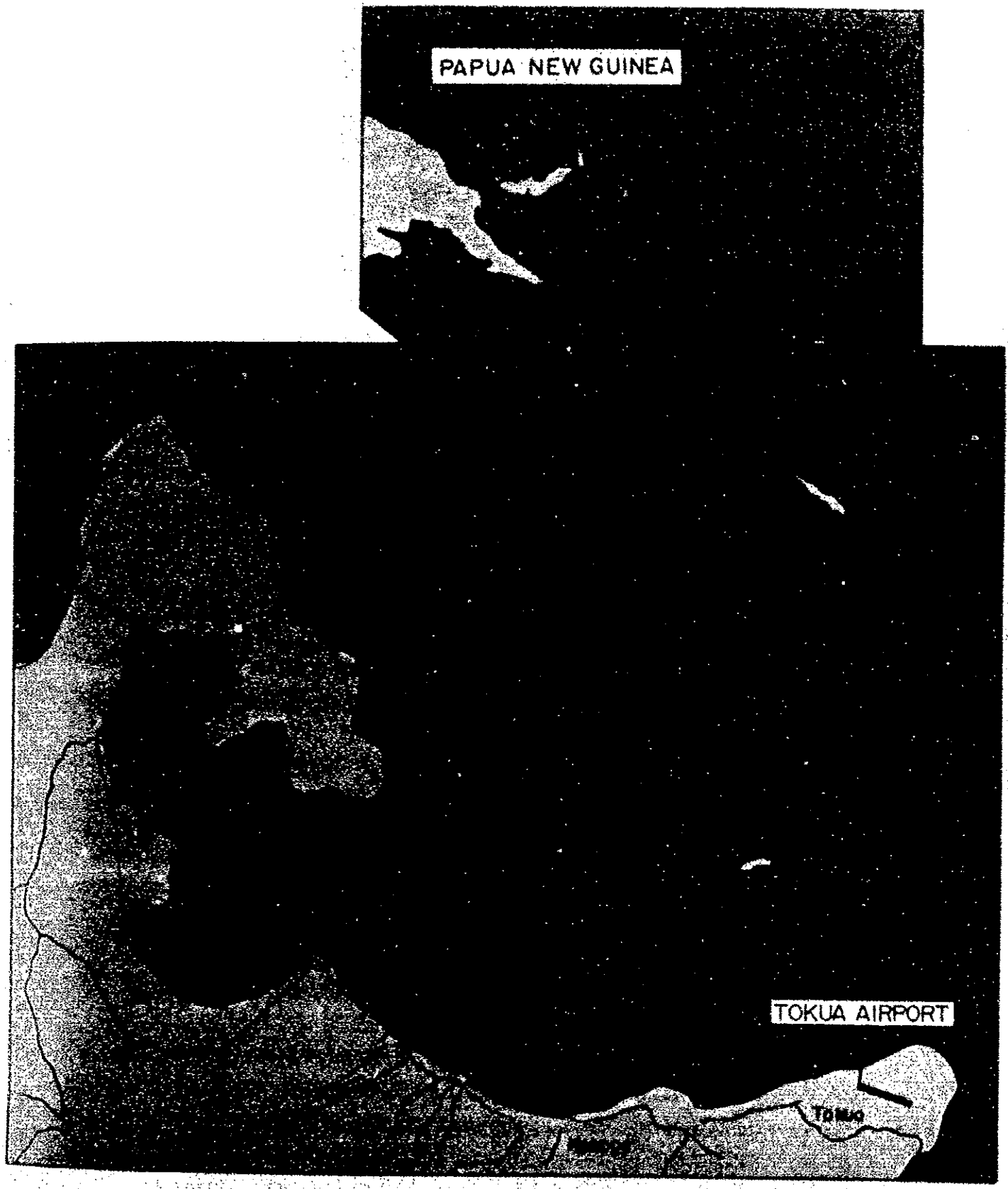
Kensuke Yanagiya
President
Japan International Cooperation Agency



PERSPECTIVE VIEW OF TOKUA AIRPORT (MASTER PLAN)



EXISTING TOKUA AIRFIELD



TOKUA AIRPORT PROJECT SITE

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ABBREVIATIONS

[Organizations]

BAA	British Airport Authority
DCA	Department of Civil Aviation
DEC	Department of Environment and Conservation
DMC	Developing Member Country
DTCA	Department of Transport and Civil Aviation
EC	European Community
ENBP	East New Britain Province
FAA	Federal Aviation Authority
GOJ	Government of Japan
GOP	Government of Papua New Guinea
IATA	International Air Transport Association
ICAO	International Civil Aviation Organization
IFALPA	International Federal Airlines Pilot Association
JCAB	Japan Civil Aviation Bureau
JICA	Japan International Cooperation Agency
NEC	National Executive Council
OIDA	Office of International Development Assistance
PNG	Papua New Guinea
POM	Port Moresby
PTC	PNG Telecommunication Corporation
RAB	Rabaul
TDC	Tourism Development Corporation

[Airport Terminology]

ABN	Aerodrome Beacon
ACN	Aircraft Classification Number
AFL	Apron Flood Light
AFS	Aeronautical Fixed Services
AFTN	Aeronautical Fixed Telecommunication Network
AIS	Aeronautical Information Services
ALS	Approach Lighting System
AMS	Aeronautical Mobile Services
AS	Asphalt
ASR	Airport Surveillance Radar
ATC	Air Traffic Control (ler)
ATIS	Automatic Terminal Information Service
ATS	Air Traffic Services

ATSO	Air Traffic Service Officer
B/C	Benefit-Cost Ratio
C (Value)	Ratio of Compaction Volume
CAT	Category
CBR	California Bearing Ratio
CCR	Constant Current Regulator
CCTV	Closed Circuit Television
CFR	Crash, Fire and Rescue
CIQ	Custom, Immigration and Quarantine
CVCF	Constant Voltage Control Frequency
DME	Distance Measuring Equipment
DVOR	Doppler Very High Frequency Omni Range
EIRR	Economic Internal Rate of Return
EPNL	Effective Perceived Noise Level
EQA	Equivalent Aircraft Factor
FIRR	Financial Internal Rate of Return
GDP	Gross Domestic Product
GSE	Ground Service Equipment
HF	High Frequency
HIRL	High Intensity Runway Edge Lights
IFR	Instrument Flight Rule
ILS	Instrument Landing System
IMC	Instrument Meteorological Condition
K (Value)	Modulus Subgrade Reaction
MBIT	Mega Bit
MD	McDonell Douglas
MDA	Minimum Descent Altitude
MHz	Mega Hertz
MLS	Microwave Landing System
MN/m^3	$Meganewton/m^3$
MOO	Meteorological Observation Office
MVA	Mega Volt Ampere
NDB	Non-Directional Beacon
NM	Nautical Mile
NPV	Net Present Value
OD	Origin and Destination
OLS	Obstacle Limitation Surface
OM	Outer Marker
PABX	Private Automatic Branch Exchange
PAPI	Precision Approach Path Indicators
PANCAP	Practical Annual Capacity

PBX	Private Branch Exchange
PCC	Portland Cement Concrete
PCN	Pavement Classification Number
PDR	Peak Day Ratio
PHR	Peak Hour Ratio
PMR	Peak Month Ratio
PNL	Perceived Noise Level
RAPCON	Radar Approach Control
REL	Runway End Lights
RIV	Rapid Intervention Vehicle
RNAV	Area Navigation
RWCL	Runway Centerline Lights
RWTL	Runway Threshold Lights
RWY	Runway
RVR	Runway Visual Range
RX	Receiver
SALS	Simplified Approach Lighting System
SELCAL	Selective Call
SIDs	Standard Instrument Departures
SSR	Secondary Surveillance Radar
STARs	Standard Terminal Approach Routes
SM	Statute Mile
STOL	Short Field Takeoff and Lift
TDME	Terminal Distance Measuring Equipment
TMA	Terminal Area
TWCL	Taxiway Centerline Lights
TWL	Taxiway Edge Lights
TWY	Taxiway
TX	Transmitter
UHF	Ultra High Frequency
UPS	Unprecedented Power Supply
VASIS	Visual Approach Slope Indicator System
VFR	Visual Flight Rule
VHF	Very High Frequency
VMC	Visual Meteorological Condition
VTOL	Vertical Takeoff and Lift
WECPNL	Weighted Equivalent Continuous Perceived Noise Level

PART-I GENERAL

PART I GENERAL

1. INTRODUCTION

1.1 Background of Study

Air travel and transportation have been playing an increasingly significant role in the socio-economic development of Papua New Guinea (hereinafter, referred to as PNG). And there is a widely held view that a period of sustained economic growth lies ahead. Therefore, there appears to be a high probability that this Study on the Airport Development Project in East New Britain Province can provide needed and important benefits to the national and regional economy.

The Study on Tokua Airport Development Project was initiated by JICA on the basis of an official request from the Government of PNG (GOP) to the Government of Japan (GOJ). JICA conducted the field investigations on 20 - 29 November, 1990 and the First Study in PNG from May 27 - July 28, 1991 which was followed by the First Study in Japan from the middle of June through the middle of August, 1991. This was programmed in the Inception Report submitted and agreed upon on May 31, 1991. The Progress Report was submitted to and accepted by DCA and OIDA on 21 August, 1991 in the Second Study in PNG, through the discussion and some comments delivered by DCA. This process was followed by the second study in Japan, from November, 1991 through January, 1992 to make up the Draft Final Report, taking into account the content of discussions and comments exchanged between the relevant authorities of PNG and JICA team.

Over the years several studies have been conducted for the improvement of Rabaul Airport. A major investigation conducted by National Executive Council (NEC) initiated an urgent development plan for temporary airfield at Tokua, particularly for emergency use in a disaster. The Tokua Airfield was provided under the Rabaul Disaster Plan Work Program and started its operation on October 27, 1984, with an operational penalty which might impede efficient and safe operation of the present facilities. These constraints would become more serious in future when the traffic operation increases. Meanwhile, the Department of Transport and Civil Aviation (DTCA) in 1983 had undertaken an overall study of transport investment nationwide in PNG, through which the concept of transferring whole operation from Rabaul Airport to Tokua Airport had been established. Then, the development policy of upgrading the existing Tokua Airfield was formulated by NEC in October 1984.

1.2 Scope of Study

Major constraints of Rabaul Airport are the threat of likely volcanic eruption of potentially active volcanoes located in the midst of the volcanically hazardous area and various other constraints which might impede efficient and safe operation of the present facilities. These constraints would become more serious in future when the traffic operation increases.

The Terms of Reference concluded for this Study between JICA and GOP specified that Master Plan and Short Term Development Plan would be proposed for Tokua Airport which is supposed to substitute the present Rabaul Airport. More specifically, this Study sets forth:

1) Evaluation of the existing Rabaul Airport;
2) Formulation of a Master Plan for target year 2010; and
3) Study on technical, economic and financial feasibility of a Short Term Development Plan for the target year 2000.

1.3 Frame of Final Report

The Terms of Reference concluded for this Study between JICA and DCA with OIDA is to focus on the development plan of Tokua Airport to substitute the present Rabaul Airport.

This Final Report presents the results of analyses and studies carried out during the period of the Third Study in Japan. The studies are concerned with the preparation of a master plan for long term development of Tokua Airport up to the year 2010. Within the framework of the proposed master plan, a basic plan for technical, economic and financial feasibility has also been prepared for the target year 2000, as specified in the Scope of Work agreed upon between GOJ and GOP.

In Part I of the Final Report, the results of the analyses, concerning major constraints of the present Rabaul Airport, are presented in Chapter 4.

In Part II, the plan for the development of Tokua Airfield is discussed. Chapter 8 of the report presents the results of the analyses and forecast of traffic volumes of Rabaul in 2000 and 2010. Regional development and environmental consideration, which are related to this development project, are presented in Chapter 6. On the basis of requirements for development and traffic volume forecast, the required scales for the said airport development project has been established as shown

in Chapter 9. A master plan for long term development of Tokua by the target year 2010, has been accordingly formulated as described in Chapter 10. A phased-out implementation of the proposed short term development for the target year 2000 has been formulated as proposed in Chapter 11.

In Part III, conclution and recommendation of this Study are presented.

1.4 Study Program

For the execution of the Study, JICA assembled a team of nine (9) experts (Study Team) as well as an Advisory Committee. On the PNG side, DCA nominated the counterpart experts to jointly work with the JICA Study Team. (Refer to 1.5)

The conduct of the Study involved periods of work in PNG and in Japan. The first study in PNG was initiated by submitting the Inception Report in May, 1991 and followed by submitting the Progress Report in August, 1991. The Study was followed by analysis and planning for the master plan, formulation of a phased development plan and preparation of the Interim Report during the period of First Study in Japan in September and October, 1991, and the development plan was discussed in November in the second Study in PNG, when the Interim Report was submitted to GOP. At the same time, supplementary data and informations for preliminary design and project evaluation at a feasibility study level were collected in the field.

After the presentation of the Interim Report in November, 1991, taking into account the content of discussions and comments exchanged between JICA Team and the relevant authorities of PNG, in depth analyses and studies for the short term development plan were resumed by the Study Team in December, 1991 and January, 1992 and the Draft Final Report was submitted to GOP in the fourth week of January, 1992.

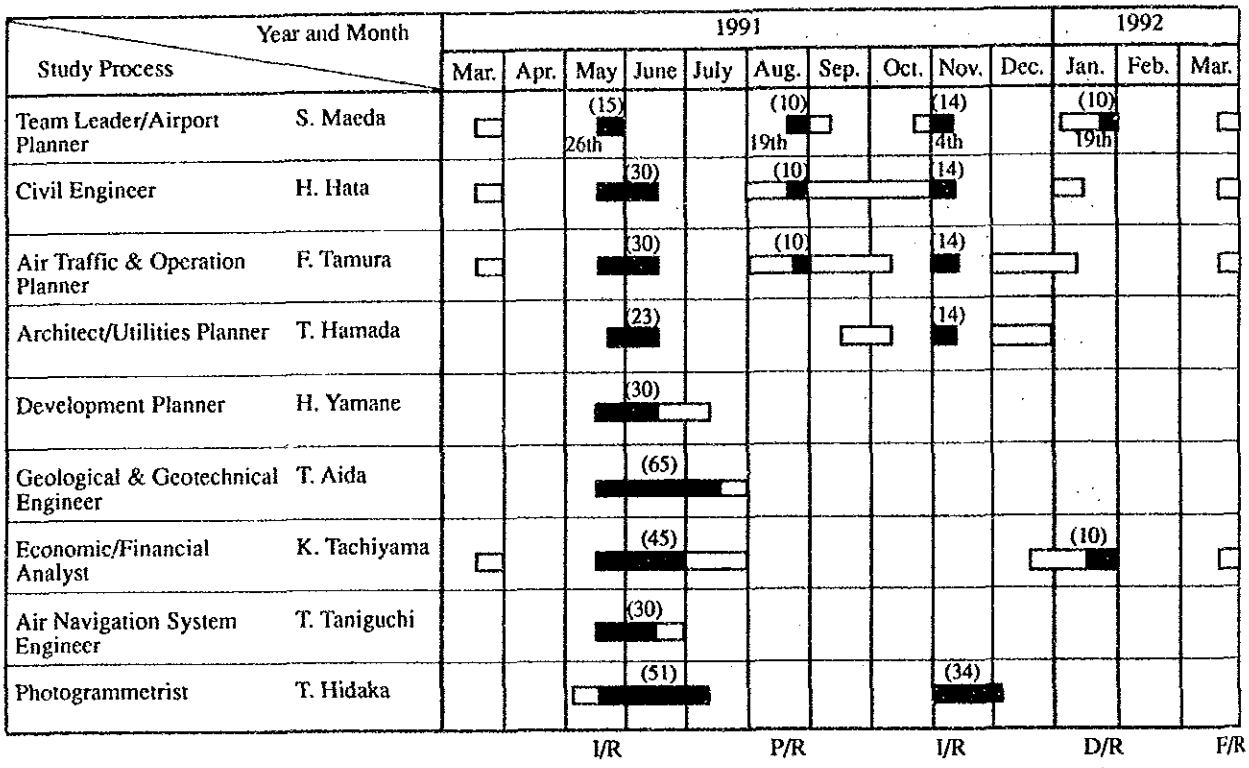
The Study has been executed in such a manner that the reasonable opinions and views of DCA, OIDA and other PNG's authorities are reflected in the short term and long term developments proposed and evaluated in the Final Report.

1.5 Study Members of Project

1) Advisory Committee

Mr. Y. IWAMI	Chief, Ministry of Transport, Japan
Mr. H. ANDO	Member, Ministry of Transport, Japan
Mr. K. SAKAI	Member, Ministry of Transport, Japan
Mr. H. SASAKI	Member, JICA

2) Study Team of JICA



Notes: ■ Work in PNG
□ Work in Japan

3) Counterparts of PNG

Mr. A. VENEIK	Project Manager
Mr. N. ITANA	Assistant Secretary, Aerodrome Engineering
Mr. K. ZORIKA	O.I.C. National Weather service
Mr. W. SAGATI	Assistant Secretary, Flying Operations
Mr. N. GOROGO	Policy, Programme & Planning
Mr. J. SENDI	Inspector, Rabaul Airport
Mr. F. WAGAIA	Programmes Officer, OIDA
Mr. E. LOHIA	Liaison Officer

2. TRANSPORTATION NETWORK

2.1 Air Transport

PNG has a total of 452 airports/airstrips, ranging from heliport and 500 meter landing strips to the principal international airport at Jackson, Port Moresby. Out of these airports, 23 are major ones, playing important role for international and domestic transports. Air transport in PNG is the sole transport mode to connect the isolated areas in the nation, thus developing very much more than the other transport modes. Rabaul (Lakunai) Airport does not handle international flights. Passengers arriving at Rabaul Airport are primarily domestic visitors for business and tourism purposes.

1) Airlines

As of 1991, there are 7 airliners of foreign and domestic operating at airports in PNG, as well as 20 non-scheduled domestic airliners. PNG's airliners are Air Niugini, the flag-carrier, which is exclusively operating international and domestic routes and 4 liners of Talair, Airlink, Island Aviation and Milne Bay Air which are operating for domestic routes.

2) Air demand

International air routes operated at present are shown in Figure 2.1-1. The total traffic demand of 1989 in PNG were 1,833,000 of passengers and 20,000 tons of cargoes. Ratio shared by domestic routes was approximately 93% and 83% respectively, showing that the domestic being overwhelmingly bigger than the international. However, the average annual growth rate of passengers was about 7.9% for international and 4.1% for domestic during the period from 1983 to 1989. Therefore, international demand increase is further expected in conjunction with the developments of natural resources and tourism industry in future. It is also notable that cargo demand shows annual growths of about 13.1% for international cargo and 4.5% for domestic cargo depicting that international cargo tends to increase while domestic cargo levels off.

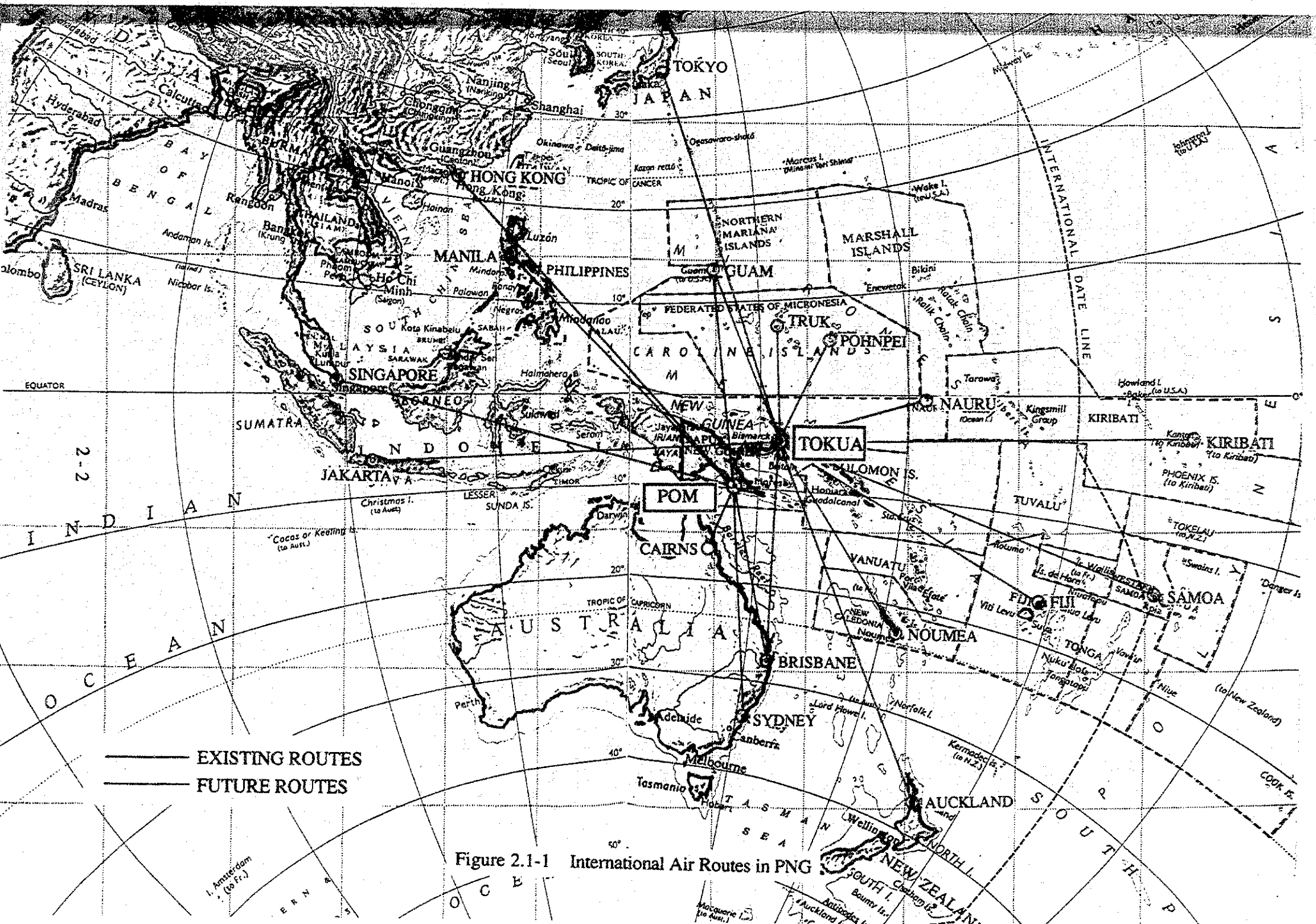


Figure 2.1-1 International Air Routes in PNG

2.1.1 International Aspect of PNG Air Transport

The international aspects of air transport operations at Jackson Airport can be comprehended by reviewing the International Airlines Guide. A number of foreign cities are shown as having scheduled connections with Jackson Airport, the Gateway of the nation. To an extent, this is an understatement, since every airport in the world - in a real sense - is linked, via connecting flights, to Jackson Airport, by and large, Jackson is dependent on multi-stop and connecting flights to reach the major airports of the world. The other airports such as, Daru, Kieta, Momote, Vanimo, Misima, Mt. Hagen and Wewak are available as international entry ports. However, Kieta is presently closed for international operation.

International routes are linked with 9 international airports in the regions of Australia. 19 flights per week are operated for South-Pacific and South-East Asia routes . The major routes are for Sydney, Brisbane and Cairns of Australia, sharing 60% of the total international passengers. The operating aircraft types are A310, followed by B767, B737 and F28. Cairns, and to a slightly lesser extent, Sydney are the principal major foreign urban centers linked by multiple, regular, non-stop service to Jackson Airport.

Based on March 1991 airline schedules, Cairns is served by 13 non-stop flights a week from and to Jackson. These flights are provided by 11 Air Niugini and 2 Qantas, both using F28, except on Tuesday when Air Niugini switches to a A310, under joint service with Qantas. Sydney receives 4 A310 and 3 B767 weekly services, both under joint service, and 3 B767 weekly services by Qantas, from and to Jackson via Brisbane. In addition, 2 non-stop flights from and to Manila by A310 under joint service with Philippine Airlines, 4 A310 non-stop joint service flights from and to Singapore and 1 B727 on Sunday by Continental Airlines from and to Jackson via Guam from where it is connected with New Tokyo International Airport.

Jackson Airport, in brief, is a full scale international airport. But it is mainly a relay station for connecting flights that can be considered a global facility.

2.1.2 Domestic Aspect of PNG Air Transport

Domestic routes are linked with the major airports for 20 towns through the scheduled and chartered flights of 220 a week. According to the 1989 data, the four major airports, Jackson, Nadzab (Lae), Lakunai (Rabaul) and Mount Hagen, accounted for 65% and 67% respectively of the nation's passenger and cargo volume.

More than 400 runways in PNG are used primarily for general aviation flights. Figure 2.1-2 shows the location of the most important of these many strips. These general aviation flights are overwhelmingly for business purpose. Recreational flying is almost non-existent. There are at present about 130 general aviations (74 fixed wing and 56 helicopters) in the country. It is not expected that there will be any significant increase in these flights in the years ahead.

The interviews conducted by the Study Team indicated that many of these flights were stagnated due to poor road conditions or because telecommunication contact with other parts of the country was deficient. As roads improve and the country becomes more stable, major reasons for general aviation flights will be changed. Similarly, as the development of telecommunications network proceeds, there will be a changed requirement for business trip by air.

It does not now appear that a significant pattern of scheduled domestic flights will develop in PNG, with the exception of travel between Jackson and Rabaul Airports.

2.1.3 Present and Possible Future Relationship between Tokua and Port Moresby Airports

At present Rabaul is the airport serving passengers visiting Rabaul for tourism or business reasons. Its future potential role is a matter of considerable interest to development planners and airport authorities. ENBP is a prospective tourism attraction. So far, ENBP has not tapped its potential as a tourist attraction. In line with traffic volume increase, airport development is needed.

It has been expected by PNG authorities that Tokua will become a major international airport. A judgment on this matter had already been made. It will be seen to what extent the area tributary to Tokua will develop the hotels, restaurants and other recreational facilities needed to support and complement major international airport. While international experience suggests that the national capital tends to be the principal

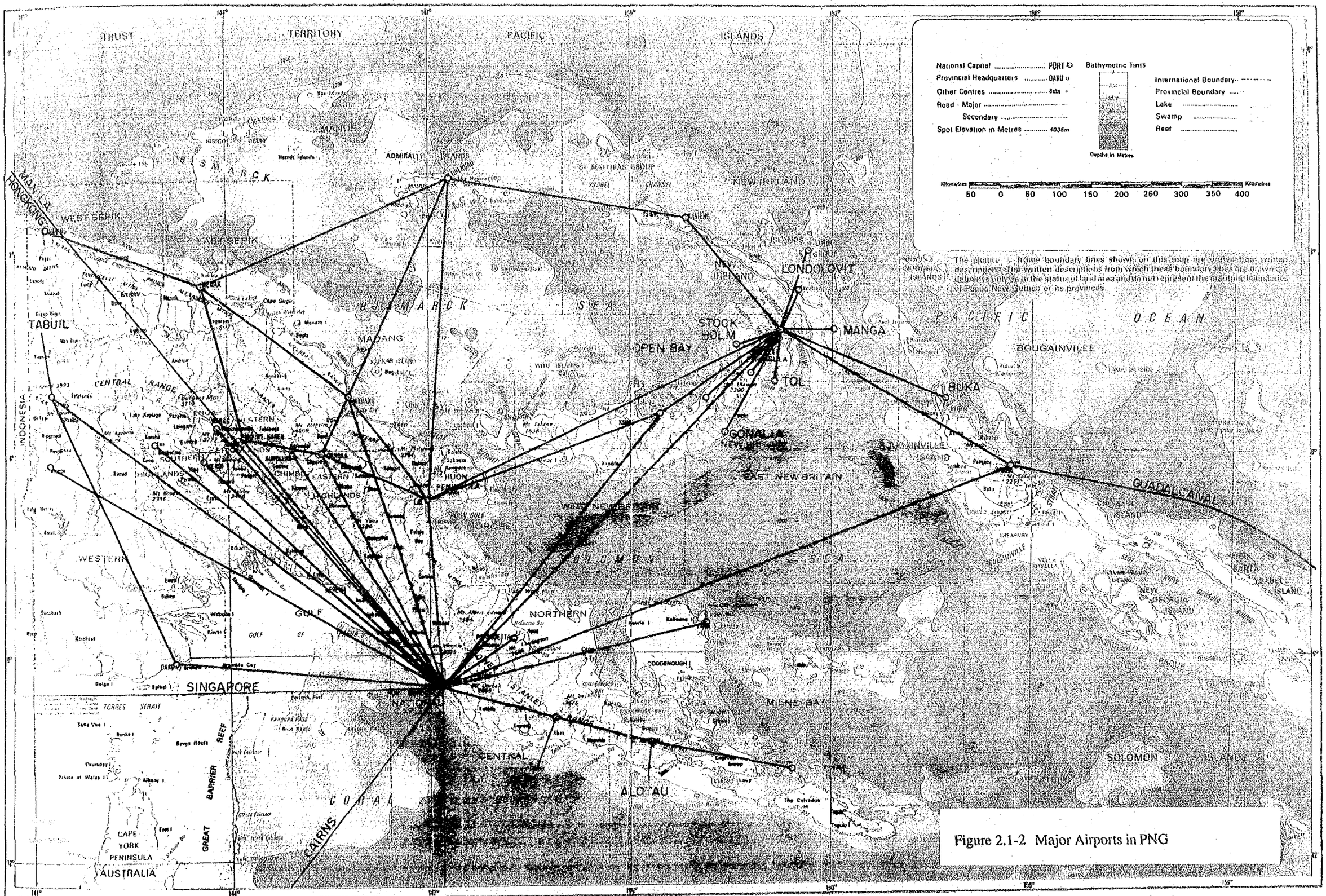


Figure 2.1-2 Major Airports in PNG

point of entrance, it is expected that Tokua will become a new gateway to the nation spearheaded by tourism growth.

As Tokua is opened up as a new international gateway, it will become possible for international visitors to enter at Rabaul and its environ and then fly down to Port Moresby to continue their stay in the country. To realize this possibility, consorted efforts by the public and private sectors are required to develop various infrastructures, both institutional and physical, necessary for tourism growth.

Another role for Tokua Airport is to serve as an alternative national airport. At present when landings are impossible at Jackson, planes are obliged to divert to Cairns. This is a cost for PNG that could be avoided if an alternative national facility is available. This role is a near term prospect. It requires only some development to Tokua Airport. However, the evidence indicates that weather related aircraft diversions to Cairns probably accounts for an insignificant portion of the landing operations scheduled for Jackson.

The best present evidence seems to suggest that a developed Tokua Airport, in concert with enhanced and expanded tourist facilities in the Rabaul-Kokopo-Tokua region, will serve primarily as an airport for travellers to PNG who wish to include a visit to the tourism spots during their stay in the country. For the foreseeable future it seems that those foreign passengers who wish only to visit the said area will make use of international charter aircraft for their direct flight to Tokua Airport.

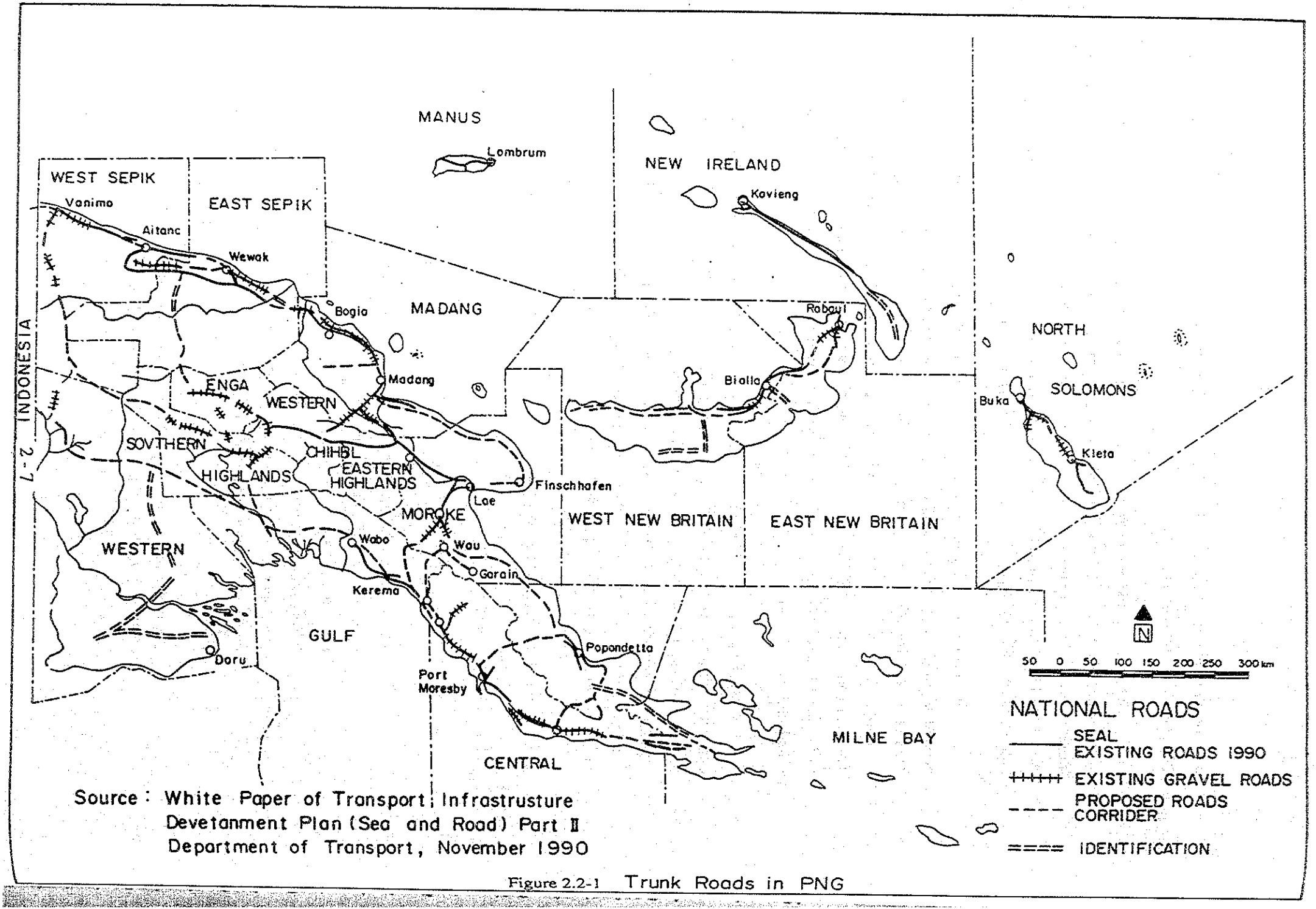
2.2 Land and Maritime Transports

2.2.1 Land Transport

1) Nationwide

For the land transportation, there is no railway facility at all. The road system is the sole transportation mode. There are about 24,000 km of roads in the nation, out of which the national and provincial roads cover 6,700 km and only 22% of them are paved. The domestic road development has not yet reached sufficient level because of such factors as steep topography, tropical jungle, scarce population density, etc. (Refer to Figure 2.2-1)

An ambitious road development program, called "Road Construction Project in Bereina-Malalaua (Trans Island Highway)" with a financial assistance by the Japanese Government is expected to upgrade the



Source : White Paper of Transport Infrastrusture
Devetanment Plan (Sea and Road) Part II
Department of Transport, November 1990

Figure 2.2-1 Trunk Roads in PNG

present maintenance procedures, to expand the road network into rural areas and extend and improve the major national highways.

2) New Britain

The total length of the national roads in East New Britain Province is 211.8 km with pavement rate of 56%, relatively higher in comparison with that (22%) of the whole nation. The maintenance control status of the paved road is rather good and able to cope with the present traffic volume. Early completion of the Highway Development Project to connect Rabaul in East New Britain with Kimbe in West New Britain is desired. While the Tokua Road to connect Rabaul with the proposed Tokua Airport is paved up to the Kabakaul area, about 39 km distance from Rabaul with a width of 6.5 m, a 4 km portion from Kahakaul to Tokua has not yet been paved. DCA is now planning to complete the improvement work of the non-paved road of the said section, including bridges, which is an important access road for the airport. This work should be of the Government's implementation.

3) Motor Vehicle

The motor vehicle in PNG was recently estimated to consist of about 50,000 vehicles. Table 2.2-1 indicates the vehicle type which make up this total.

Table 2.2-1 Components of Vehicles Registered (1988)

Types of vehicle	Number	Share (%)
Motor Car	11,962	23.3
Station Wagon	5,861	11.4
Commercial Vehicle		
Light open	17,838	34.6
Light closed	3,398	6.6
Truck	6,931	13.5
Other Truck types	248	0.5
Buses	2,239	4.4
Total	30,654	59.6
Motor Cycles	1,385	2.7
Tractors	1,563	3.0
Total	51,425	100.0
Vehicle Density	14.5	–
per 1,000 Population		
per Km of road	2.2	

Source: National Statistical Office

2.2.2 Marine Transport

1) Nationwide

PNG operates thirteen principal ports for mainly cargo transport through inter-islands operations, but not for passengers. Passenger transport is mainly done by air transport. PNG's main exports are timber, wood-chip, copper, agricultural products, etc. exported through the major ports, Kieta, Kimbe, Rabaul and Madan. (Refer to Figure 2.2-2)

While, the main imports including general goods and petroleum primary products are unloaded at Kieta, Lae and Port Moresby ports.

2) Rabaul (Simpson) Port operates for passenger transport from/to Kimbe, Lae, Kavieng, Bialla, etc. and functions as the customs port of inter-regional transport, feeder service for the inbound cargo from the ports in New Britain and New Ireland.

In general, port activities do not tend to be revenue earning, when debt service and capital expansion are included. Port of profit is regularly transferred from the port accounts to the Treasury.

In connection with the transportation network in PNG, it is noted that a long term development plan of the transportation sector was under preparation and the sector policies for development was yet unknown to the Study Team. This study, therefore, has been conducted under the general framework to principally resolve problems that Tokua Airport has in safety and efficient operations. Nevertheless, general policy to promote exports and tourism development has been reflected in planning and study of the improvement programs.

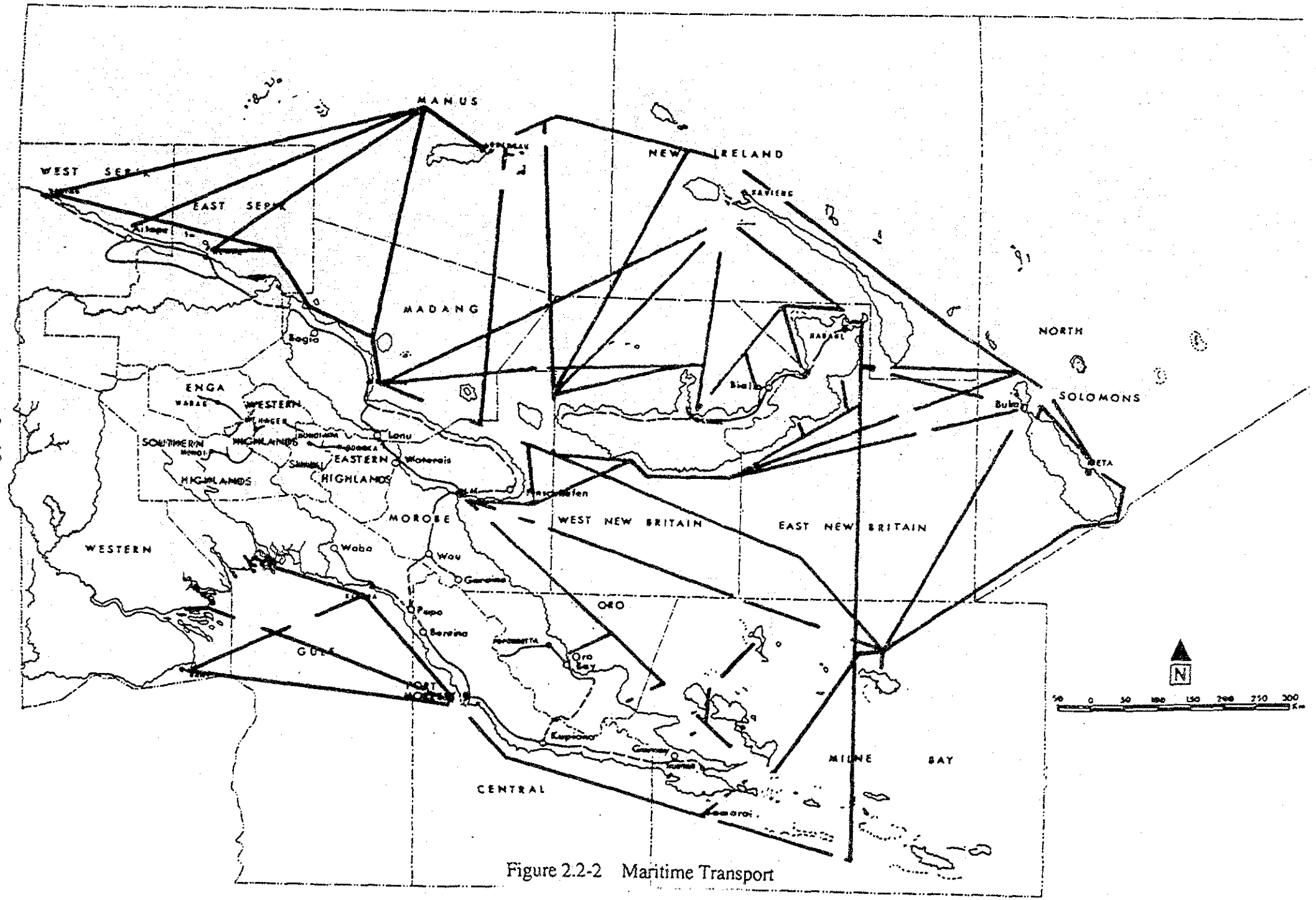


Figure 2.2-2 Maritime Transport

3. RABAUL AIR TRAFFIC

3.1 Historical Data on Air Traffic

3.1.1 Air Passengers

1) General

Passenger traffic to/from Rabaul Airport has been increasing during the period from 1983 to 1989 at an average annual growth rate of 3.9% as shown below. From 1983 to 1986 passenger traffic decreased, while it increased during 1987 through 1989.

Table 3.1-1 Historical Passenger Traffic at Rabaul Airport

	(Unit: persons)
1983	116,330
1984	112,759
1985	109.298
1986	101,705
1987	111,182
1988	132,823
1989	146,255
Annual Growth Rate	3.9%

Inspite of the upward trend, the recent passenger flow can not be observed optimistic because of closure of Bougainville Copper Limited Mine. This fact has directly influenced passengers' activity. According to OD traffic statistics of Air Niugini and Talair, passengers between Rabaul Airport and Kieta Airport shows a drastic decrease from 61,022 in 1989 to 5,945. (Refer to Table 3.1-2 and 3.1-3)

Total passengers of the two airlines also decreased from 158,000 in 1989 to 109,000 in 1990 which represents a drop by 31%.

One of the key factors for the passenger traffic at Rabaul Airport to continue an upward trend is the reopening of Bougainville Copper Limited.

Table 3.1-2 OD Air Passengers Between Rabaul and Other Airports (1989)

(Unit: Persons)

Route		Outbound			Inbound			Total
		Air Niugini	Talair	Subtotal	Air Niugini	Talair	Subtotal	
Rabaul	- Hoskins	4,072	1,610	5,682	-	1,630	1,630	7,312
	- Nissan Is.	-	9	9	-	-	-	9
	- Kieta	27,174	64	27,238	33,772	12	33,784	61,022
	- Kavieng	5,273	736	6,009	5,416	718	6,134	12,143
	- Lae	7,185	1,711	8,896	7,493	1,540	9,033	17,929
	- Madang	684	5	689	770	79	849	1,538
	- Manus	1,912	13	1,925	4,817	4	4,821	6,746
	- Port Moresby	24,395	1,391	25,786	22,439	983	23,422	49,208
	- Wewak	-	-	-	242	-	242	242
	- Goroka	-	-	-	-	-	-	-
	- Buka	-	-	-	-	1,500	1,500	1,500
	- Popondetta	-	2	2	-	-	-	2
	- Mt. Hagen	-	-	-	-	6	6	6
	- Tabubil	-	-	-	-	3	3	3
	- Mendi	-	-	-	-	9	9	9
Total		70,695	5,541	76,236	74,949	6,484	81,433	157,669

Note: There are some routes which have only inbound or outbound traffic such as Rabaul-Nissan Is. Rabaul-Wewak and Rabaul-Buka etc. These routes seem to have triangle routes respectively.

Table 3.1-3 OD Air Passengers Between Rabaul and Other Airports (1990)

(Unit: Persons)

Route		Outbound			Inbound			Total
		Air Niugini	Talair	Subtotal	Air Niugini	Talair	Subtotal	
Rabaul	- Hoskins	4,690	858	5,548	5,114	901	6,015	11,563
	- Nissan Is.	167	-	167	3,533	-	3,533	3,700
	- Kieta	824	-	824	5,121	-	5,121	5,945
	- Kavieng	5,500	230	5,730	6,724	277	7,001	12,731
	- Lae	8,096	1,003	9,099	3,385	1,120	4,505	13,604
	- Madang	569	7	576	492	9	501	1,077
	- Manus	1,895	-	1,895	2,220	-	2,220	4,115
	- Port Moresby	27,490	388	27,878	26,614	263	26,877	54,755
	- Wewak	500	12	512	-	-	-	512
	- Goroka	-	-	-	41	-	41	41
	- Buka	-	131	131	-	-	-	131
	- Popondetta	-	12	12	-	1,118	1,118	1,130
Total		49,731	2,641	52,372	53,244	3,688	56,932	109,304

Note: There are some routes which have only inbound or outbound traffic such as Rabaul-Wewak, Rabaul-Goroka and Rabaul-Buka. These routes seem to have triangle routes respectively.

2) Traffic Survey

For the purpose of making an accurate demand forecast and obtaining more detail information with regard to the behaviour of passengers, the Study Team carried out a traffic survey during the two days from 11th (Tuesday) to 12th (Wednesday) of June, 1991 at Port Moresby Airport and Rabaul Airport.

The survey was conducted in the way of interview by surveyors to passengers in the waiting rooms. The collected survey sheets numbered 144 at Rabaul Airport and 681 at Port Moresby respectively, 825 in total.

The questionnare survey sheet is composed of twelve items, such as nationality, purpose of trip, origin and destination places, access and igress time and cost to/from airports, occupations etc. (Refer to Attachment 3-1)

According to this survey, passengers of foreign nationality accounted for 30.5% at Rabaul Airport (RAB), and 40.0% at Port Moresby (POM). Their main purposes of trips are visiting relatives and commercial business at RAB. A few tourists were identified. At POM, the main purposes of trips are commercial/business, tourist and visiting relatives. The survey showed only 2% of the total passengers from POB to RAB were tourists. In reality it is considered that there are a higher percentage of passengers with the purpose of tourism from POM to RAB, because the survey dates of Tuesday and Wednesday are not the peak days of the week. Usually, peak days in a week seemed to be Saturday or Monday and more foreign tourists arrive from POM to RAB during a whole week. More detail results of survey are referred to Attachment 3-2.

3.1.2 Air Cargo

Different from passenger traffic, air cargo movement to/from Rabaul Airport has been increasing constantly during the period from 1983 to 1989, except in 1985, indicating an average annual growth rate of 11.5% as shown below.

Table 3.1-4 Historical Cargo Traffic at Rabaul Airport

	(Unit: tons)
1983	756
1984	1,169
1985	1,028
1986	1,243
1987	1,250
1988	1,404
1989	1,455
Annual Growth Rate	11.5%

The same trend as passenger traffic can be seen with regard to air cargo traffic. Inspite of the overall upward trend, the rate of growth of air cargo flow to/from Rabaul Airport seems to have slowed down because of the closure of Bougainville Copper Limited Mine. OD traffic statistics of Air Niugini and Talair shows a decrease in almost all of air cargo between Rabaul Airport and other airports. (Refer to Table 3.1-5 and 3.1-6)

Total air cargo of the two airlines decreased also from 1,234 tons in 1989 to 1,001 tons in 1990 which is a decrease of 19%.

3.2 Air Traffic Route and Aircraft Type

There are three airliners operating at Rabaul Airport. Air Niugini operates for Port Moresby, Lae, Madang, Wewak, Hoskins, Kavieng, Kieta and Manus. Their air craft types are mainly F-28 (60 seater) and DHC7 (48~54 seater).

Island Airways operates the inter-regional transport between the regions in New Britain, New Ireland and Bougainville by smaller aircrafts such as DHC6 Islanders (15~20 seater) and EMB-1210 (30 seater).

Air-Link operates for shorter distances with Turbo Prop and Prop type (9 sitters) and helicopters.

It must be noted that the general aviation accounts for a high proportion (25~30%) of the number of operations at Rabaul Airport.

3.3 Scheduled Operations at Rabaul Airport (Refer to Table 3.3-1)

Table 3.1-5 OD Air Cargo Traffic Between Rabaul and Other Airports (1989)

(Freight & Mail: Unit: KGS)

Route		Outbound			Inbound			Total
		Air Niugini	Talair	Subtotal	Air Niugini	Talair	Subtotal	
Rabaul	- Hoskins	28,312	28,201	56,513	15,222	12,333	27,555	84,068
	- Nissan Is.	-	258	258	-	-	-	258
	- Kieta	31,857	-	31,857	37,796	320	38,116	69,973
	- Kavieng	62,130	26,268	88,398	22,075	5,281	27,356	115,754
	- Lae	22,382	48,569	70,951	69,766	75,731	145,497	216,448
	- Madang	2,616	464	3,080	778	4,274	5,052	8,132
	- Manus	15,434	137	15,571	5,878	4	5,878	21,449
	- Port Moresby	134,567	12,837	147,404	518,522	34,951	553,473	700,877
	- Wewak	1,494	-	1,494	654	-	654	2,148
	- Goroka	-	-	-	-	-	-	-
	- Buka	-	13,857	13,857	-	1,244	1,244	15,101
	- Popondetta	-	-	-	-	-	-	-
	- Mendi	-	-	-	3	-	3	3
	- Tabubil	-	-	-	100	-	100	100
Total		298,792	130,591	429,383	670,794	134,134	804,928	1,234,311

Note: There are some routes which have only inbound or outbound traffic such as Rabaul-Nissan Is., Rabaul-Mendi and Rabaul-Tabubil. These routes seem to have triangle routes respectively.

Table 3.1-6 OD Air Cargo Traffic Between Rabaul and Other Airport (1990)

(Freight & Mail: Unit: KGS)

Route		Outbound			Inbound			Total
		Air Niugini	Talair	Subtotal	Air Niugini	Talair	Subtotal	
Rabaul	- Hoskins	30,092	19,594	49,686	12,376	-	12,376	62,062
	- Nissan Is.	-	-	-	-	-	-	-
	- Kieta	9,073	-	9,073	5,354	-	5,354	14,427
	- Kavieng	59,794	7,619	67,413	12,087	765	12,852	80,265
	- Lae	30,523	20,262	50,785	67,783	52,629	120,412	171,197
	- Madang	1,705	225	1,930	314	44	358	2,288
	- Manus	11,289	-	11,289	3,953	-	3,953	15,242
	- Port Moresby	126,438	3,671	130,109	505,241	17,781	523,022	653,131
	- Wewak	1,785	-	1,785	-	-	-	1,785
	- Goroka	-	830	830	-	-	-	830
	- Buka	-	644	644	-	6	6	650
	- Popondetta	-	-	-	-	9	9	9
Total		270,699	52,845	323,544	607,108	71,234	678,342	1,001,886

Note: There are some routes which have only inbound or outbound traffic such as Rabaul-Wewak, Rabaul-Goroka and Rabaul-Popondetta. These routes seem to have triangle routes respectively.

Table 3.3-1 Scheduled Operations at Rabaul Airport

Time	Monday		Tuesday		Wednesday		Thursday		Friday		Saturday		Sunday	
	DEP	ARR	DEP	ARR	DEP	ARR	DEP	ARR	DEP	ARR	DEP	ARR	DEP	ARR
06:00				*DH7x1					F28x1			F28x1	F28x1	
07:00	F28x1		*DH7x1 CN4x1		CN4x1	CN4x1 BNIx1		CN4x1			F28x1 CN4x1 BNIx1			
08:00	CN4x1	CN4x1	CN4x1	CN4x1	CN4x1	CN4x1	CN4x1	CN4x1	CN4x1	CN4x1	CN4x1	CN4x1		
09:00	CN4x1		CN4x1		F28x1 CN4x1	F28x1	F28x1 CN4x1	F28x2	CN4x1 BNIx1	F28x1	CN4x1			
10:00	BNIx1		F28x2	F28x1			F28x1		F28x1					
11:00					F28x1	F28x1 BNIx1		F28x1		F28x1 BNIx2	F28x1	F28x2		F28x1
12:00		CN4x1 BNIx1	F28x1	F28x1 CN4x1			F28x1 CN4x1	CN4x2	F28x1	CN4x1		CN4x2	F28x1	F28x1
13:00	CN4x1	CN4x1	CN4x1		BNIx1	CN4x1			BNIx1	CN4x1			F28x1	
14:00	F28x1 BNIx1	F28x1		CN4x1						BNIx1				F28x1
15:00	CN4x1	CN4x1	CN4x1		CN4x2	CN4x1 BNIx1	CN4x1	CN4x1		CN4x1	CN4x1		F28x1	
16:00	F28x1 CN4x1	F28x2 CN4x1 BNIx1	F28x1	F28x1 CN4x1 BNIx1		CN4x1		F28x1 CN4x1 BNIx1	F28x1	F28x2		F28x1 CN4x1 BNIx1		F28x1
17:00			F28x1	F28x1					F28x1					
Total:	F28x3 CN4x5 BNIx2	F28x3 CN4x5 BNIx2	F28x5 CN4x5 DH7x1	F28x4 CN4x4 BNIx1 DH7x1	F28x2 CN4x5 BNIx1	F28x2 CN4x5 BNIx3	F28x3 CN4x4	F28x4 CN4x6 BNIx1	F28x5 CN4x2 BNIx2	F28x4 CN4x4 BNIx3	F28x2 CN4x4 BNIx1	F28x3 CN4x4 BNIx1	F28x3	F28x4
DEP+ARR:	F28x6 CN4x10 BNIx4		F28x9 CN4x9 BNIx1 DH7x2		F28x4 CN4x10 BNIx4		F28x7 CN4x10 BNIx1		F28x9 CN4x6 BNIx5		F28x5 CN4x8 BNIx2		F28x7	
Operation per Day:	20		21		18		18		20		15		7	

Note: * Stands for Freight
Source: AIR NIUGINI Schedule Issue No. 70 (Eff: 3rd March, 1991) and AIRLINK Schedule (EFF: 26th November, 1990).

4. STATUS OF EXISTING RABAUL AIRPORT

The Study Team has reviewed various previous reports about the feasibility of the airport at Tokua and surveyed the site. The Tokua site was found to be superior to that of the Rabaul for the proposed airport development.

In order to clarify the need to develop a new airport at Tokua as the alternative airport to the existing Rabaul Airport, status of Rabaul Airport is described hereunder in a summarized form. Table 4-1 shows the comparison of the status of Rabaul Airport and Tokua Airfield.

4.1 Airside Infrastructure

1) Historical Background

Rabaul Airport (AYRB) is located at 04°13'30"S and 152°12'00"E (aerodrome reference point), adjacent to the Simpson Harbour, approximately 3 km south-east from the center of Rabaul city with a population of 16,000 (as of 1985), and is operated by the DCA of PNG. AYRB started as an airbase during the World War II, followed by construction of the terminal building and extension of the runway for civil aircraft operation use after the termination of the war.

However, the need of introduction of bigger aircraft with their increased operations as the time has elapsed, as is the case in the airports in the world, Rabaul Airport has now become to have various constraints. Among the constraints, the physical conditions as the following factors are the mains. No one can get rid of factors (1) through (4). But factor (5) has to do with the Government policy.

(1) The expandability of the runway is very limited because of the deep sea existing at the both ends of the runway.

(2) The existing volcanoes penetrate over the approach surface, thus hampering aircraft IFR operations.

(3) Pressure from remaining air in the runway base material caused by the underground-water level rise, when it rains, damages the surface pavement.

Table 4-1 Comparison of Subject Airports

Items	Rabaul	Tokua
Ref. Coordinate	4°13'30"S 152°12'00"E	4°20'00"S 152°23'30"E
Height/Slope	4.0 m/0.2° longi.	9.7 m/0.82° longi.
R/W Orientation	12/30	10/28
Main Facilities		
- Runway	1,586 m x 30 m	1,720 m x 30 m
- Pav. Strength	AS/PCN 20/F/C/Z/U	WC/PCN 12/F/CZ/T
- Runway Strip	1,646 m x 90 m	1,720 m x 80 m
- Taxiway	15 m x 85 m	15 m x 135 m
- Apron	210 m x 60 m	150 m x 70 m
- Pav. Strength	AS/PCN 20/F/C/Z/U	
- Terminal Build.	880 m^2, 1F	
- Admi. Build.	DCA, 1F	
- Nav. Aid	NDB, DME, T-VASIS	NDB
- Comm.	VHF, SSB-HF	
- Wx	A set of equipments	Auto-Anemometer
- Fuel	AVIGAS, JET-A1	
Expandability	None	Sufficient
Airspace	Limited	Ample
Volcanic danger	High	Low
Equipment	Insufficient and under urgent renewal	New

(4) Sulphurous gas is generated from volcanic activity right under the runway and it has been reported that there is a high possibility of volcano eruption which would endanger the lives of the mass of people using the airport, and

(5) A number of trees in the plantation on the southern side along the runway intruding over the Transitional Surface do not conform with ICAO standards.

2) Potential Demand

The average load factor of the aircraft is more than 90%. This reflects that the potential demand is big and the air transport demand is deemed to further increase in future through the implementation of the proposed airport development project in harmony with the promotion of tourism industry and the others.

3) Operational Traffic

(1) Airliners

There are 3 major airliners operating at the airport. Air Niugini operates for Port Moresby, Nadzab, Madang, Wewak, Hoskin, Kavieng and Kieta by F28 of 57 flights a week. In addition, Island Airways and Air Link operate for inter-regional transport in between the other regions in New Britain, New Ireland and Bougainvill by smaller aircraft such as DHC7, BN Islanders, etc. thus Rabaul Airport being the key station for these areas.

(2) Traffic Demand

The number of passengers reached a peak of 146,255 in 1989. Cargo volume reached a peak of 1,455 tones in the same year. The scheduled flights are 219 per week, of which the cargo flights counted 15 according to the time-table of October 1990. The peak day of the schedule flights comes to 44. While the cargo flights were 4 of DHC7 on Tuesday. Type of aircraft in service are F28 as the main and DHC7, with their annual frequency being 13,507 of carriers in 1987 and 13,217 in 1988, dropping off thereafter to 10,294 in 1989. Operation-hour is limited to Sunrise-Sunset.

The passenger traffic demand is estimated to be 6.2% up annually through the historical records from 1983 to 1989.

4.1.1 Runway, Runway Strip, and Taxiway

1) Runway

The present runway of 1,586 m in length and 30 m in width is considered too short and narrow. Thus, weight suppression is imposed for take-off in the case of a F28 departure for Port Moresby under the penalty of 30% of MTOW. An aircraft in excess of 20,000 kg must use the full length of the runway on landing and execute maximum radius turn on the threshold or prepared nodes.

The pavement of the runway consists of a sub-base of 30 cm which is overlaid by asphalt with a strength of PCN 20 F/C/Z/U. This pavement strength cannot cater for aircraft operations bigger than F28 type. In addition, the pavement material is prone to damage, due to sulphurous gas being generated from volcanic activity under the runway, acute braking of landing aircraft which has to be applied due to the short runway length and pressure from remaining air in the runway base material caused by the underground-water level rise when it rains.

2) Runway Strip

The runway strip is 1,646 m in length and the width of the runway strip zone is limited to 90 m which does not permit instrument landing. It is also noticeable that a number of trees along the runway strip infringes over the Transitional Surface or the Obstacle Limitation Surface (OLS), not conforming to the requirements under the ICAO Standards and recommended practices (150 m) even for VFR operations. For instrument landing, it should be expanded to have 300 m in width.

3) Taxiway

There is a pair of taxiways of 85 m x 30 m connected with the apron at the angle of 90 degrees, but no parallel taxiway exists. This condition would hamper smooth aircraft operations in taxiing, taking-off and landing in future when traffic demand increases.

4.1.2 Apron Area

The passenger terminal apron has a dimension of 210 m x 60 m (12,600 m^2) with pavements of concrete structure and which is only capable to accommodate a F28 and some small aircraft. Pavement surface is generally in good condition, except for some cracks observed and deteriorated in some construction joints. The size of the passenger terminal apron hinders, even at present, introduction of aircraft bigger than F28, since the small apron area cannot provide the required separation of 15 meters between a moving plane and parked aircraft.

The pavement of the apron has a sub-base of 30 cm thick which is overlaid by asphalt. The strength is PCN 20 F/C/Z/U, the same as that of the runway. This strength is not suitable for parking and manouvring of aircraft bigger than F28.

Inadequacy of the apron area is a limiting factor during period of busy hours. Peak use of apron area springs not from the airline schedule. Frequently prolonged use of gate arises from mechanical problems, arrival or departure delay caused by conditions at origin or destination airports. It is apparent that as traffic mounts at the airport in the years ahead, the apron limitations will become an increasing restraint on airport efficiency.

4.1.3 Drainage Systems

The purpose of airport drainage is to dispose of water which may hinder any activity necessary to the safe and efficient operation of the airport. The natural catchment area of the surface water runoff is open ditch along and close to the runway. Such will be dangerous to aircraft operation and hamper activities of crash, fire extinguishing and rescue operation for an aircraft accident on or off the runway.

4.2 Terminals

4.2.1 Passenger Terminal

The passenger terminal building complex has a floor area of 880 m^2 and is of wooden structure constructed in the year 1960. It is considered to be much too deteriorated and congested for safety use. Such cases are clearly witnessed when two F28 happen to arrive within an hour's period, caused by the reasons mentioned in Section 4.1.2. There seems to have no space to provide CIQ, tourism information, restaurant, VIP room, etc. It is apparent that the provision is inadequate to satisfy a prospected demand increase.

1) ATS Staff Building

The ATS staff building, located adjacent to the passenger terminal area, is also of wooden structure and much too small for the required number of staff. Consequently, all rooms for the staff's field of responsibilities are very small and laid not in a neat manner. The staff should not work in such an unfavorable condition.

2) Car Parking Area

The car parking area is located in front of the terminal building and capable to accommodate 50 ~60 cars. Expandability of the area is totally limited.

4.2.2 Cargo Terminal

None of any specific cargo sorting area exists, but just a minor storage attached to the passenger terminal building. This is a serious problem - a real sense -, since the cargo demand is at present 1,500 tons handled. On-site observations and various interviews with airlines have pointed out the inadequacy of cargo handling. Baggages are handled without any conveyor and cargo are processed in the apron.

The export/import cargo is made up of perishable items from and to Rabaul and other parts of the regions and neighboring countries. Because of the absence of refrigerated storage, the exporters/importers must time their shipping and arrival with each flight movement in order to minimize losses.

4.2.3 General Aviation Facilities

So-called general aviation specified in this report is not only for recreational or business purposes but the non-scheduled smaller aircraft than F28 type aircraft such as DHC6, 7 and 8, BN Islander, Bandeirante, Beech Baron, Cessna 402, etc.

There are no centralized airport facilities for general aviation at the airport. The number of general aviation in PNG shares a large portion of air operations. However, it has been determined - on a preliminary and tentative basis - that general aviation activities are likely to remain relatively constant throughout the study period. The evidence indicates that the main reason for general aviation flights are commercial consideration, rather than recreational purposes.

4.3 Support Activities

4.3.1 Airport Support Facilities

The existing facilities which contribute to the support of activities taking place on the ground (both airside and landside) are briefly described hereunder.

1) Crash, Fire and Rescue (CFR) Building

There are two components in every CFR building analysis: The equipment (mostly fire trucks) which are the main elements in determining rescueing capacities, and the building which contributes to the comfort of the crew and facilitates the efficiency of the operation.

At Rabaul Airport presently, the CFR building is relatively new and there exist one fire truck. The building is small to accommodate more vehicles prospected in future, however it can be expanded to an extent in the area adjacent to the existing building.

2) Maintenance Facilities

The maintenance shop located in an area off the car parking area is so shabby and narrow, which services vehicles and runway maintenance equipment and aircraft maintenances done by the airlines themselves.

The equipment, as witnessed by the Study Team, is totally inadequate, not only in terms of its working condition, but also in terms of the type of instruments which is being used.

3) Fuel Farm

There is a fuel tank in the airport compound from which AVIGAS Jet-A1 is supplied to the hydrant pits on the apron. The area's expandability to install more tanks is very limited.

4) Utilities

Water supply to the airport relies upon the subterranean water and rain fall, which is the cause of water shortage in the dry season.

4.3.2 Operation Support Services

Most of the facilities to support operations on ground and in the air are old and do not satisfy the ICAO standards. The present operational condition of these facilities is briefly summarized as the following:

1) Air Traffic Services (ATS)

No air traffic control tower exists at the airport, but ATS officers operate in the room on the ground floor in the administration building and deliver aeronautical informations to a pilot. The pilot makes landing, taking-off, taxiing, etc. in the air or on the ground at his own discretion. Hence, there are no Air Traffic Controllers (ATC) who have jurisdiction to issue a clearance to a pilot.

All of ATS equipment in the ATS room are found to be very behind the date which might be hard to maintain in the neat and tight functioning, since the spare parts for such equipment are no longer on a production line. They seem to reach their life expectancies in near future.

2) Navigational Aids and Telecommunications

There is only an old NDB/DME but no VOR/DME, thus the landing minimum is low. A set of AT-VASIS exists as a visual navigational aid, but some of them are not functioning.

A VHF air/ground frequency of 120.9 MHZ are provided for aeronautical mobile services (AMS). The emergency frequency of 121.5 MHZ is, however, not provided.

3) Power Supply and Lighting Systems

Electricity power supply is provided through hydraulic and diesel engine generations.

There are none of lighting systems such as Approach Light System, Runway Lights, Runway Threshold Lights, Runway End Lights, Taxiway Edge Lights, Apron Flood Lights and the others needed.

4) Field Meteorological Observation

A set of meteorological equipment are installed to observe fundamental weather data on altimeter, temperature and wind direction and velocity, needed for aircraft operations. The equipment are found to be out of the date.

4.3.3 Airport Administration

DCA is responsible for the airports administration. Rabaul Airport operation is conducted by 12 Air Traffic Services Officers (ATSO) and 28 maintenance personnel under an Administrator.

1) ATSO

ATSO are working on 2 shifts between 05:00 ~12:00 (morning shift) and 12:00 ~19:00 (afternoon shift) with one man on each shift, 1 or 2 ATSO take a day-off every day. An ATSO works through the entire span as shown below:

ATSO	Work-Hour
1st Day	12:00 ~19:00
2nd Day	12:00 ~19:00
3rd Day	05:00 ~12:00
4th Day	05:00 ~12:00
5th Day	Free ~
6th Day	07:45 ~16:00

Then, he comes back on the work-hour 12:00 ~19:00

A shift consists of 3 ATSOs working for AFIZ (Aerodrome Flight Information Zone), FPA (Flight Planning Area) and SFIO (Senior Flight Information Officer). Number of ATSOs is supposed to be 9 in total plus 1 vacant. Airport Administrator is also fully licensed, but not in shift.

2) Telecommunication Maintenance

Aeronautical telecommunication equipment are repaired by maintenance personnel in the maintenance shop and their functionability is monitored

through the line connected with the small office quarter and maintained by a periodical visit from Fiji.

3) Ground Maintenance

The air field is maintained in a good order by the routine maintenance by resident staff who work mainly in grass cutting.

PART-II TOKUA AIRPORT DEVELOPMENT

PART-II TOKUA AIRPORT DEVELOPMENT

5. SITE CONDITIONS

5.1 Meteorology

5.1.1 General

The subject site lies in a tropical zone. Therefore, no big climate change is seen throughout the year with the temperature of 26° ~ 27° monthly average and exceeding 30° in the daytime.

And it is noted that this area is geologically located in the midst of volcanic region surrounded by the Rabaul Volcanics.

5.1.2 Wind

An analysis of wind is essential for planning runway(s). As a general rule, the principal traffic runway at an airport should be oriented as closely as practicable in the direction of the prevailing winds. For all airports, ICAO requires that runways should be oriented so that planes may be landed at least 95 percent of the time with cross wind components of 23 miles/h (20 knot) of airfield code A and B runways, 15 miles/h (13 knot) for airfield code C runways, and 11.5 miles/h (10 knot) for airfield code D and E runways.

Based on the collected data at Tokua Airfield site, the analysis of the wind has been performed by the Study Team, and the process and result of that are as follows.

1) Collected weather record:

   24 times per day at interval of 1 hour for one year from January 1990 to December 1990.

2) Analysis criteria

   a) Considering the airport operational hour, the wind data from 7:00 am to 8:00 pm were selected.

   b) Following the ICAO requirement, the cross wind component should be categorized in 10, 13, 20 and 25 knot.

c) The wind coverage should be calculated in the case of all season, dry season (May to Oct.) and rainy season (Nov. to Apr.)

Table 5.1-1 ~ 5.1-3 show the wind coverage categorized in the cross wind component of 10, 13, 20 and 25 knot.

Table 5.1-1 Result of Wind Coverage Analysis: Dry Season

Cross Wind Direction	10 knot (%)	13 knot (%)	20 knot (%)	25 knot (%)
E-W	75.59	90.26	98.68	100.00
ENE-WSW	79.59	91.22	99.09	100.00
NE-SW	90.01	95.40	99.82	100.00
NNE-SSW	97.33	99.10	100.00	100.00
N-S	99.36	99.75	100.00	100.00
NNW-SSE	98.46	99.58	99.83	100.00
NW-SE	90.88	96.53	99.57	100.00
WNW-ESE	79.50	92.09	98.93	100.00
Specific Runway Orientation				
R/W 10 - 28	76.32	90.72	98.72	100.00

Table 5.1-2 Result of Wind Coverage Analysis: Rainy Season

Cross Wind Direction	10 knot (%)	13 knot (%)	20 knot (%)	25 knot (%)
E-W	87.77	95.79	99.48	99.93
ENE-WSW	80.76	90.89	98.49	99.38
NE-SW	8032	89.31	97.47	98.66
NNE-SSW	83.50	90.59	97.06	98.53
N-S	88.31	93.11	97.63	98.80
NNW-SSE	93.40	96.20	98.98	98.57
NW-SE	96.46	99.55	99.96	100.00
WNW-ESE	94.31	98.09	99.78	100.00
Specific Runway Orientation				
R/W 10 - 28	90.93	97.05	99.57	99.98

Table 5.1-3 Result of Wind Coverage Analysis: Total

Cross Wind Direction	10 knot (%)	13 knot (%)	20 knot (%)	25 knot (%)
E-W	84.13	94.14	99.24	99.95
ENE-WSW	80.41	90.99	98.67	99.57
NE-SW	83.22	91.13	98.18	99.06
NNE-SSW	87.64	93.13	97.94	98.97
N-S	91.61	95.09	98.34	99.16
NNW-SSE	94.61	97.21	99.23	99.70
NW-SE	94.80	97.95	99.84	100.00
WNW-ESE	89.88	96.30	99.53	100.00
Specific Runway Orientation				
R/W 10 - 28	86.56	95.15	99.32	99.99

From the tables, it is considered that the orientation of existing runway can keep the wind coverage of more than 95 percent in the both categories of 13 and 20 knot cross wind.

Wind Coverage of Existing runway

Cross Wind	Rainy Season	Dry Season	All Year
13 knot	97.1	90.7	95.2
20 knot	99.6	98.7	99.3

Regarding the General aviation for the small aircraft, however, a new runway with clock wise rotation of 28 to 66 degrees from the existing runway would be recommendable in order to keep the coverage of more than 95 per cent.

3) Remark

Analysis of wind in Tokua Airfield site has been performed as mentioned above, however, there are problems regarding the reliability of the data as follows.

a) Recorded data was for one year. According to the ICAO requirement, at least 5 years of the record is recommendable.

b) Number of the data in each month were deviated due to the missing of the record.

As for the low reliability caused by deviated number of the data, relationship of the wind velocity and direction between Tokua Airfield site and Rabaul airport has been checked.

However, the relation between both areas in the wind condition was considered to be nothing in which the wind velocities and direction at the same time in the both areas have been plotted.

5.1.3 Rainfall

Since the rainfall data at Tokua Airfield site were not recorded, rainfall conditions at Rabaul located of about 25 km from the site is mentioned.

Maximum annual rainfall is 2616 mm in 1976, the minimum is 1429 mm in 1984 and the average is approximately 2040 mm, the value of which is smaller than 4610 mm in Lae area, but larger than 1170 mm in Port Moresby.

Regarding the averaged monthly rainfall, the average rainfall from December to March was approximately 250 mm. However, the maximum rainfall reached to about 800 mm in February as shown in Figure 5.1-1.

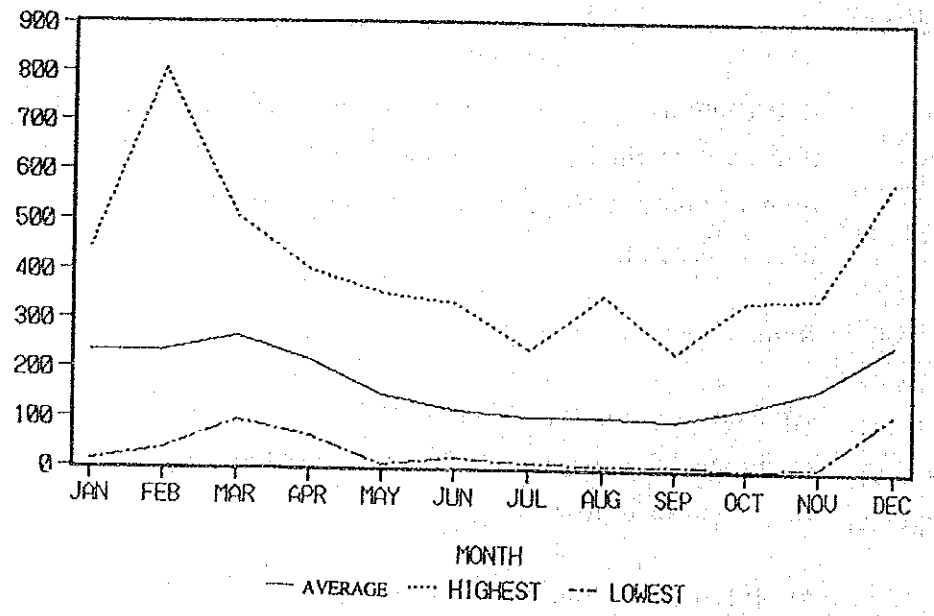


Figure 5.1-1 Monthly Rainfall

The monthly averaged rainfall for the period from 1946 to 1991 appears to be about 200 mm as shown in Figure 5.1-2.

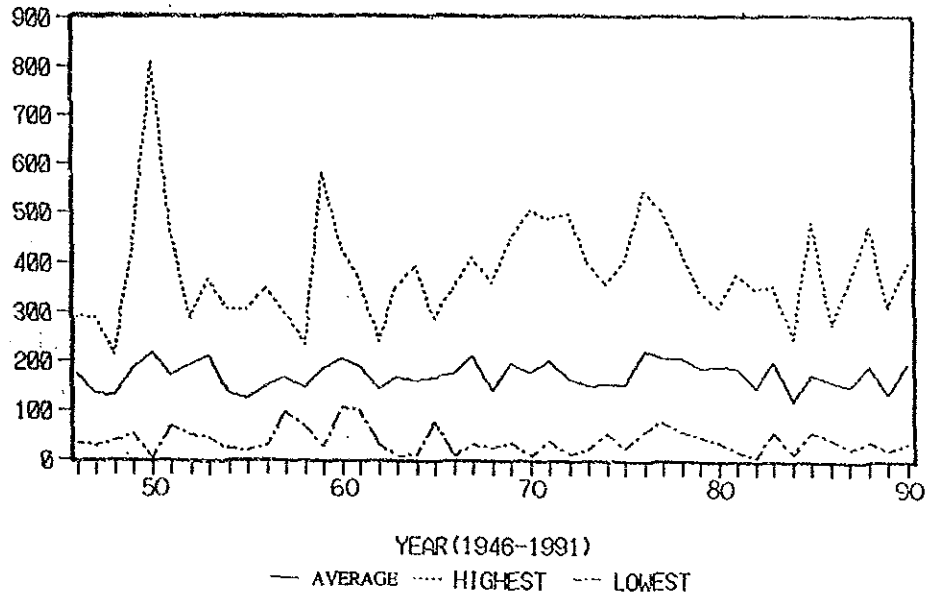


Figure 5.1-2 Monthly Averaged Rainfall (1947 - 1991)

Based on the record of rainfall intensity in 1990 at Tokua Airfield site, maximum rainfalls in a short period are tabulated below.

Maximum rainfall in 1990

Period	Rainfall	Month
15 minute	29.5 mm	Dec.
30 minute	36.0 mm	Apr.
1 hour	58.0 mm	May
2 hour	97.0 mm	May
3 hour	108.5 mm	May

These heavy rainfalls mainly occur in April or May, which belong to the dry season. However, since the record of the rainfall intensity was available in 1990 only, it cannot be concluded that heavy rain would occur in the dry season.

5.2 Topography and Geology

Details of topography and geology in the Tokua site are stated in "Geotechnical Investigation Report".

5.2.1 Summarized Geotechnical Features of Tokua Airport Site

1) The existing airfield is located on a firm or very firm silty/clayey deposits and dense sandy deposits of volcanic origin. The sub-surface conditions of the existing airfield and proposed site is sufficient except the west low land of the existing airfield. It is recommended that the proposed runway should be extended on the east side to the maximum extent.

2) It is expected that the ground water level in the west low land would be lower than EL. 4 m during the dry season.

3) The sandy material which is to be excavated in the airfield is sufficient for the embankment material.

   The coronous deposit is the good subbase material.

4) The foundation of the terminal building is proposed to be the spread foundation.

5) The value of field CBR for the existing subgrade is varied from 6% to 14%.

   The paved runway with coral material shows the K value of about 200 MN/m^3 (20 kgf/cm^3). The strength of this existing coronous pavement is sufficient and therefore is considered to be used for the subbase course of the future runway construction.

6) The Warangoi River deposits which consist of well graded sand and gravel are suitable material for the base course and asphalt/concrete aggregate.

   The small hill which was formed by the upheaval phenomenon of coral around the site is also suitable for the subbase course material.

7) In eruptions in the order of 1 billion m^3 with mean return intervals of several hundred years, the maximum Tsunami height of 5 m above

mean sea level will occur, therefore it is recommended that the future extended subgrade in the west side should be made higher than EL. 5 m. This level can also avoid the inundation of the ground water to the subgrade during the rainy season.

8) In the event of larger eruptions (1-10 billion m^3), it is likely that there may be local earthquake of the magnitude of 6 to 6.5. The earthquake of magnitude 6.5 will induce the maximum ground acceleration of 0.19 g.

The large expected earthquake of magnitude range from 7 to 7.5 will occur near Tokua site in the Ocean and this would induce the maximum ground acceleration larger than 0.3 g.

g : gravity

The earthquake resistant factor should be considered for the building and structures design.

9) The expected airfall volcanic ash at the Tokua site induced by the volcanic eruption of such magnitude similar to the 1937 Vulcan eruption would be thinner than 5 cm thick by northwest wind.

5.3 Volcanic Activities

The general problems related with the Rabaul Volcanics were studied in "Geotechnical Investigation Report".

The summary of impacts that will be caused by these volcanic activities are stated as follows.

5.3.1 Tsunami

In eruptions in the order of 1 billion m^3 with mean return intervals of several hundred years, the maximum Tsunami height of 5 m above mean sea level will occur, therefore the lowest elevation of the runway should be at least 5 m or more as a counter measure for possible tsunamis in future.

5.3.2 Volcanic Ash Fall

According to the data of past eruptions in this area, Tokua site is considered to be adequately safe from the Rabaul volcanoes and it is expected that thickness of ash fall would be thinner than 5 cm even if the wind will blow towards this site.

5.3.3 Seismic Impact

The large historical earthquakes in the vicinity of Tokua are shown below.

Year	Latitude	Longitude	Magnitude
1913	5.0	154.0	7.5
1916	4.0	154.0	7.9
1919	5.0	154.0	7.9
1920	4.0	152.5	7.7
1941	4.5	152.5	7.0
1944	2.5	152.7	7.5
1946	4.5	153.5	7.8
1953	4.0	154.0	7.5
1967	4.4	152.5	6.2
1968	5.5	153.2	7.8

The counter-measures for seismic impact should be carefully referred to "Code of Practice for General Structural Design and design loadings for Buildings", Part 4, Earthquake loadings, PNG Standards Council, 1982.

5.4 Topographic Mapping

1/5,000 topographic maps covering 35 sq. km, 4.0 km longitudinal profile and 41 cross section drawings and 1/1,000 topographic maps were prepared. Followings are the work results.

1) 1/5,000 topographic maps

- Aerial photography at a scale of 1/20,000
- Traversing and levelling data
- Field verification data
  (Compiled on two times enlarged photos)
- Aerial triangulation data
- 1/5,000 topographic maps

2) Longitudinal profile and cross sections

- Field data
- Longitudinal profile drawings
  (H = 1/1,000 V = 1/50)
- Cross section drawings
  (H = 1/500 V = 1/50)

3) 1/1,000 topographic maps

- Supplementary field data
- 1/1,000 topographic maps

6. REGIONAL DEVELOPMENT

6.1 Role of Tokua Airport in Regional Development

1) Objective of Analysis

The roles of Tokua Airport are two-fold. The immediate need for Tokua Airport arises from the necessity to provide an alternative airport to the existing Rabaul Airport, vulnerable to volcanic erruption that could take place anytime. The longer-term objective is for Tokua International Airport to spearhead regional development. The following part presents a preliminary analysis on the possibilities of regional development of East New Britain Province triggered by Tokua Airport development. To find implications for Tokua Airport, some examples in other countries were looked into.

2) Examples in Other Countries

The creation of a new airport leads to generating a new pattern of flows of people, information, and commodities, thus providing new chances for regional economic growth. Paying attention to this aspect, there have been a number of cases in the world that try to promote regional development through establishing a new airport or expanding the capacity of the existing airport and upgrading it to an international airport. There are a variety of patterns in associating airport development with regional development depending on factors such as the level and characteristics of the economy, location, government policies, available resources, status in national and international air transport network etc. The following are some examples in other countries in which airports are playing an important role in regional economic activities.

Activities associated with airport development	Facility (City)	Country
Trade fair	Frankfurt Messe (Frankfurt)	Germany
	Dusseldof Messe (Dusseldolf)	Germany
	Makuhari Messe (Makuhari)	Japan
Convention center	McCormick Place on the Lake (Chicago)	USA
	Georgia World Congress Center (Atlanta)	USA
Distribution center	Dallas Market Center (Dallas)	USA
	Memphis	USA
	Rangis Central Market (Paris)	France
Resort	Diesneyworld (Orlando)	USA
	Mission Bay Park (San Diego)	USA
Shopping center	Singapore Frankfurt	Singapore Germany
Academic & research center	Sophia Antipolis (Nice)	France
High-tech industrial estate	Las Colinas (Dallas)	USA
	Irvine	USA
	Cilicon Island*	Japan

* a number of prefectures in Kyushu Island

In Japan, a number of regional governments are proposing concepts to revitalize regional economies through enhancing the functions of airports. "International air cargo base plan" proposed by Hokkaido government is an example of efforts to become a new regional center of air cargo traffic through reinforcing the cargo handling capability of