3.4 Evaluation of Alternative Sites

Comparative evaluation of the three alternative sites, namely Mpaka, Sikupe and Mogobi, was made to select an optimum site for the new airport construction both from technical and economic points of view.

The technical evaluation was made in terms of availability of airspace required for safe aircraft operation and practicability of construction as well, which was followed by the evaluation from economic aspects. The overall evaluation of the three sites was then made taking also into consideration other factors such as land use and future development potential around each site, etc., which can be foreseen but not quantifiable for the moment.

3.4.1 Technical Aspects

1) Availability of Airspace

As mentioned earlier it was confirmed that all three sites satisfy the minimum airspace requirements specified in the ICAO Annex 14. Presented hereunder is the identification of obstacles in wider range of airspace, if any, which may cause any restriction in establishing ILS approach and instrument departure procedures in accordance with the criteria contained in PANS-OPS (ICAO Doc. 8168/611/3).

a. Mpaka Site

<u>ILS Approach procedure</u>

ILS approach procedure can be established in either direction of the proposed runway without any restriction.

Takeoff and climb procedure

Straight takeoff/climb procedure can be established in either direction of the proposed runway. Turn-out takeoff/climb procedures to the west, however, will be restricted due to Mt. Nutabankulu which is located 14.5 km to the west of the proposed runway.

b. Sikupe Site

ILS Approach procedure

ILS approach procedure can be established in either direction of the proposed runway without any difficulty.

Takeoff and climb procedure

Straight takeoff/climb procedure can be established in either direction of the proposed runway. Turn-out takeoff/climb procedures to the west and to the south-west will be restricted due to mountains located at 4 km to the west, 8 km and 15 km each to the south-west of the proposed runway.

c. Mogobi Site

ILS Approach procedure

ILS approach procedure to the proposed runway from the south-east can be established without any difficulty. ILS approach procedure from the north-west will require rather sophisticated routing and altitude restrictions due to the mountains located near the final approach path.

Takeoff and climb procedure

Straight takeoff/climb procedure can be established in either direction of the proposed runway. Turn-out takeoff/climb procedures to the west and to the south-south-east, however, will be restricted due to Mt. Mdimba and Mt. Ntabankulu located at 28 km to the west-north-west and 11 km to the south-east of the proposed runway respectively.

2) Practicability of Construction

Practicability of construction at the three alternative sites was analyzed and evaluated in terms of construction cost of the major civil works such as earthwork, paving and drainage which mainly affect the total construction cost of each site. The construction costs of other airport facilities such as terminal building, navigational aids, etc., were not taken into account in this evaluation. It should, therefore, be noted that the construction cost estimated hereunder was used only as a parameter for the site evaluation analysis.

The construction costs presented herein were estimated on the basis of the price information as of November 1979 supplied by the Ministry of Works, Power and Communications of Swaziland. The topographical maps used for the estimate were in scale of 1 : 10,000 for Mpaka and Sikupe sites, and 1 : 5,000 for Mogobi site. After the grading plan was prepared for each site, some trial pits were excavated in the possible area to be cut in order to confirm the geological conditions.

The grading plans and longitudinal runway profile of the three alternative sites are given in Appendix 3B and 3C.

a. Mpaka Site

The maximum depth of earthfills required would not exceed 10 m, and the earthwork volume involved was estimated.at about 2.6 million cubic meters, 60% of which would be of rock. According to the trial pits observation, the rock seems to be able to be excavated by bulldozer with ripper.

b. Sikupe Site

The maximum depth of earthfills required would be about 15 m. The earthwork volume involved was estimated at about 3 million cubic meters, 60% of which would be of rock. The rock at this site would also be able to be excavated by bulldozer with ripper.

c. Mogobi Site

Maximum depth of earthfills required is expected to reach 30 m. The earthwork volume involved was estimated at about 8.8 million cubic meters, 90% of which would be of rock.

The construction costs of major civil works at the three sites estimated on the basis of the conditions mentioned above are summarized in Table 3.2.

Table 3.2 Construction Cost of Civil Works by Site

(Unit: Million E.)

Items	Mpaka	Sikupe	Mogobi
Approach Road	0.78	1.04	Nil
Grading, Pavement and Drainage	13.11	14.69	38.89
Detouring Road	Nil	Nil	0.49
Total	13.89	15.73	39.38

The evaluation of the three sites from technical aspects indicates that Mpaka site is slightly more advantageous than Sikupe site, while Mogobi site rates by far below the other two sites.

3.4.2 Economic Aspects

Comparative economic evaluation of the three sites was made on the basis of the major items of the economic costs involved in the development of the new airport at each site. The economic cost items taken into account for this analysis were the construction cost of civil works and the surface transportation cost to each site from the hotel area. The construction cost at each site estimated as shown in Table 3.2 was converted into economic cost as shown in Table 3.3 based on the conversion factor of 0.95 derived from the past performances of the similar development projects in Swaziland.

Table 3.3 Economic Construction Cost

(Unit: Million E.)

Site	Mpaka	Sikupe	Mogobi
Nominal costs	13.89	15.73	39.38
Economic costs	13.20	14.94	37.41
Difference	0	1.74	24.21

The distance to each site from the hotel area (Ezulwini Valley) is shown in Table 3.4, on which was based the calculation of the surface transportation cost made in terms of vehicle operating cost and time cost with the following assumptions and conditions.

Table 3.4 Distance from Hotel Area

(Unit: Km)

Site	Mpaka	Sikupe	Mogobi
Distance from Hotel Area	80	75	50
Difference	0	-5	-30

a. The time horizon of calculation: 1986 - 2005

b. Cost series discounted back to 1986 at an annual discount rate of 7%

c. Number of air passengers: 100,000 in 1985 to increase at 12.6% annual rate thereafter, reaching 1.07 million in 2005

d. 2 well-wishers for every three arriving or departing air passengers

e. 65% of air passengers are of business purpose with time value at 2 Emalangeni per hour. Time value of the rest of passengers and all well-wishers was not accounted.

f. 80% of air passengers and well-wishers use private cars or taxis while remaining 20%, minibus.

g. Economic cost of vehicle operation: 10 cents per km for private cars and taxis while 11 cents per km for minibuses.

h. Average number of passengers per car: 3 persons for private cars and taxis and 7 persons for minibuses.

i. Average speed of vehicles: 60 km per hour.

The differences in economic costs by item among the three sites are shown in Table 3.5.

Table 3.5 Differences in Economic Costs

(Unit: Million E.)

Site	Mpaka	Sikupe	Mogobi
Civil works	0	1.74	24.21
Vehicle operating costs	0	-0.71	-4.26
Time cost	0	-0.03	-0.17
Total	0	1.00	19.78

The foregoing comparative analysis indicates that the development of the new airport at Mpaka site was slightly more economical than that at Sikupe site, and that Mogobi site was no comparison with the other two sites.

3.5 Overall Evaluation and Recommendation

The comprehensive technical and economic analysis indicated that Mpaka site was advantageous slightly over Sikupe site and greatly over Mogobi site. The analytical conclusion thus reached was then reviewed in the light of development potentials of coal deposits in and around Mpaka site.

The two coal seams have already been identified for future exploitation as shown in Fig. 3.7 and the Government of the Kingdom is now requesting the Government of Japan to render assistance in connection with further technical investigation of the coal deposits in this area. Exploitation of the upper coal seam, if and when started, would be made by open mining method and would, therefore, cause coal dust problem hazardous to aircraft engines as well as sanitary and amenity problems on and around the airport. As for the exploitation of the lower seam, judging from the geo-technical point of view, mining operations about 400 m below surface right under the airport site would not cause any significant or critical subsidence of the airport area, but this needs further clarification through indepth study. The economic value of the lower coal deposit under the airport is estimated to be 35 million Emalangeni, which is considered to be benefical enough to the country's economy. On the other hand, the advantage of Mpaka site over Sikupe site shows only one million in economic cost as mentioned above.

In the light of all these circumstances the slight advantage of Mpaka site in economic cost is not considered significant enough to justify its selection, especially considering the disadvantage in aircraft operational safety as mentioned earlier, and consequently the Sikupe site was recommended as the optimum site for the new airport construction.

CHAPTER 4

AIR TRAFFIC FORECAST

CHAPTER 4 AIR TRAFFIC FORECAST

On the basis of the results of analysis of the past air traffic records made in Chapter 2, and based on the various premises identified below, forecast was made of the passenger and cargo transport demand of the new airport.

4.1 Methodology and Conditions of Forecast

4.1.1 General

Air transport demand of Swaziland is considered to have a close relationship with the level of economic activities of the country as stated in Chapter 2. As the country develops economically, the social, economic and cultural interchange with foreign countries becomes increasingly more active, causing increasing number of foreigners visiting the country and Swazis going abroad, hence resulting in increased international air passenger traffic. Along with the economic growth of the country, there will be increase in imports of consumer goods resulting from raised standard of living, and of capital goods necessary for the industrialization of the country, as well as increase in exports of manufactured Swazi products, which will together result in greater utilization of air transport for commodities with higher freight-bearing capacity.

4.1.2 Outline of Methodology

Gross domestic product of Swaziland was used as an independent variable in regression models of air traffic forecasting in this study, since it is regarded as one of the best economic indeces of the levels of economic activities of the country. As a first step, forecast was made of the traffic of the total international air transport, which is the traffic to be expected when there are no capacity limitations. Then, using that as the control total, forecast was made of the potential traffic projected for the selected international air routes.

4.1.3 Basic Conditions of Forecast

Basic conditions of forecast were established as follows through discussions with the officials concerned of the Government and based on the results of the study made in Chapter 2.

1) Period of Forecast

The period of forecast shall be for 20 years starting from 1985 through the ultimate design year of 2005 established for the purpose of the present study.

2) Air Route Network

a. International Air Routes

The entire existing international air route network serving Matsapa Airport is assumed to be directed to serve the New Airport. In addition seven new air routes are assumed to be established in future between Swaziland and southern African countries. International air routes considered in the forecast are as follows.

<u>Existing routes</u>

Swaziland	-	Johannesburg	(JNB)
"	-	Durban	(DUR)
"	-	Lusaka	(LUN)
"	-	Mauritius	(MRU)
"	-	Maputo	(MPM)
"	-	Maseru	(MSU)

New routes

Swaziland	-	Nairobi	(NBO)
"	-	Kinshasa	(FIH)
"	-	Lilongwe	(LLW)
"	-	Luanda	(LAD)
"	-	Salisbury	(SAY)
"	-	Tananarive	(TNR)
"	-	Dar es Salaam	(DAR)

b. Domestic Air Routes

There exists no domestic air route network in Swaziland at present and it is assumed that there will be no domestic air network serving the New International Airport in future either judging from the size of the country.

3) Gross Domestic Product

GDP of Swaziland in the 1970s shows an average annual growth rate of more than 7.5% in real terms.

The Third National Development Plan of Swaziland aims to achieve the annual growth rate of 7% throughout the plan period.

This target of the economic growth, which is necessary for Swaziland to eliminate the income gap with those of the developed countries, is deemed very likely to be achieved judging from the past economic trends in the 1970s.

Therefore, for the air traffic demand forecasting purposes, the growth rates of Swazi GDP in real term are assumed at 7.0% through 1985 and thereafter at slightly lower rates as follows to be on a conservative side.

Table 4.1 Assumption of GDP Growth Rates

Year	Case I	Case II	Case III
Present-1985	7.0%	7.0%	7.0%
1986 - 2005	6.5%	6.0%	5.5%

Applying the above growth rates, GDP of Swaziland for the three cases are calculated as follows.

Table 4.2 Estimated GDP of Swaziland

(Unit: Million E. in 1977 constant prices)

Case	Case I	Case II	Case III
1985	500	500	500
1990	685	669	654
1995	939	896	854
2000	1,286	1,198	1,116
2005	1,762	1,604	1,459

4.2 Air Transport Demand Forecast

4.2.1 International Air Passengers

1) Embarking and Disembarking Passengers

The embarking and disembarking international air passengers are estimated by the following regression equation for the aforesaid three cases of GDP growth, with the results as shown in Table 4.3.

$$\ln Pax = 0.099 + 1.837 \times \ln GDP \quad \ldots\ldots \quad (A)$$

$$\overline{R^2} = 0.968$$

Where, GDP of Swaziland is in million Emalangeni, and number of passengers in person.

Table 4.3 Embarking/Disembarking Passengers

('000 persons)

Year	Case I	Case II	Case III
1985	100.3	100.3	100.3
1990	178.9	171.3	164.0
1995	319.0	292.6	268.2
2000	568.8	499.6	438.6
2005	1,014.3	853.4	717.2

Out of these three variants, Case II is adopted for further analyses.

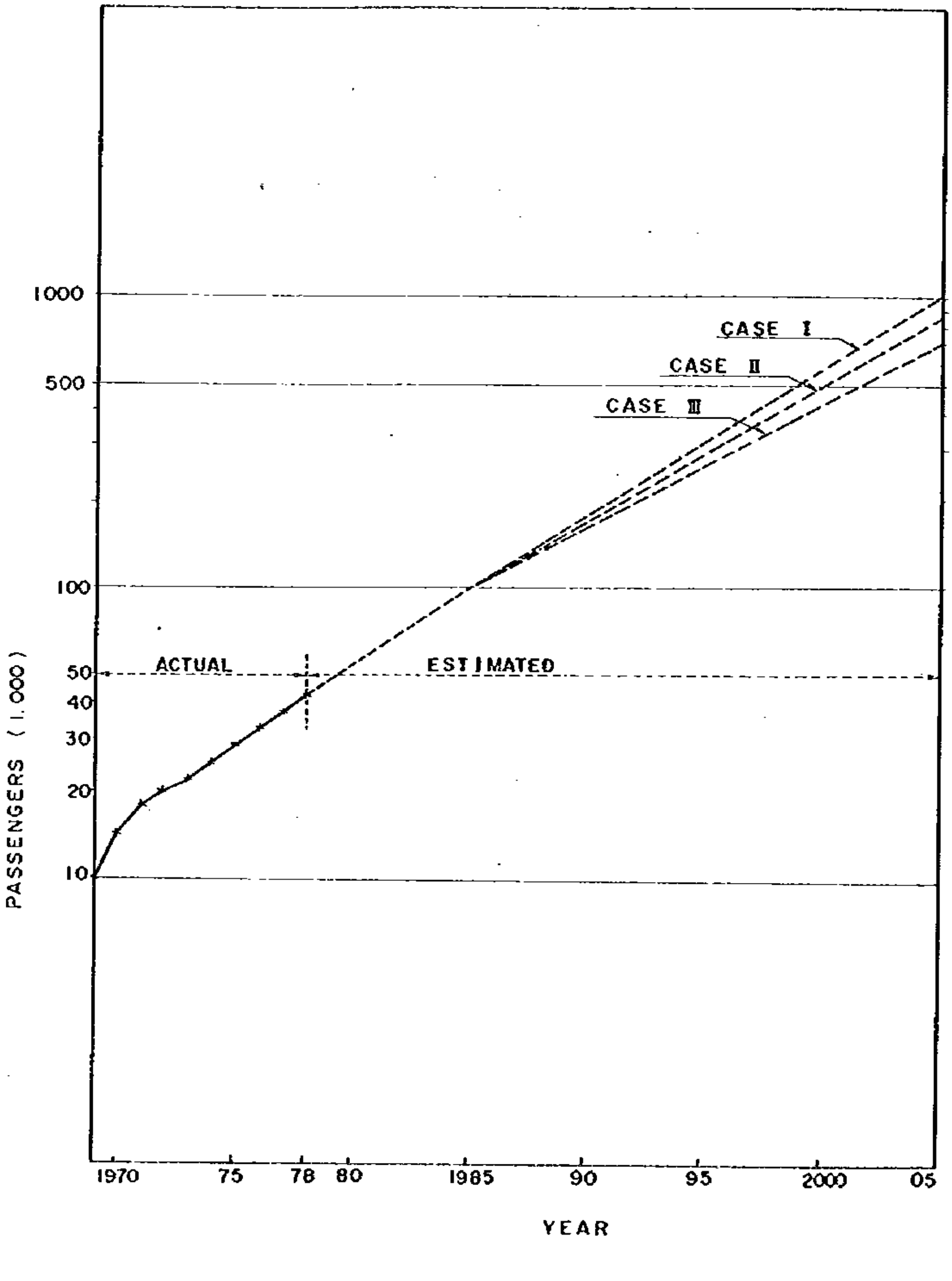


Fig.4.1 FORECAST OF EMBARKING & DISEMBARKING PASSENGERS AT NEW AIRPORT

2) Passengers by Route

By-route passengers are estimated by distributing the total embarking and disembarking passengers to each route according to the ratio of the 1977 GDP of the respective countries where the routes lead to. Traffic volume induced by the reduced transport costs on the newly opened direct air routes is calculated and added to the estimated normal traffic of each route.(*) Then the transit passengers on each route are estimated as mentioned in 3) below and added to the traffic on each route. The result is presented in Table 4.4.

3) Forecast of Transit Passengers

Because of the geographical and economic situation of Swaziland, it is assumed that all transit passengers who pass through Swaziland are considered to come from or are headed to either Johannesburg or Durban in an assumed ratio of 4:1 which is the ratio of the past embarking/disembarking passenger traffic on these two routes at Matsapa Airport. In the absence of reliable data on the past transit passenger trend except on the Lusaka route, forecast of international passengers between either of the said two routes and each of the rest of the routes is made assuming that similar trend may be expected on any other routes, provided that for those points that are connected with either Johannesburg or Durban, no transit passenger is calculated.

(*) This volume of induced traffic is nearly equal to the "reduced" traffic on the routes between Johannesburg/Durban and Swaziland which will be caused by the increased time and cost of transport on those existing routes due to the proposed relocation of the Matsapa Airport to Sikupe.

Table 4.4 Number of Passengers in 1995 and 2005

('000 persons)

Route		1995			2005		
City	Airport Code	Embarked & Disembarked	Transit	Total	Embarked & Disembarked	Transit	Total
Johannesburg	JNB	134.1	4.1	138.2	391.5	16.4	407.9
Durban	DUR	22.0	1.2	23.2	64.1	4.7	68.8
Salisbury	SAY	11.2	0	11.2	32.8	0	32.8
Lusaka	LUN	14.2	2.8	17.0	23.1	7.2	30.3
Luanda	LAD	-	-	-	18.3	3.7	22.0
Nairobi	NBO	45.4	0	45.4	132.4	0	132.4
Maputo	MPM	4.8	0.2	5.0	13.9	0.5	14.4
Lilongwe	LLW	11.5	2.3	13.8	7.2	1.5	8.7
Dar es Salaam	DAR	-	-	-	26.2	5.3	31.5
Kinshasa	FIH	24.9	0	24.9	72.7	0	72.7
Maseru	MSU	3.3	0	3.3	9.5	0	9.5
Mauritius	MRU	21.2	0	21.2	47.3	0	47.3
Tananarive	TNR	-	-	-	14.4	2.9	17.3
Total		292.6	10.6	303.2	853.4	42.2	895.6

4.2.2 International Air Cargo/Mail

Since past traffic records are available only on the three routes of Johannesburg, Durban and Maputo, loaded and unloaded international air cargo/mail of the three routes are estimated by the following regression equation for the aforesaid Case II of GDP growth, with the results as shown in Table 4.5.

$$\ln(\text{cargo/mail in kg}) = 6.116 + 1.048 \times \ln(\text{GDP})$$

$$\overline{R^2} = 0.717$$

Table 4.5 Projected Cargo/Mail Traffic of the Three Routes

Year	Weight (tons)
1985	305
1990	414
1995	562
2000	763
2005	1,036

Cargo traffic of the remaining three existing routes as well as that of the seven new routes are calculated by applying the cargo/mail-passenger ratio of the total of the above three routes to the passenger traffic of the respective routes as well. The results of cargo/mail traffic forecast are presented in Table 4.6 and in Table 4.7.

Table 4.6 Air Cargo/Mail Traffic of All Routes

Year	Weight (tons)
1985	427
1990	616
1995	821
2000	1,225
2005	1,643

Table 4.7 Projected Cargo/Mail by Route in 1995 and 2005

(Unit: tons)

Route	1995	2005
Swz - JNB	468	863
- DUR	77	142
- SAY	37	70
- LUN	13	25
- LAD	-	40
- NBO	150	280
- MPM	17	31
- LLW	8	12
- DAR	-	55
- FIH	41	80
- MSU	10	15
- MRU	-	-
- TNR	-	30
Total	821	1,643

4.2.3 Projected Aircraft Movements

1) Aircraft to be in Service

In assuming the type of aircraft to serve each route the following criteria are adopted.

a. At least one flight a week (to and from) is to serve every routes with at least 50% load factor but not exceeding 60% to secure easy flight reservation.

b. B707 or its equivalent with 160 seats is to be served for the routes longer than 500 NM, and B737 or its equivalent with 115 seats is to serve the routes shorter than 850 NM considering that some of this type of aircraft with old model engines show the shorter navigable range than that with new model engines and that it might be difficult to provide an alternative airport within a reasonable distance.

c. F27 and/or DHC6 and their equivalents are to serve those existing routes which sufficient demand to justify services of the above-mentioned jets is not forecast.

2) Number of Annual Flights

In calculating the annual number of flights to be in service, the above-mentioned criteria have also been adopted. The resultant estimates are shown in Table 4.8.

Table 4.8 Numbers of Flights in 1995 and 2005

(times)

Route	Stage Length (N.M)	1 9 9 5			2 0 0 5		
		PAX '000	Type of Aircraft	Annual Flights	PAX '000	Type of Aircraft	Annual Flights
JNB	205	138.2	B737	1,980	407.9	B737	5,830
DUR	245	23.2	B737	330	68.8	B737	980
SAY	555	11.2	B737	160	32.8	B707	340
LUN	755	17.0	B707	180	30.8	B707	320
LAD	1.635	-	-	-	22.0	B707	230
NBO	1,685	45.4	B707	470	132.4	B707	1,380
MPM	60	5.0	F27	190	14.4	B737	210
LLW	825	13.8	B737	200	8.7	B707	90
DAR	1,370	-	-	-	31.5	B707	330
FIN	1,780	24.9	B707	260	72.7	B707	760
MSU	315	3.3	DHC6	300	9.5	B737	140
MRU	1,640	21.2	B707	220	47.3	B707	490
TNR	1,080	-	-	-	17.3	B707	180
Total		303.2		4,290	895.6		11,280

4.2.4 Forecast of Number of Small Aircraft Registered in Swaziland

The historical data of small aircraft registered in Swaziland is shown in Table 4.9.

Table 4.9 Number of Small Aircraft Registered in Swaziland

Year	Total	2-engine	1-engine
1974	25	-	-
1975	28	-	-
1976	28	8	20
1977	31	11	20
1978	37	14	23

Source: Swaziland Gvt. Civil Aviation Branch

The forecast of the number of small aircraft registered in Swaziland is made by the following regression formula and the result is shown in Table 4.9.

$$\text{Number of Small Aircraft} = -5{,}699 + 2.9\,(t)$$

$$\overline{R^2} = 0.935$$

Where, (t) is the years in A.D., 1974,....

Table 4.10 Forecast of Number of Small Aircraft Registered in Swaziland

Year	Number of Small Aircraft
1985	57
1990	71
1995	86
2000	100
2005	115

CHAPTER 5

AIRPORT PLANNING

CHAPTER 5 AIRPORT PLANNING

5.1 General

Planning of the airport facility and of the airspace use were made for the assumed construction of the new airport in Sikupe site officially selected by the Government in December 1979 as mentioned in Chapter 3, with due consideration for the results of the discussions on the planning conditions with the officials concerned of the Government of the Kingdom during the field survey period.

Ultimate design year of the new airport construction project was established for the year 2005, and the development of the new airport was planned in the following two stages;

1) First stage (hereinafter called Stage I): Facilities with the instrument approach runway to be serviceable up to 1995; and

2) Second stage (hereinafter called Stage II): Facilities with the precision approach runway Cat-I to be serviceable from 1996 through 2005.

Facility planning was made using the topographical map in scale of 1 to 5,000 prepared in Japan on the basis of the aerial photos supplied by the Government of the Kingdom.

5.2 Airport Facility Requirements

The facility requirements to accommodate the air transport demand forecast in the two stages in Chapter 4 were developed in conformity with the standards and recommended practices of ICAO and/or FAA regulations as appropriate, with due consideration for the specific requirements of the Government of the Kingdom ascertained during the field survey period.

The sequence of this work as outlined below is shown in the flowchart in Fig. 5.1 and the results of this analysis are summarized in Table 5.1.

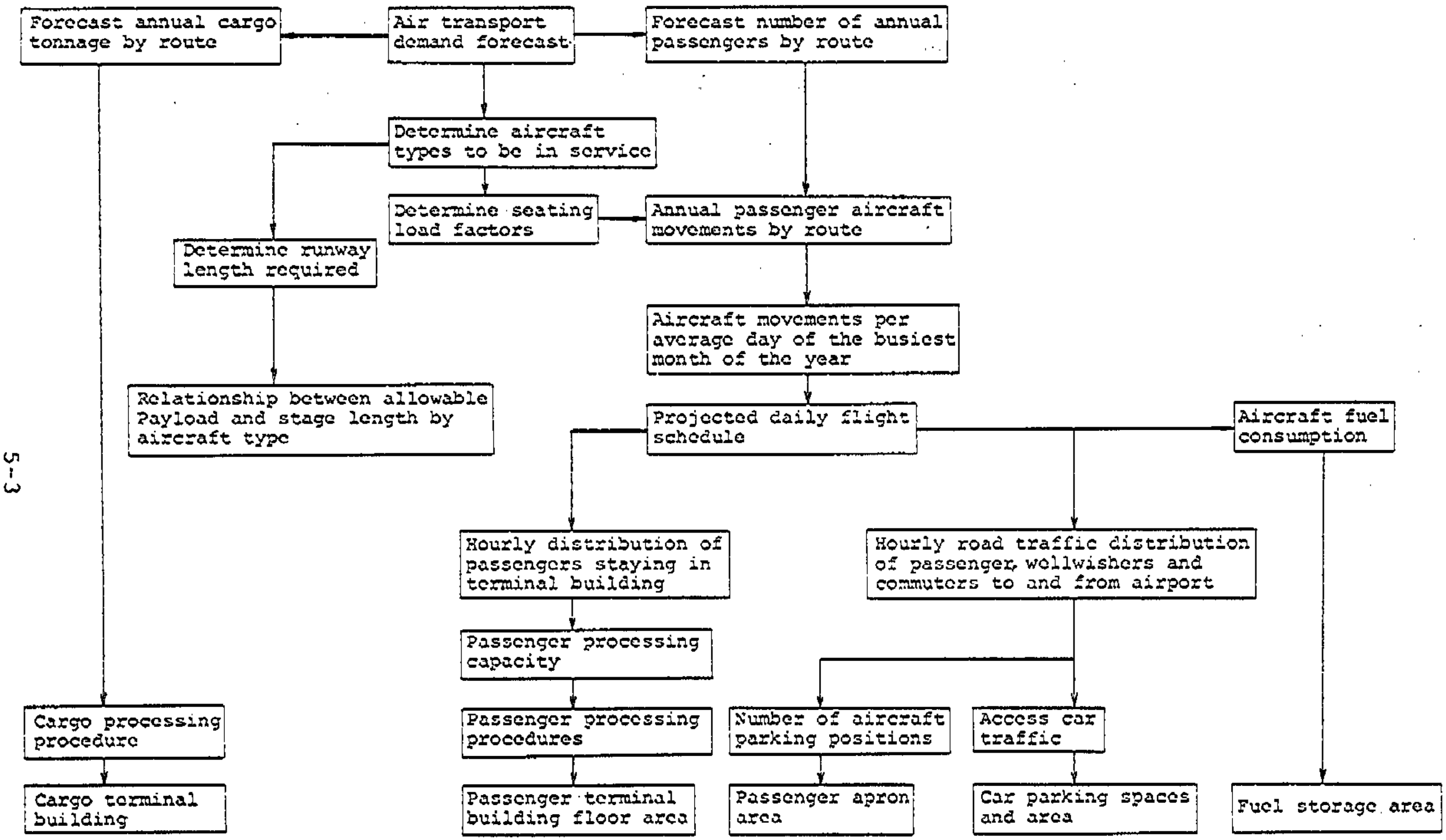


Fig. 5.1 SEQUENCE OF FACILITY REQUIREMENTS ANALYSIS

Table 5.1 Air Transport Demand and Airport Facility Requirements

Description	Stage I (1995)	Stage II (2005)
Annual Air Traffic		
Passengers		
Emb. & Disemb.	292,600	853,400
Transit	10,600	42,200
Total	303,200	895,600
Cargo (metric ton)		
Inbound	575	1,150
Outbound	246	493
Total	821	1,643
Aircraft Movements		
Scheduled Aircraft	4,290	11,280
Small Aircraft (General Aviation)	3,000	3,600
Total	7,290	14,880
Peak Demand		
Scheduled Aircraft Movements		
Week	106	238
Busiest Day	18	36
Aircraft Parking Positions		
B707 Class	2	4
B737 Class	2	3
Total	4	7
Small Aircraft	25	45

Description	Stage I (1995)	Stage II (2005)
Passengers/hour		
Departure	160	250
Arrival	140	220
Transit	10	20
Total	310	490
Cargo Tonnage/day		
Inbound	2	3
Outbound	1	2
Total	3	5

Airfield Facility

		Stage I (1995)	Stage II (2005)
Runway Strip		2,570 m x 300 m	
Runway,	4° - 184°	2,450 m x 45 m	
	Longitudinal Gradient	Max. 0.5%	
Taxiway,	Exit	27 m x 2	27 m x 4
	Parallel	-	2,450 m x 23 m
Apron,	Passenger	24,000 m^2	74,000 m^2
	Maintenance	6,000 m^2	6,000 m^2
	Small Aircraft	10,000 m^2	18,000 m^2
Horizontal Clearance			
Runway-Taxiway Center Line Clearance (Precision Approach Cat-I)		195 m	
Edge-to-Edge Runway-Taxiway Clearance (Precision Approach Cat-I)		150 m	
Clearance between Taxiway Edge and Fixed Object		30 m	
Taxiway-Apron Wingtip Clearance		15 m	
Apron Parking Wingtip Clearance		7.5 m	

Description	Stage I (1995)	Stage II (2005)
Buildings		
Passenger Terminal	6,700 m^2	8,500 m^2
Cargo Terminal	-	450 m^2
Airport Administration & Tower	1,100 m^2	1,100 m^2
Fire/Rescue Station	675 m^2	675 m^2
Main Power Substation	1,000 m^2	1,000 m^2
Area to be Airconditioned		
Passenger Terminal Building	620 m^2	960 m^2
Airport Adm. & Tower	60 m^2	60 m^2
Aeronautical Telecommunications Facility		
Aeronautical Mobil Service Facilities		
VHF Transmitter & Receiver (single channel)	3 units	
VHF Transmitter & Receiver (multi-channel)	1 unit	
HF Transmitter & Receiver 500W	2 units	
Air Traffic Control Consoles	1 unit	
Approach Control Consoles	1 unit	
Flight Data Consoles	1 unit	
Aeronautical Fixed Service Facilities		
Teletypewriter	3 units	
Radio Navigational Aids		
VDF	1 unit	
VOR/DME (transferred from Matsapa Airport)	1 unit	
NDB (500W)	1 unit	
ILS	-	1 unit

<table>
<tr><th>Description</th><th>Stage I
(1995)</th><th>Stage II
(2005)</th></tr>
<tr><td><u>Meteorological Service Facility</u></td><td></td><td></td></tr>
<tr><td>Weather Data Collecting Equipment</td><td colspan="2">1 unit</td></tr>
<tr><td>Runway Visual Range Measuring Equipment</td><td colspan="2">1 unit</td></tr>
<tr><td>Ceilometer (removed from Matsapa Airport)</td><td colspan="2">1 unit</td></tr>
<tr><td>Weather Facsimile Receiver</td><td colspan="2">2 units</td></tr>
<tr><td><u>Airfield Lighting Facilities</u></td><td></td><td></td></tr>
<tr><td>Approach Lighting System</td><td></td><td></td></tr>
<tr><td>Runway 02</td><td>-</td><td>SALS 420 m</td></tr>
<tr><td>Runway 20</td><td>SALS 420 m</td><td>ALS 900 m</td></tr>
<tr><td>Approach Light Beacons</td><td>-</td><td>1 unit</td></tr>
<tr><td>VASI System (3 bar)</td><td colspan="2">1 unit</td></tr>
<tr><td>Runway Edge Lights</td><td></td><td></td></tr>
<tr><td>High Intensity Elevated Type</td><td colspan="2">1 unit</td></tr>
<tr><td>Runway Threshold Lights</td><td></td><td></td></tr>
<tr><td>High Intensity Elevated Type</td><td colspan="2">1 unit</td></tr>
<tr><td>Runway End Lights</td><td></td><td></td></tr>
<tr><td>High Intensity Elevated Type</td><td colspan="2">1 unit</td></tr>
<tr><td>Taxiway Edge Lights</td><td></td><td></td></tr>
<tr><td>Medium Intensity Elevated Type</td><td>1 unit</td><td>1 unit</td></tr>
<tr><td>Aerodrome Beacon</td><td colspan="2">1 unit</td></tr>
<tr><td>Wind Directional Indicator Lights</td><td colspan="2">2 units</td></tr>
<tr><td>Apron Flood Lights</td><td>1 unit</td><td>1 unit</td></tr>
<tr><td>Street Lights</td><td colspan="2">1 unit</td></tr>
</table>

Description	Stage I (1995)	Stage II (2005)
Car Parking		
Private Car	80	135
Taxi	45	70
Bus	5	7
Area Requirements	4,700 m^2	8,000 m^2
Car Traffic/Hour		
Private Car	100	165
Taxi	60	100
Bus	10	15
Total	170	280
Fuel Storage		
Daily Consumption	40,000 liter	105,000 liter
7-day Reserve	300,000 liter	750,000 liter
Storage Area	2,000 m^2	4,000 m^2
Storage Tank	200,000 liter x 2	200,000 liter x 4
Fuelling System	Fuel Truck	
Utilities		
Electric Power Capacity		
Buildings	630 kVA	780 kVA
Airfield Lighting	210	290
Radio Nav-aids	60	80
Others	100	100
Total	1,000	1,250
Water Supply		
Daily Consumption	400 m^3	750 m^3
Design Capacity	550 m^3	1,000 m^3
Required Reservoir Capacity	800 m^3	1,500 m^3
Sewage Treatment Capacity	650 m^3	800 m^3
Telephone	50 lines	

Description	Stage I (1995)	Stage II (2005)
Fire/Rescue Vehicles		
Crash Fire & Rescue Truck (2,650 lit/min)	2	
Water Supply Truck (6,000 liter)	–	1
Rescue Vehicle	1	
Commander Vehicle	1	

5.2.1 Basic Conditions

1) Passenger and Cargo Traffic

The passenger and cargo traffic forecast in the preceding chapter are listed again by development stage in Table 5.2.

Table 5.2 Passenger and Cargo Traffic Demand

Items		Stage I (1995)	Stage II (2005)
Passenger	Emb. & Disemb.	292,600	853,400
	Transit	10,600	42,200
	Total	303,200	895,600
Cargo (Tons)	Inbound	575	1,150
	Outbound	246	493
	Total	821	1,643

2) Air Route Network and Type of Aircraft to be in Service

Projected air route network for the years 1995 and 2005 are shown in Fig. 5.2 and Fig. 5.3 respectively. The type of aircraft to be in service by route was determined on the basis of the criteria established in Chapter 4 as summarized in Table 5.3.

Table 5.3 Aircraft Types to be in Service

	Route	Haul Length (N.M)	Aircraft Type Stage I (1995)	Stage II (2005)
JNB	Johannesburg	205	B737	B737
DUR	Durban	245	B737	B737
SAY	Salisbury	555	B737	B707
LUN	Lusaka	755	B707	B707
LAD	Luanda	1,635	-	B707
NBO	Nairobi	1,685	B707	B707
MPM	Maputo	60	F-27	B737
LLW	Lilongwe	825	B737	B707
DAR	Dar es Salaam	1,370	-	B707
FIH	Kinshasa	1,780	B707	B707
MSU	Maseru	315	DHC-6	B737
MRU	Mauritius	1,640	B707	B707
TNR	Tananarive	1,080	-	B707

3) Aircraft Movements

The aircraft movements calculated for the two development stages on the basis of the following conditions are summarized in Tables 5.4 and 5.5 respectively.

a. The average seating load factor: 60%;

b. The busiest month peaking coefficient for passenger traffic in Stage I and Stage II: 1.3 and 1.1 respectively.

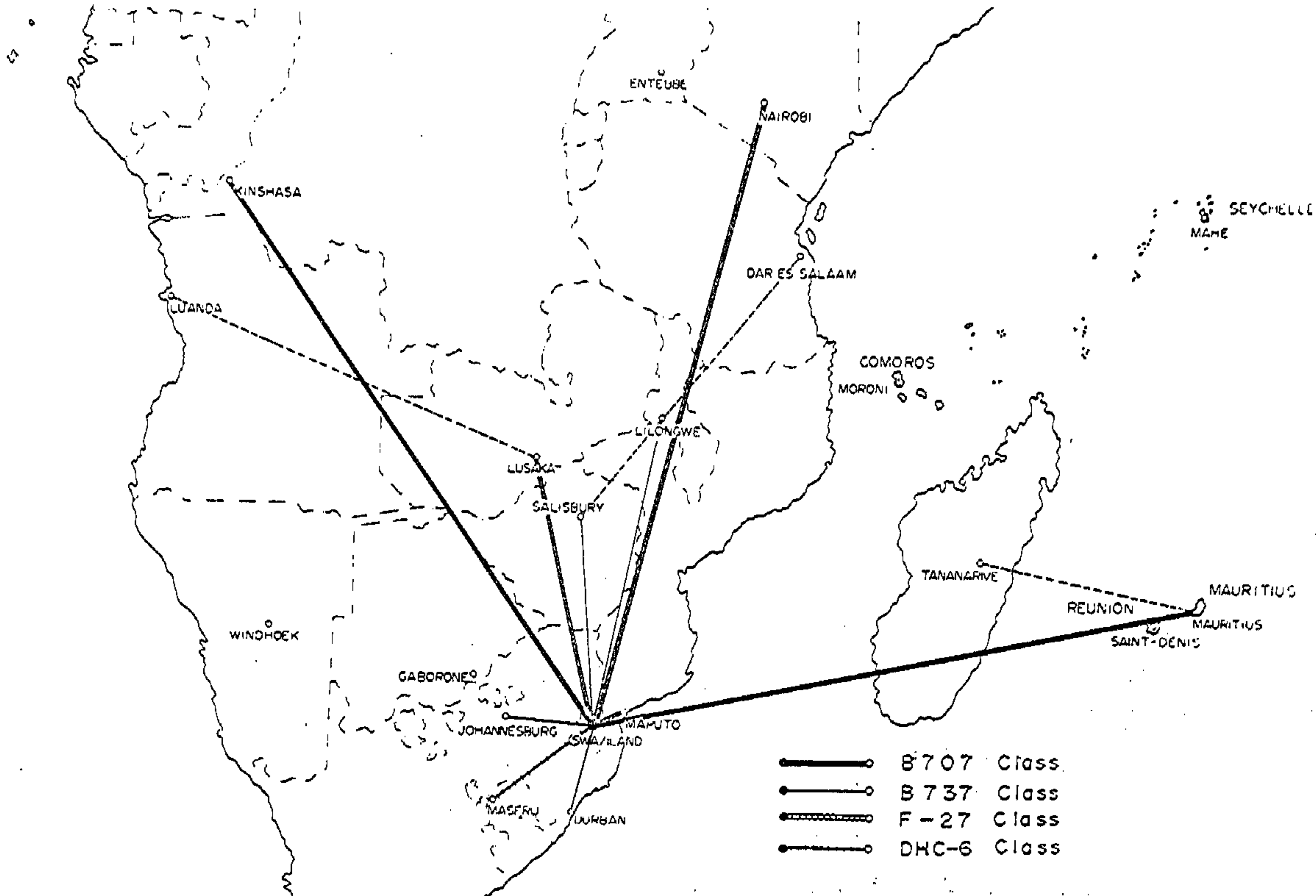


Fig 5.2 PROJECTED AIR ROUTE NETWORK (1995)

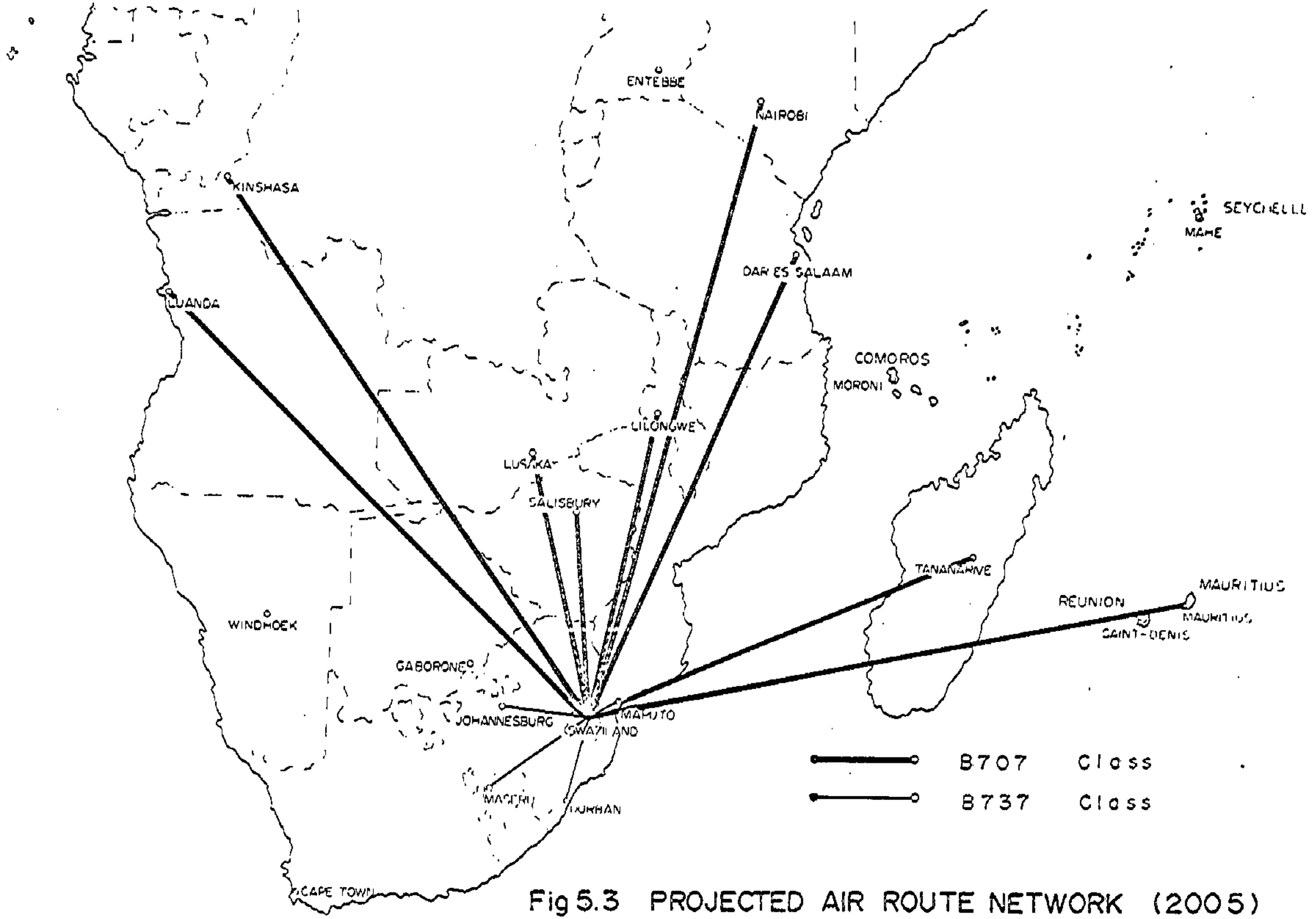


Fig 5.3 PROJECTED AIR ROUTE NETWORK (2005)

Table 5.4 Projected Aircraft Movements by Route (1995)

Aircraft Type to be in Service	Route	Annual Passengers (1,000)	Annual Aircraft Movements	Weekly Aircraft Movements
DHC-6 Type	MSU	3.3	300	8
F-27 Type	MPM	5.0	190	4
B737 Type	JNB	138.2	1,980	50
	DUR	23.2	330	8
	SAY	11.2	160	4
	LLW	13.8	200	4
B707 Type	LUN	17.0	180	4
	NBO	45.4	470	12
	FIH	24.9	260	6
	MRU	21.2	220	6
Total		303.2	4,290	106

Table 5.5 Projected Aircraft Movements by Route (2005)

Aircraft Type to be in Service	Route	Annual Passengers (1,000)	Annual Aircraft Movements	Weekly Aircraft Movements
B737 Type	JNB	407.9	5,830	122
	DUR	68.8	980	20
	MPM	14.4	210	4
	MSU	9.5	140	4
B707 Type	SAY	32.8	340	8
	LUN	30.3	320	6
	LAD	22.0	230	4
	NBO	132.4	1,380	30
	LLW	8.7	90	2
	DAR	31.5	330	8
	FIH	72.7	760	16
	TNR	17.3	180	4
	MRU	47.3	490	10
Total		895.6	11,280	238

4) Projected Flight Schedule

The following conditions were taken into account in establishing the possible flight schedule for each development stage on the basis of the aircraft movements calculated for each stage. The projected flight schedule by stage is given in Appendix 5A.

a. The new airport shall be equipped to permit night time operation.

b. The number of aircraft to serve the projected air route network shall be minimized so as to ensure airlines' payability.

c. The aircraft movements of foreign airlines shall not exceed 50% of the total movements at the new airport.

d. Aircraft parking time of the B737 type and the B707 type jet aircraft shall be 60 minutes and 90 minutes respectively as the operational characteristics and available records of past performances of each aircraft type indicate.

5.2.2 Airfield Facilities

1) Runway Strip

The width of the runway strip shall be 300 m throughout its entire length so as to accommodate a precision approach runway.

2) Runway

The length of the runway required for the new airport was determined based on the following design conditions.

a. Critical aircraft: B707 with full passenger, (Payload: 38,800 lbs.)

b. Maximum stage length: 1,780 NM, equal to the distance between the new airport and Kinshasa.

c. Normal maximum temperature: 31.5°C.

d. Effective runway gradient: 0.5%.

e. Airport elevation: 330 m above sea level.

In the basis of the above design conditions the required length of the runway was calculated to be 2,450 m. The relationship between the stage lengths and the permissible payload of each aircraft type on the said runway length is shown in Appendix 5B.

The width of runway shall be 45 m in accordance with the ICAO recommendations for the corresponding runway category.

3) Taxiway

At least one right-angle taxiway with a width of 27 m connecting the runway with the apron shall be provided in Stage I.

In Stage II, parallel taxiway with a width of 23 m shall be provided along the full length of the runway taking into account the peak hour aircraft movements in the year 2005.

4) Apron

a. Passenger Loading Apron

The number of passenger aircraft parking positions required was obtained as tabulated in Table 5.6 using the aforementioned projected flight schedules.

Table 5.6 Number of Passenger Loading Apron

	Stage I (1995)	Stage II (2005)
For B737 type aircraft	2	3
For B707 type "	1	3
Reserve	1	1
Total	4	7

b. General Aviation Apron

The general aviation apron area required was estimated as shown in Table 5.7 based on the forecast of numbers of small aircraft registered at the new airport in Chapter 4.

Table 5.7 General Aviation Apron Area

	Stage I (1995)	Stage II (2005)
Number of Parking Positions	25	45
Apron Area (m^2)	10,000	18,000

5.2.3 Terminal Buildings

1) Passenger Terminal Building

The hourly distribution of passengers expected to stay in the terminal building was analyzed by applying the average stay time of passengers of each category, estimated to be 60 minutes preceding departure for departing passengers and 30 minutes following arrival for arriving passengers based on the projected daily flight schedule, with the result as shown in Appendix 5C.

Based on the hourly distribution of passengers staying in the terminal building as estimated above, the number of passengers to be processed during the peak hour period was determined as shown in Table 5.1.

Taking into account the number of aircraft parking position and passenger processing capacity requirements as established above, the centralized passenger processing system with a linear terminal concept was considered most suitable for the proposed new airport.

Through analyses of all relevant design factors, the floor area requirements for the passenger terminal building were determined as shown in Table 5.1.

2) Cargo Terminal Building

The floor area requirements for the cargo terminal building were estimated based on the projected daily cargo traffic by stage as listed in Table 5.1, assuming that outbound cargo would stay in the building for one day and the inbound cargo for 7 days.

5.2.4 Approach Feeder Road and Car Parking

1) Approach Feeder Road

The peak hour road traffic to/from the airport was estimated based on the following conditions and on the projected hourly distribution of passengers and well-wishers passing through the airport entrance and exit based on the projected flight schedule.

a. The number of well-wishers per passenger: 0.6 person

b. Vehicles used:

Private car each with 3 persons aboard - 50% of passengers and well-wishers,

Taxi each with 2 persons aboard - 20% of passengers and well-wishers,

Bus each with 30 persons aboard - 30% of passengers and well-wishers.

The peak hour road traffic volume thus obtained is summarized in Table 5.1, and the number of lanes of approach feeder road was determined to be one in each direction.

2) Car Parking

Number of cars expected to stay on the airport at any given point in time was obtained from the cumulative differences of the incoming and outgoing access traffic, and the parking space requirements were estimated as shown in Table 5.1.

5.2.5 Radio Navigational Aids, Telecommunications and Meteorological Service Facilities

In order to ensure safe and efficient operation of airport landing and taking off at the new airport, the facility requirements of the radio navigational aids, telecommunications and meteorological service facilities were determined in conformity with the ICAO Air Navigation Plan.

A set of VOR/DME and an NDB shall be installed in Stage I. An Instrument Landing System CAT-I shall be provided in Stage II.

5.2.6 Airfield Lighting System

The airfield lighting system shall be such that the requirements of instrument approach runway as specified in Annex 14, ICAO are satisfied in Stage I, and those of precision approach runway CAT-I in Stage II.

5.2.7 Fire Fighting and Rescue Facilities

The number of fire fighting vehicles required was determined in conformity with the ICAO requirements of Airport Category 6 in Stage I and Category 7 in Stage II. The total area needed to accommodate the said facilities was estimated as shown in Table 5.1.

5.2.8 Fuel Storage Facilities

The daily requirements of aviation fuel supply were calculated on the basis of the projected daily flight schedule. The fuel storage requirements to provide the airport with a 7-day supply capacity are shown in Table 5.1.

5.2.9 Utilities

1) Electric Power Supply

The electric power supply required for the new airport facilities was estimated as shown in Table 5.1. Stand-by engine generators are required for emergency use in case of commercial power failure.

2) Water Supply and Sewerage

The daily water supply capacity required was estimated on the basis of the number of passengers, airport employees and visitors, and with due consideration for fire fighting requirements as well. The water supply requirements are estimated as shown in Table 5.1.

Sewerage treatment system shall conform to the Purification of Industrial Water and Effluent Regulations in Swaziland.

The capacity of the treatment plant was estimated so as to be sufficient to process 800 m^3 of sewage per day which is equal to 80% of the design water supply capacity of the Stage II.

5.3 Airport Facility Plan

Planning of the facilities of the new airport was made for the aforesaid two stages of development based on the planning parameters established in the preceding section 5.2.

5.3.1 Layout Plan

Fig. S-1 in CONCLUSION AND SUMMARY shows the entire airport layout plan. Figs. S-2 and S-3 show the layout plans for Stage I and Stage II respectively.

Layout plan of the major facilities was so developed as to minimize the amount of earthwork involved and to avoid the existing water veins.

The runway is to be orientated 02/20, with the aprons and other terminal facilities located on the west side of the runway which is advantageous for the surface approach from the existing main road, MR 3. Since aircraft approach to the runway is to be made principally from the north, simple approach lighting system (SALS) shall be provided on the north end of the runway in Stage I. In stage II where the runway is to be upgraded to precision approach runway CAT-I, calvert type approach lighting system shall be provided on the north end of the runway and SALS on the south end.

On the opposite side of the approach feeder road to the west of the terminal area an airport community area is reserved for possible future use. Besides the staff housing, this area may accommodate airport hotel and catering building, etc.

5.3.2 Runway, Taxiway and Apron

The runway, 2,450 meter long, is planned for construction in Stage I, and no addition nor extention is considered necessary for Stage II. The width is planned to remain at 45 m through the ultimate design year of 2005. A turning pad designed for B707 class aircraft is to be provided at either end of the runway in Stage I.

Right angle exit taxiways, 27 m wide, shall comprise one connecting to the passenger loading apron and another to the maintenance apron. 23 m wide parallel taxiway is to be provided along the entire runway length in Stage II.

All aprons are planned for two stage construction in accordance with the facility requirements as shown in Table 5.1. Passenger loading apron is to be sited away from the water vein that crosses under the runway and to extend to a depth of 165 m from the centerline of the parallel taxiway so as to accommodate nose-in parking of B747 class aircraft. Aprons for aircraft maintenance and general aviation use are planned on the north of the passenger loading apron.

5.3.3 Terminal Facilities

1) Facility Layout Plan

The entire terminal facility layout plan for each development stage is shown in Appendix 5D and 5E respectively.

a. Passenger Terminal and Airport Administration Building

The airport administration/operation facilities and the control tower are located on the upper floor of the passenger terminal building to optimize administrative efficiency. The terminal building is placed right in front of the center of the apron in order to minimize the passenger walking distance and to facilitate staged construction.

b. Cargo Building

Cargo building is planned for Stage II development to be located on the north side of the passenger terminal building so as to segregate the traffic of cargo vehicles from those of passengers directed to the curb side of the passenger terminal building.

c. Fire Fighting and Rescue Facilities

These facilities are planned on the north side of the passenger terminal building where few obstacles exist, at a location to facilitate speedy mobilization in case of emergency.

d. Main Power Substation

Main substation is to be placed at the south end of the terminal area for the sake of optimizing layout of the electric power distribution system.

e. Fuel Storage Facility

Aviation fuel storage facility is placed on the north side of the car parking lot away from other facilities of the airport for reasons of safety and security.

f. Area Reserved for Other Facilities

The area for Head of State Building, maintenance hanger and general aviation hanger are to be reserved.

2) Facilities

a. Terminal Building

One-level passenger processing system is planned for the terminal building. Central lobby, departure block and arrival block are to be located on the ground floor. Since separate cargo building is not required in Stage I, cargo stores and offices are placed in the passenger terminal building also on the ground floor. From the central lobby a staircase leads to the restaurants, shops and observation decks on the first floor.

The administration/operation block is located on the first and second floors for the sake of effective separation from passengers and visitors.

The control tower is to be located on top of the second floor of the terminal building.

The ground floor is to be expanded on the north side by four 7.5 meter spans in order to meet the passenger handling requirements in the second stage of development.

The plan and elevation of the proposed terminal building for the two stages are shown in Appendix 5F through 5K.

b. Cargo Building

Cargo building with freight handling, storage and office space is planned in Stage II. The ground floor level is raised one meter above ground level in order to facilitate loading and unloading of cargo as shown in Appendix 5L.

5.3.4 Radio Navaids, Telecommunications and Meteorological Service Facilities

The facilities are planned as listed in Table 5.1 above.

1) Radio Navigational Aids

A set of VHF-Omnidirectional Radio Range, Distance Measuring Equipment (VOR/DME) and Nondirectional Radio Becon (NDB) are planned in Stage I as shown in Fig. S-2.

The ILS planned for Stage II for the precision approach runway 20 consists of Localizer (LLZ), Glide Path (GP), Middle Marker (MM) and Outer Marker (OM) collocated Nondirectional Radio Becon (NDB) which functions as a compass locator. The location of these facilities is shown in Fig. S-3. The VOR/DME will be transferred from Matsapa Airport.

2) Aeronautical Telecommunications Facilities

The aeronautical telecommunications facilities planned for the new airport consist of those for the Aeronautical Mobile Service (AMS) and the Aeronautical Fixed Service (AFS) as shown in Table 5.1 above. All of the telecommunications facilities to be designed serviceable through the year 2005 are to be provided in Stage I.

3) Meteorological Service Facilities

The meteorological service facilities to accommodate the requirements through the year 2005 are planned for installation all in Stage I as listed in Table 5.1 based on the requirements of meteorological service standards specified in Annex 3, ICAO.

5.3.5 Airfield Lighting System

Airfield lighting system is planned as listed in Table 5.1 above for installation as illustrated in Appendix 5M and 5N in conformity with the standards and recommendations of Annex 14 and Aerodrome Design Manual Part 4 both of ICAO.

Simple approach lighting system is planned for the instrument approach runway 20 for Stage I.

In Stage II lighting system of runway 20 is to be suitably developed for precision approach runway CAT-I and that of runway 02 for instrument approach runway.

5.3.6 Approach Feeder Road

An access feeder road connecting to the existing main road (MR 3) which is about 6.5 kilometers away is planned as follows. Appendix 5P presents standard cross section, longitudinal section and plan of the approach feeder road.

1) Basic Planning Considerations

a. Number of Lanes

One lane for each direction is considered enough to cope with the peak hour traffic volume with inbound and outbound.

b. Design Criteria

Design velocity	60 km/hour
Min. radius of curvature	150 m
Min. length of curvature	100 m ($\theta^* \geq 7°$)
	700 m/θ^* ($\theta < 7°$)
Max. longitudinal slope	5%

* intersection angle of road center-lines.

2) Routing Alignment

The routing alignment was determined so as to minimize the quantity of earthwork involved and to provide smoothest possible connection with the existing main road (MR 3).

The total length of the approach feeder road planned amounts to about 6.5 kilometers.

5.3.7 Utilities

1) Electric Power Supply System

Power supply system is planned as shown in Fig. 5.4. Power to be supplied to the new airport by Swaziland Electricity Board (SEB) from the 66 kV line under plan and expected to be serviceable in time for the project inplementation, will be of the following characteristics:

Service Voltage	11 kV 2 circuit
System	3 phase 3-wire
Cycle	50 Hz

The main substation is planned on the southern part of the terminal area to receive the SEB-supplied power and to supply the power at the same voltage of 11 kV to substations A through K for distribution to the entire airport facilities including the buildings, navigational aids, etc.

Two stand-by engine generators are to be installed in the main substation. One of 600 kVA is to serve the terminal building, cargo building, fire/rescue station etc., and the other of 350 kVA for the radio navigational aids and the airfield lighting.

Schematic diagram of the electric power distribution system is shown in Fig. 5.5.

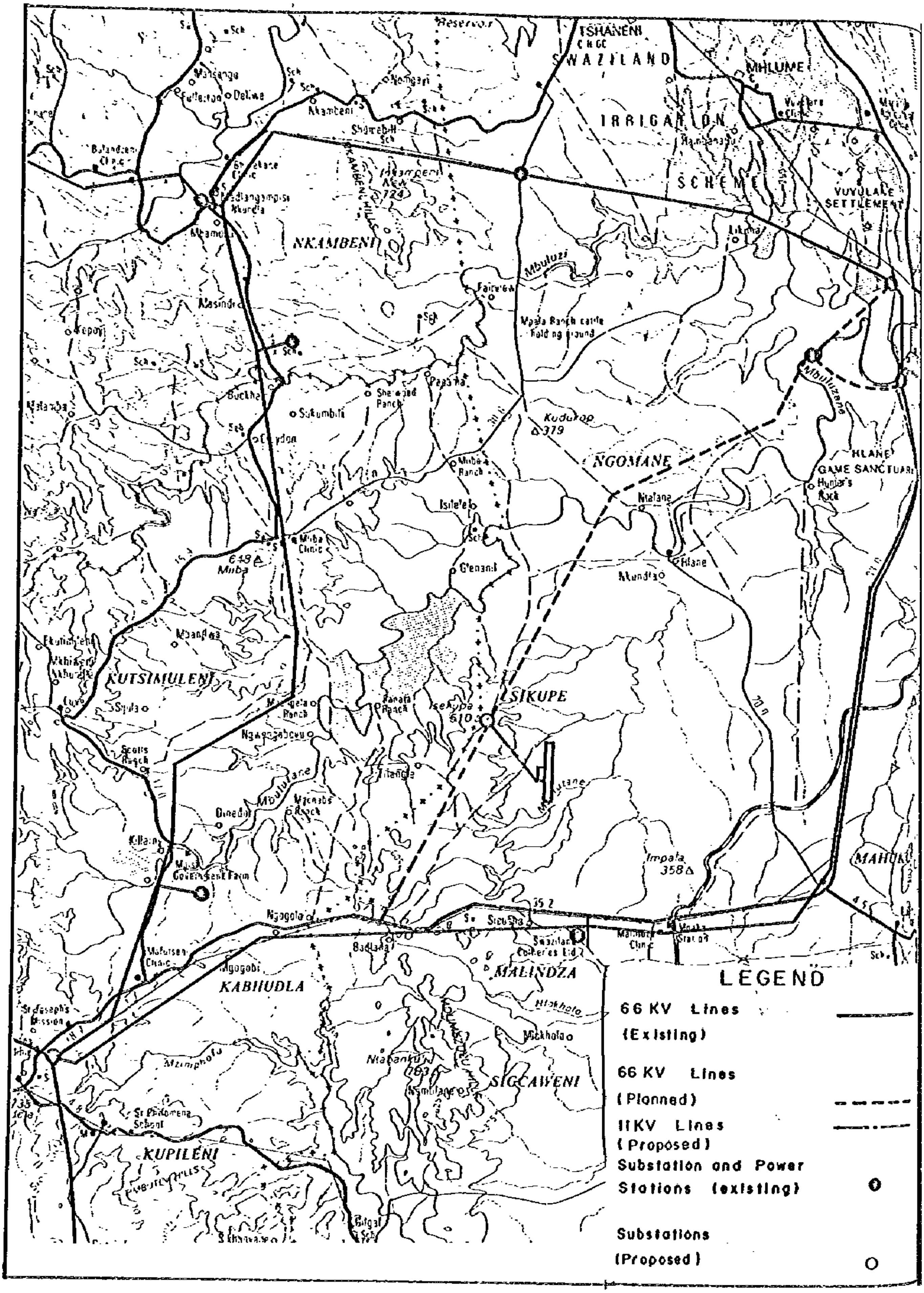
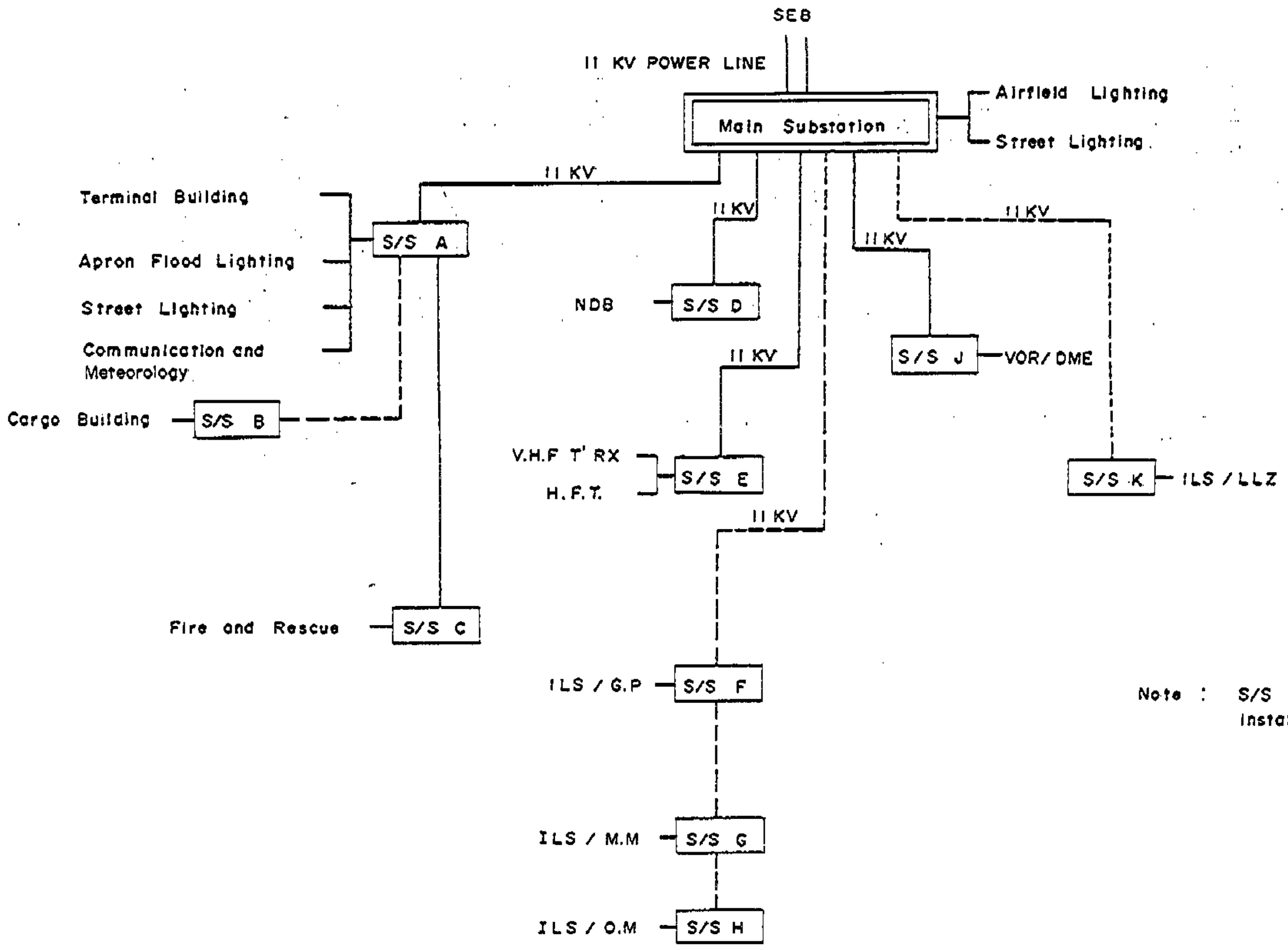


Fig 5.4 ELECTRIC DISTRIBUTION LINE



Note : S/S B, F, G, H, K are installed in Stage II.

Fig. 5.5 ELECTRIC POWER DISTRIBUTION SYSTEM

2) Water Supply Facilities

The independent water supply system for exclusive use of the airport is planned as shown in Figs. 5.6 and 5.7. Raw water pumped up from the well located in the White Mbuluzi River bed is purified through the water treatment plant situated on the southern bank. The treated water is pumped up to the clear water reservoir near Mt. Isekupe by the high lift pump.

The static head is 100 meters and the length of the pipe is 6.5 kilometers. The main distribution pipe of 3.8 kilometers in length leads the water by gravity down to the terminal area.

3) Sewage Treatment Facilities

The sewerage drains off the sewage of the terminal area to the sewage treatment plant sited at about 200 meters to the south of the terminal area. Sewers are not sized for storm water drainage as is commonly practiced in Swaziland. The treatment system is an activated sludge plant as shown in Fig. 5.8.

The facilities include screening, aeration in an activated sludge aeration unit, settlement, sludge return and sludge disposal as shown in Fig. 5.9.

4) Telephone

The required telephone lines are to be connected with the Siteki Automatic Exchange Station of Post and Telecommunication Board.

Telephone exchange room is located on the second floor of the terminal building.

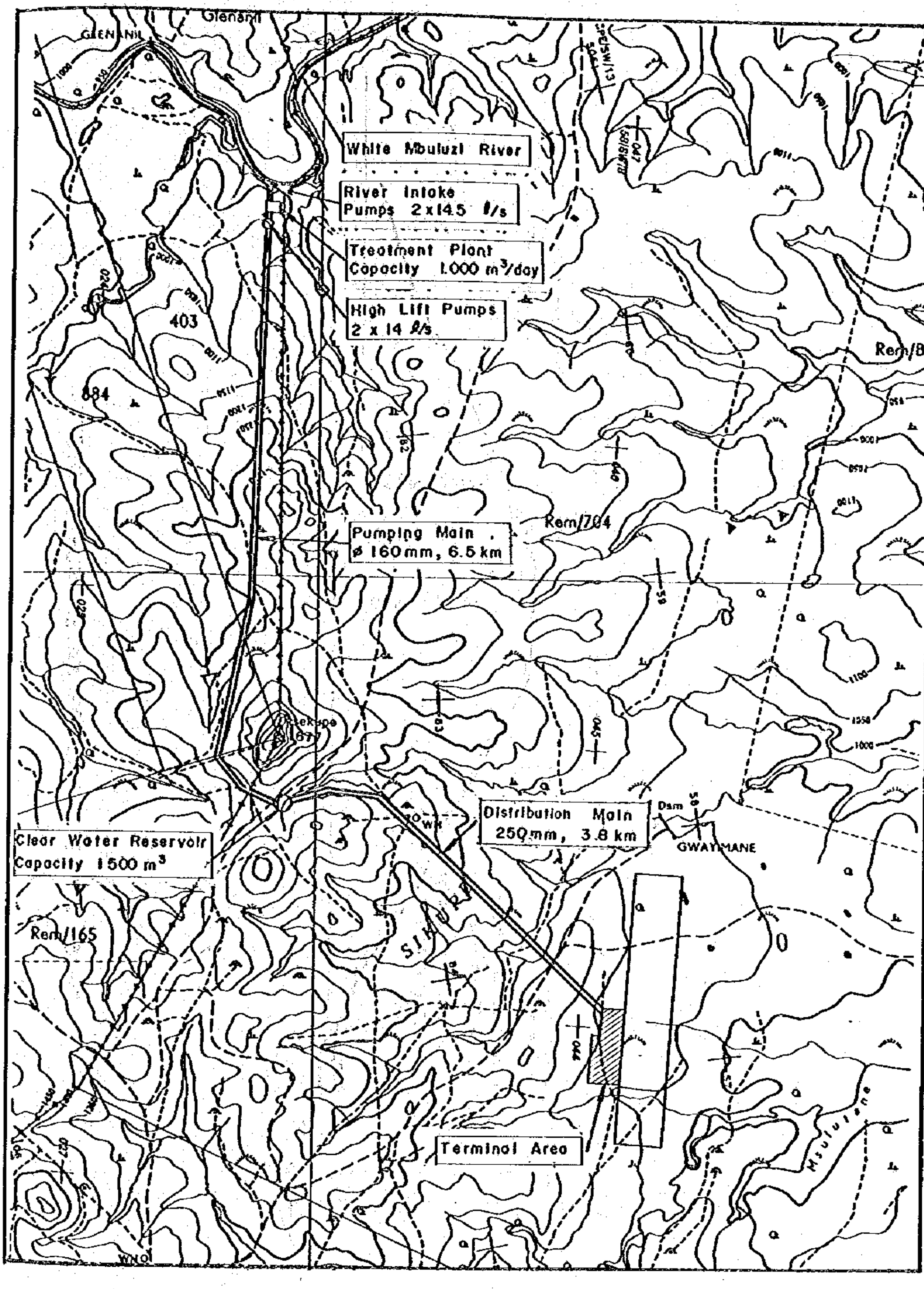


Fig.5.6 PLAN OF WATER SUPPLY SYSTEM

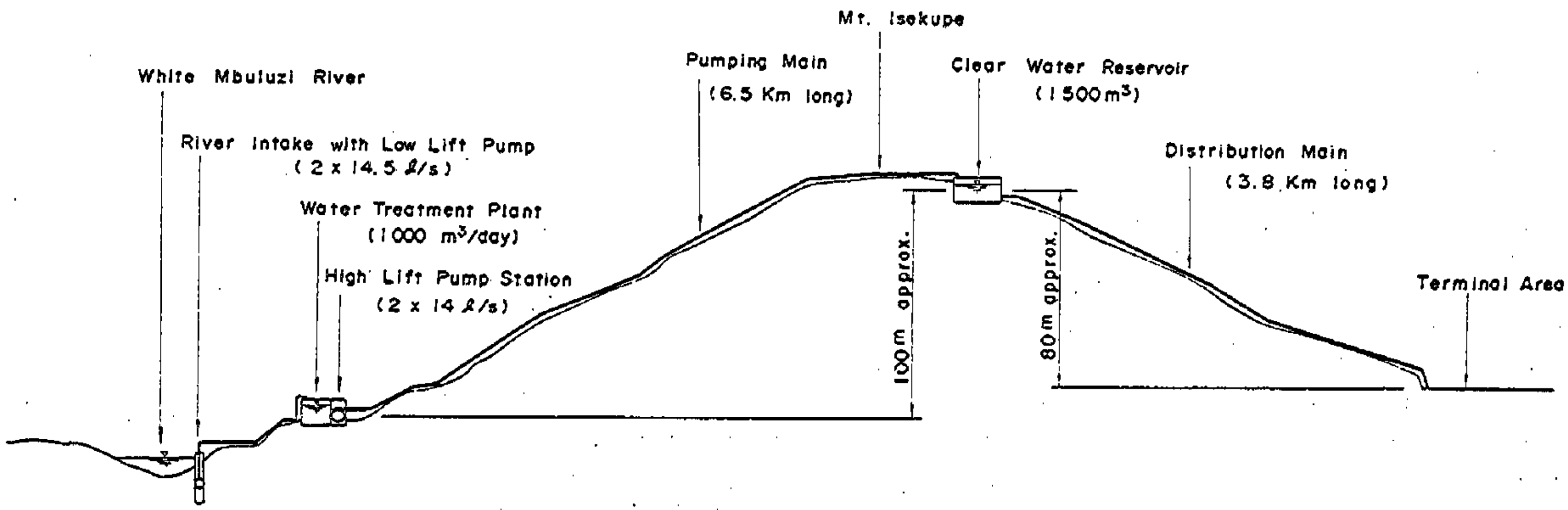


Fig. 5. 7 DIAGRAM OF WATER SUPPLY SYSTEM

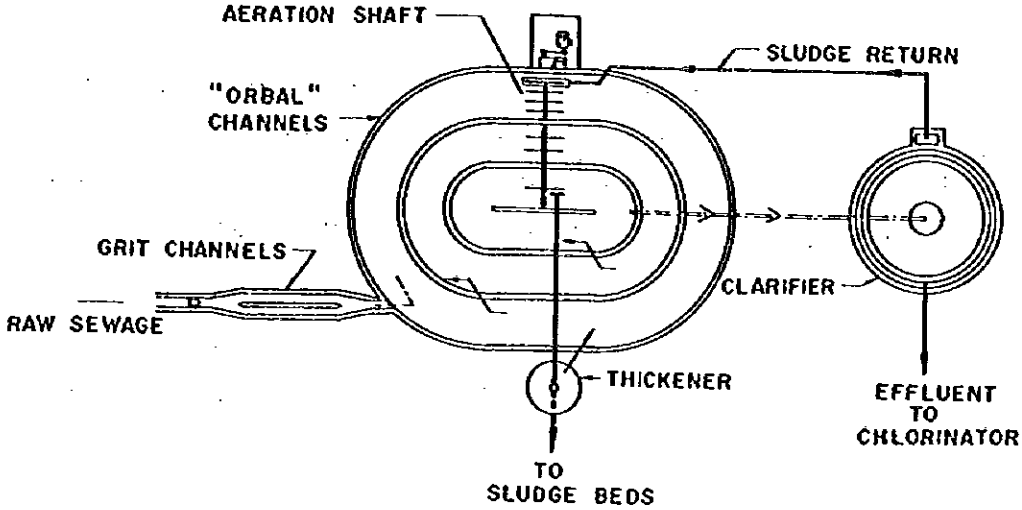


Fig.5. 8 PLAN OF SEWAGE TREATMENT PLANT

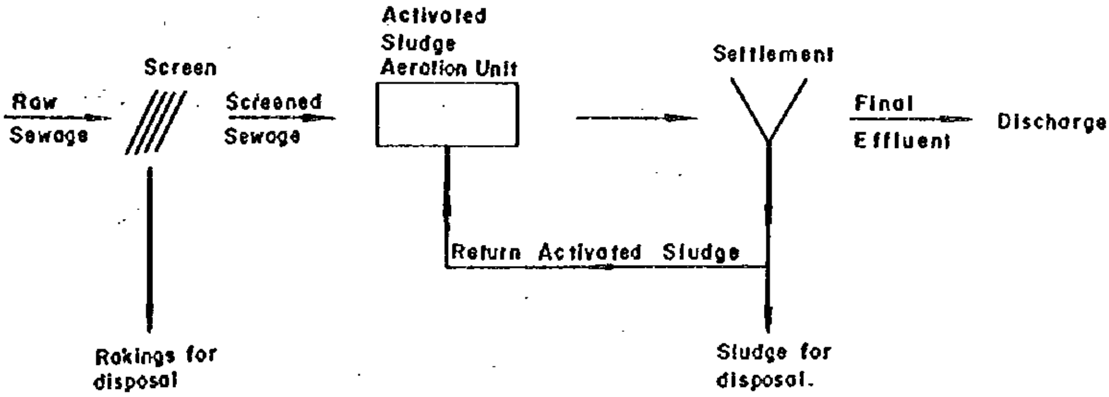


Fig.5. 9 DIAGRAMMATIC REPRESENTATION OF SEWAGE TREATMENT

5.4 Airspace Use Plan

5.4.1 Basic Concept

According to the air traffic demand forecast, aircraft movements in 1995 and 2005 are 18 and 36 times per day respectively which are not considered heavy enough to cause traffic delay. Therefore, approach-and-landing procedures using only on-airport VOR/DME are planned.

As for VOR approach, two procedures are planned to enable straight-in approach for either direction of landing.

Direction of ILS approach is selected for landing from north to runway 20 because most of the new air routes in future will be to the north and wind in the Lowveld is expected to allow approximately 89% of operation for south landing ILS approach. The south landing ILS approach procedure would allow the R-NAV equipped aircraft to make straight-in approach to runway 20 without having to make intermediate approach using VOR.

5.4.2 Instrument Approach and Departure Procedures

1) VOR Approach Procedure No.1 (Fig. 5.10)

a. Holding Procedure

Inbound : 048 deg.
Right turn
Outbound : 228 deg. for one minute
Altitude : 5,000 ft

b. Intermediate Approach Procedure

Outbound : 048 deg. for two minutes

Left base turn

Minimum descending altitude: 2,680 ft

c. Final Approach Procedure

Inbound : 208 deg.

Minimum Descending Altitude: 1,650 ft

d. Missed Approach Procedure

Climb on radial 178 deg. to 3,000 ft, left climbing turn to VOR/DME and hold at 4,000 ft.

2) VOR Approach Procedure No.2 (Fig. 5.11)

a. Holding Procedure

Inbound : 192 deg.

Left turn

Outbound : 012 deg. for one minute

Altitude : 5,000 ft

b. Intermediate Approach Procedure

Outbound : 192 deg. for two minutes

Left base turn

Minimum Descending Altitude: 3,300 ft

c. Final Approach Procedure

Inbound : 352 deg.

Minimum Descending Altitude: 1,550 ft

d. Missed Approach Procedure

Climb on radial 032 deg. to 3,000 ft, right climbing turn to VOR/DME and hold at 4,000 ft.

3) ILS Approach Procedure (Fig. 5.12)

a. Holding Procedure
Inbound : 044 deg.
Right turn
Outbound : 224 deg. for one minute

b. Intermediate Approach Procedure
Outbound : 044 deg.
Left base turn
Minimum Descending Altitude: 2,680 ft

c. Final Approach Procedure
Localizer Course: 202 deg.
Glide Path Angle: 3 deg.
Decision Height : 1,293 ft

d. Missed Approach Procedure:
Climb on radial 192 deg. to 3,000 ft, left climbing turn to VOR/DME and hold at 4,000 ft.

4) Instrument Departure Procedures

a. For south-bound traffic:
Left turn after takeoff runway 20 (right turn for runway 02), climb on radial 195 deg.

b. For west-bound traffic:
Left turn after takeoff runway 20 (right turn for runway 02), climb on radial 195 deg. until reaching 4,000 ft, then right turn and climb on course.

c. For north-bound traffic:
Left turn after takeoff runway 20 (right turn for runway 02), climb on radial 044 deg.

d. For Directions Other than the above:
Left turn after takeoff runway 20 (right turn for runway 02) and climb on course.

5.4.3 Minimum Weather Conditions

Minimum weather conditions are summerized as shown below.

Table 5.8 Minimum Weather Conditions

	STRAIGHT-IN		CIRCLING		STRAIGHT-IN	
	MDA	VIS	MDA	VIS	DH	RVR
VOR NO.1	1,650 ft	2,600 m	1,650 ft	3,200 m		
VOR NO.2	1,550 ft	2,100 m	1,650 ft	3,200 m		
ILS					1,293 ft	800 m
TAKE OFF	VISIBILITY: 600 m, CEILING: N/A					

5.4.4 Runway Usability

Based on our knowledge of the present Matsapa Airport, the runway usability at Sikupe site is estimated to be 97% for VOR approaches and 99% when VOR and ILS approaches are used.

It is generally known that the lower the elevation of an airport, the better it is the runway usability, unless specific weather phenomena cause to reverse the situation. As Sikupe site is about 310 m lower in elevation than the present Matsapa Airport, the proposed new airport should, generally speaking, enjoy a better runway usability. To be sure that this holds true, however, it should be clarified that the ocurrence at Sikupe site of in-flight visibility which is lower than the VOR straight-in approach weather minima as shown in Table 5.8 above, is not unreasonable frequent. It is, therefore, recommended that detailed weather observation at Sikupe site, be commenced as soon as the implementation of the Project is decided upon by the Government. The weather observation should include such items as wind, ceiling, visibility, temperature, dewpoint and general weather phenomena, and be made in accordance with the ICAO procedures. As for the period of observation, two or three years against the ICAO requirements of five years are considered to be sufficient for practical purpose of this study.

Based on the present knowledge of prevailing weather conditions, ILS (Instrument Landing System) is planned for installation in the second stage of the Project for the purpose of the present study. Should the results of above mentioned adequate weather observation prove to be substantially different from the assumed, the ILS installation plan should then be adjusted to suit the situation.

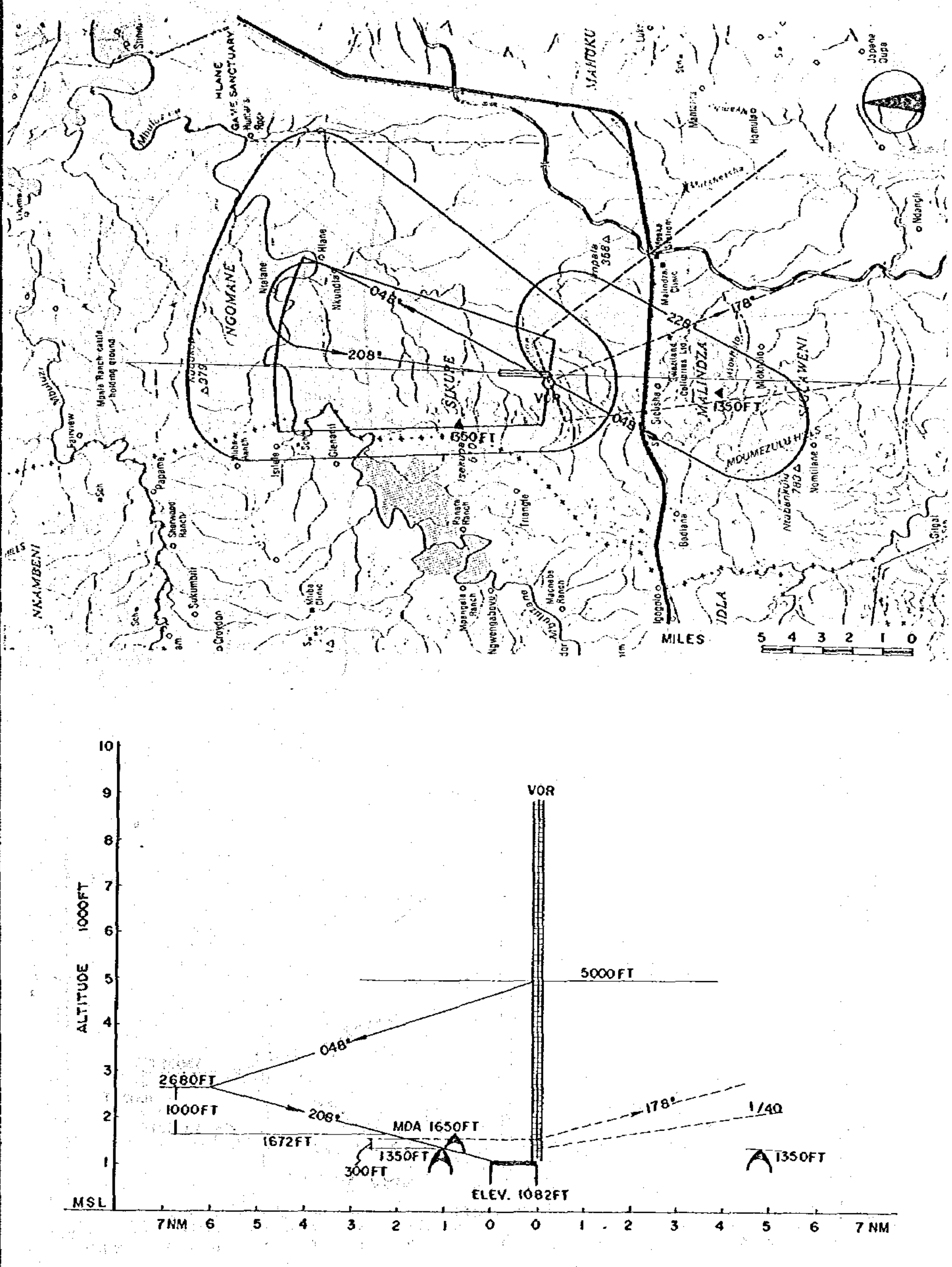
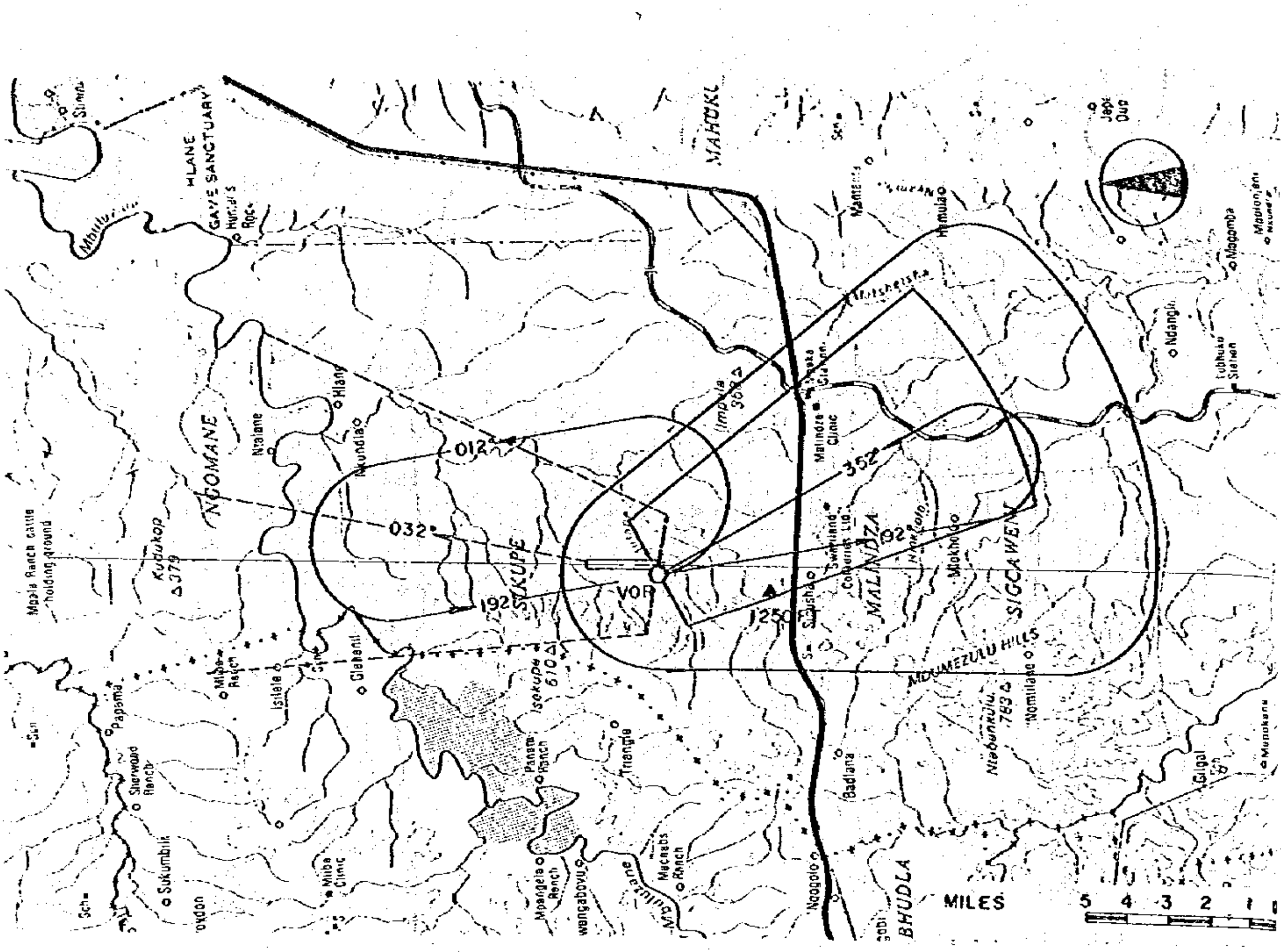


Fig 5.10 VOR APPROACH PROCEDURE NO.1



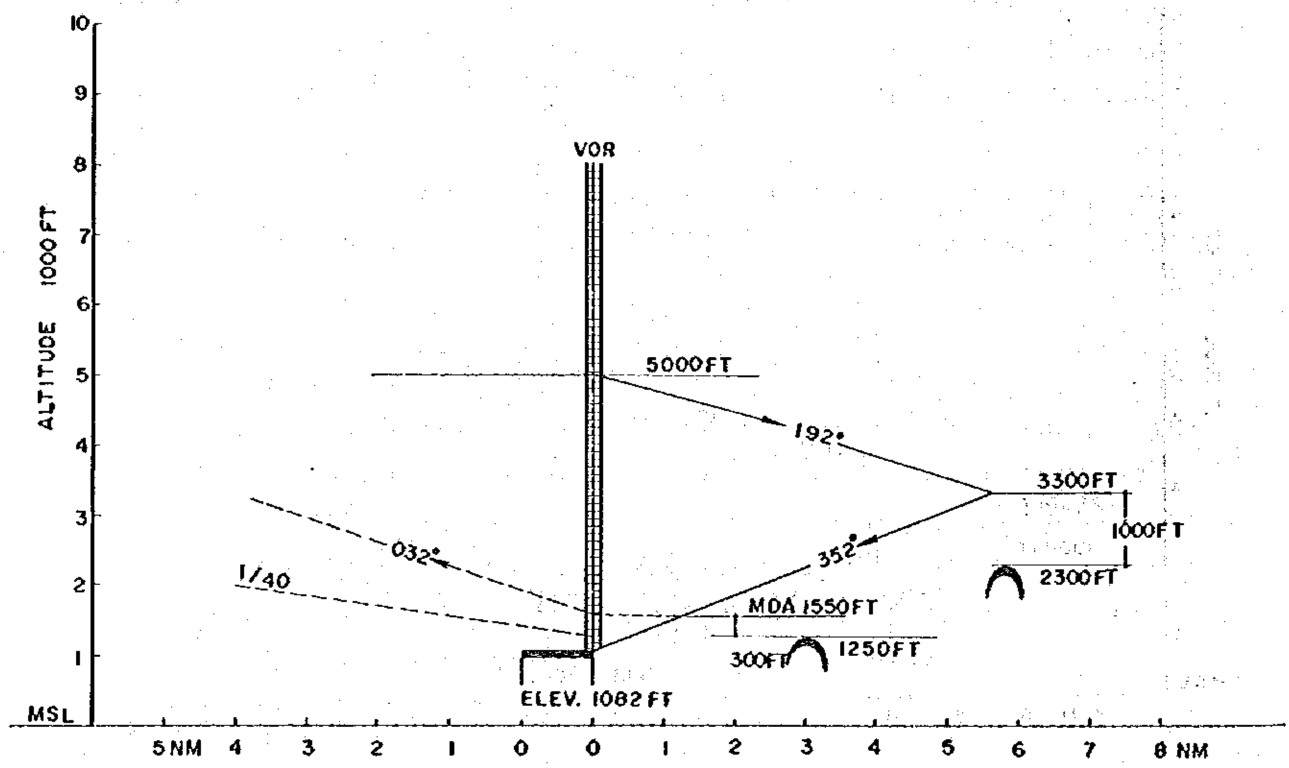


Fig 5.11 VOR APPROACH PROCEDURE NO. 2

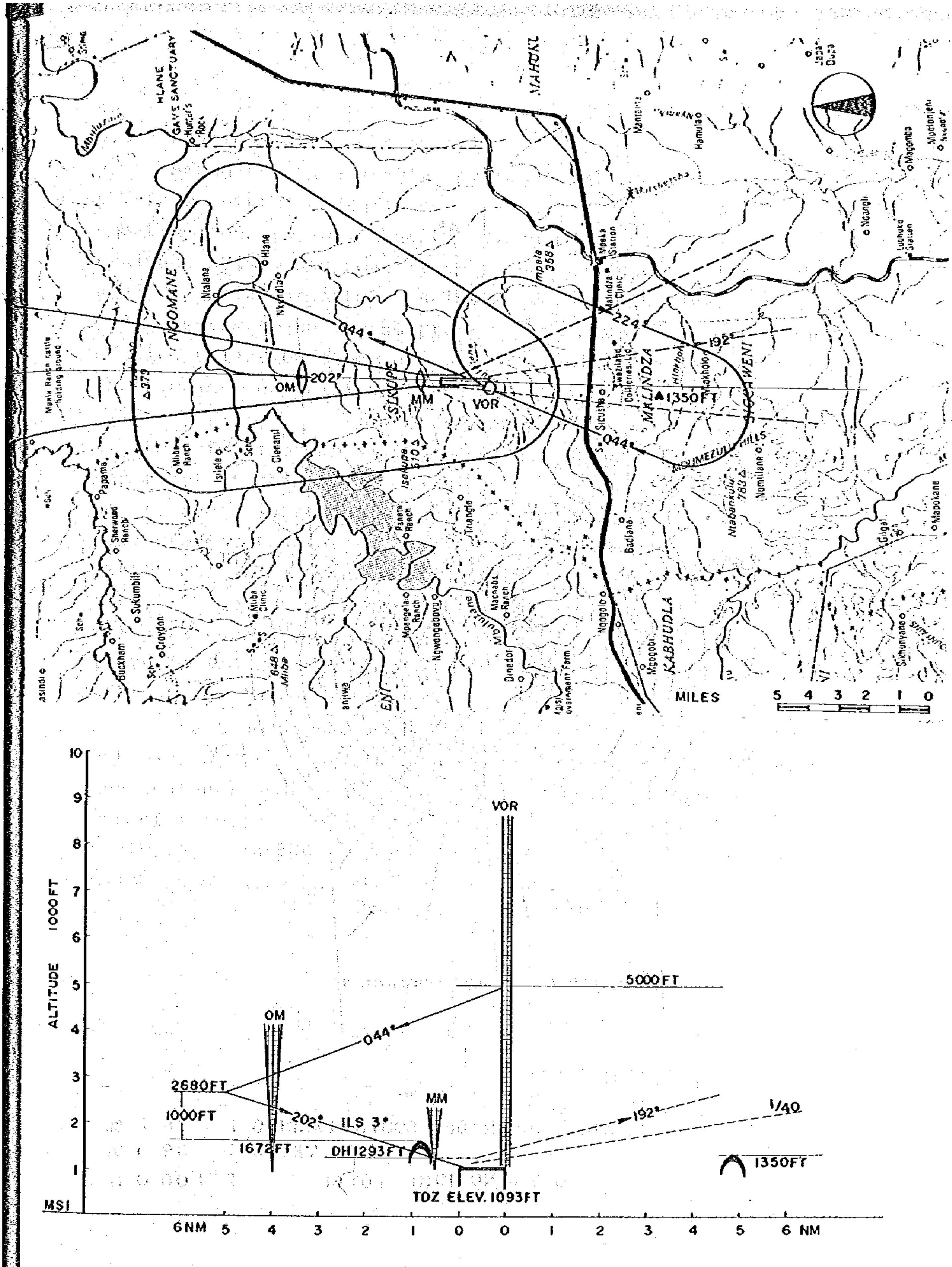
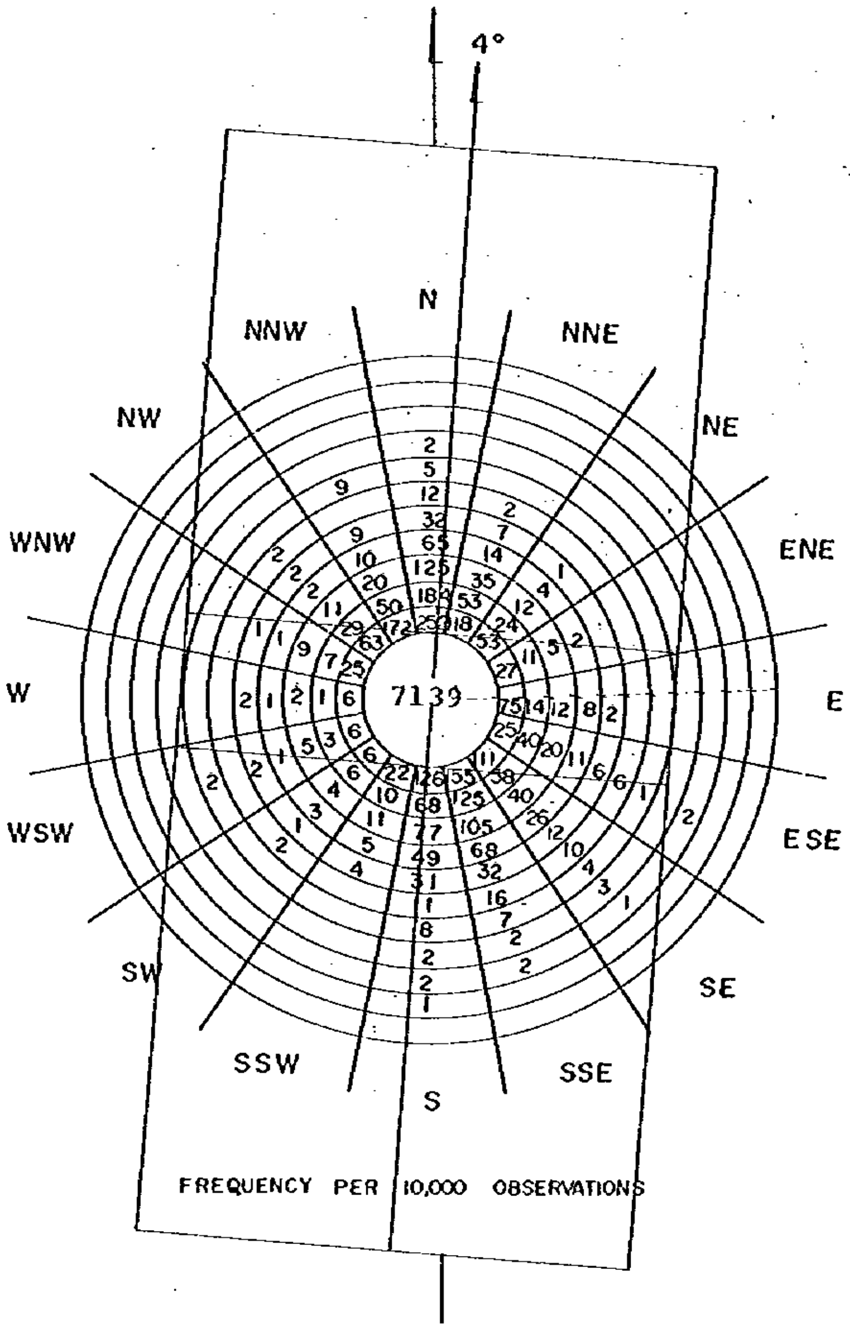


Fig 5.12 ILS APPROACH PROCEDURE



WIND COVERAGE : SOUTH LANDING ; 88.7 %
NORTH LANDING ; 89.5 %
CROSS WIND 19KT TOTAL ; 100.0 %

Fig 5.13 WIND ROSE (MPAKA)

5.5 Environmental Considerations

Among the undesirable environmental impacts of physical nature generally conceivable of a new airport construction project, possible disturbance to the natural drainage system was considered to be the only problem that needed particular attention in the case of this Project, and measures to solve the problem were studied in the stages of site selection study and airport facility planning in the present feasibility study.

As for the conceivable social impacts of air pollution and aircraft noise, the new airport to be constructed at the scarcely inhabited Sikupe site will naturally cause less problem than at the present Matsapa Airport which is situated in the vicinity of densely populated area. In fact, air pollution problem is considered to be practically nil at Sikupe judging from its wide open topographical features and the forecast number of air traffic in the ultimate design year of 2005. According to ICAO, influence of aircraft noise should be assessed not only by its intensity but also by frequency of ocurrence and duration after daily and seasonal adjustment, and for this purpose ICAO recommends use of a noise exposure reference unit of "Weighted Equivalent Continuous Perceived Noise Level". The WECPNL value is obtained by the following formula.

$$\mathrm{WECPNL} = 10 \log \left[\frac{5}{8} \operatorname{antilog} \frac{\mathrm{ECPNLD}}{10} + \frac{3}{8} \operatorname{antilog} \frac{\mathrm{ECPNLN} + 10}{10} \right] + S$$

where,

ECPNLD = ECPNL during daytime (for two period rating) 0700 - 2200 hours

ECPNLN = ECPNL during night-time (for two period rating) 2200 - 0700 hours

S = Seasonal adjustment

= -5dB for months in which there are normally less than 100 hours at or above 20°C (68°F)

= 0dB for months in which there are normally more than 100 hours at or above 20°C (68°F) and less than 100 hours at or above 25.6°C (78°F)

= +5dB for months in which there are normally more than 100 hours at or above 25.6°C (78°F)

Note: 1)

$$ECPNL = TNEL - 10 \log \frac{T}{t_0}$$

where T = total period of time under consideration

2)

$$TNEL = 10 \log \sum_{i}^{n} \text{antilog} \frac{EPNL(n)}{10} + 10 \log \frac{T_0}{t_0}$$

where EPNL(n) is the Effective Perceived Noise Level for the n-th event as defined in 4.1.1 of Appendix 1 of ICAO Annex 16;

T_0 = 10 seconds;

t_0 = 1 second.

3) For further details, refer ICAO Annex 16.

Fig. 5.14 shows the projected WECPNL contours based on the forecast air traffic at Sikupe in the year 2005. The contour of 70 WECPNL, which is often regarded as a border line value that causes noise nuisance is confined to a limited area in the vicinity of the proposed airport. Fig. 5.15 shows the WECPNL contours prepared with a doubled traffic for reference. The WECPNL value of 70 is not an absolute value, and may, of course, vary according to the Government's noise control policy. Once the specific level is decided upon, the urban development in the vicinity of the airport should then be controlled accordingly. Control of aircraft noise at source through noise abatement procedures should be avoided from the safety point of view, unless there is absolutely no other effective means of noise control. Influence of aircraft noise to wild life is not well known. However, it is considered to be no problem as the proposed airport at Sikupe is more than 12 km away from the Hlune Game Sanctuary.

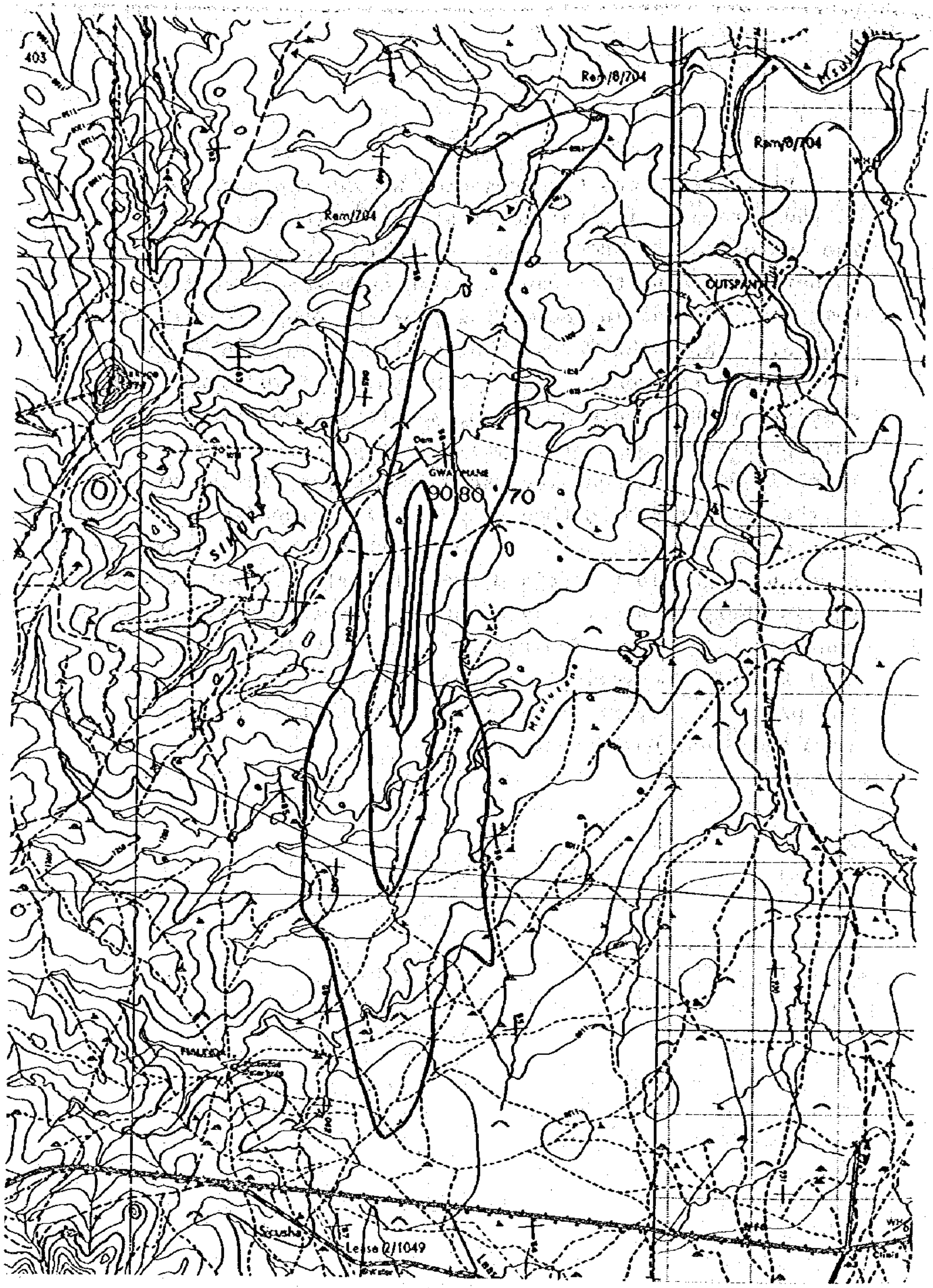


Fig.5.14 WECPNL NOISE CONTOURS

(Stage II Busiest Day Aircraft Movements, B707=14, B737=22)

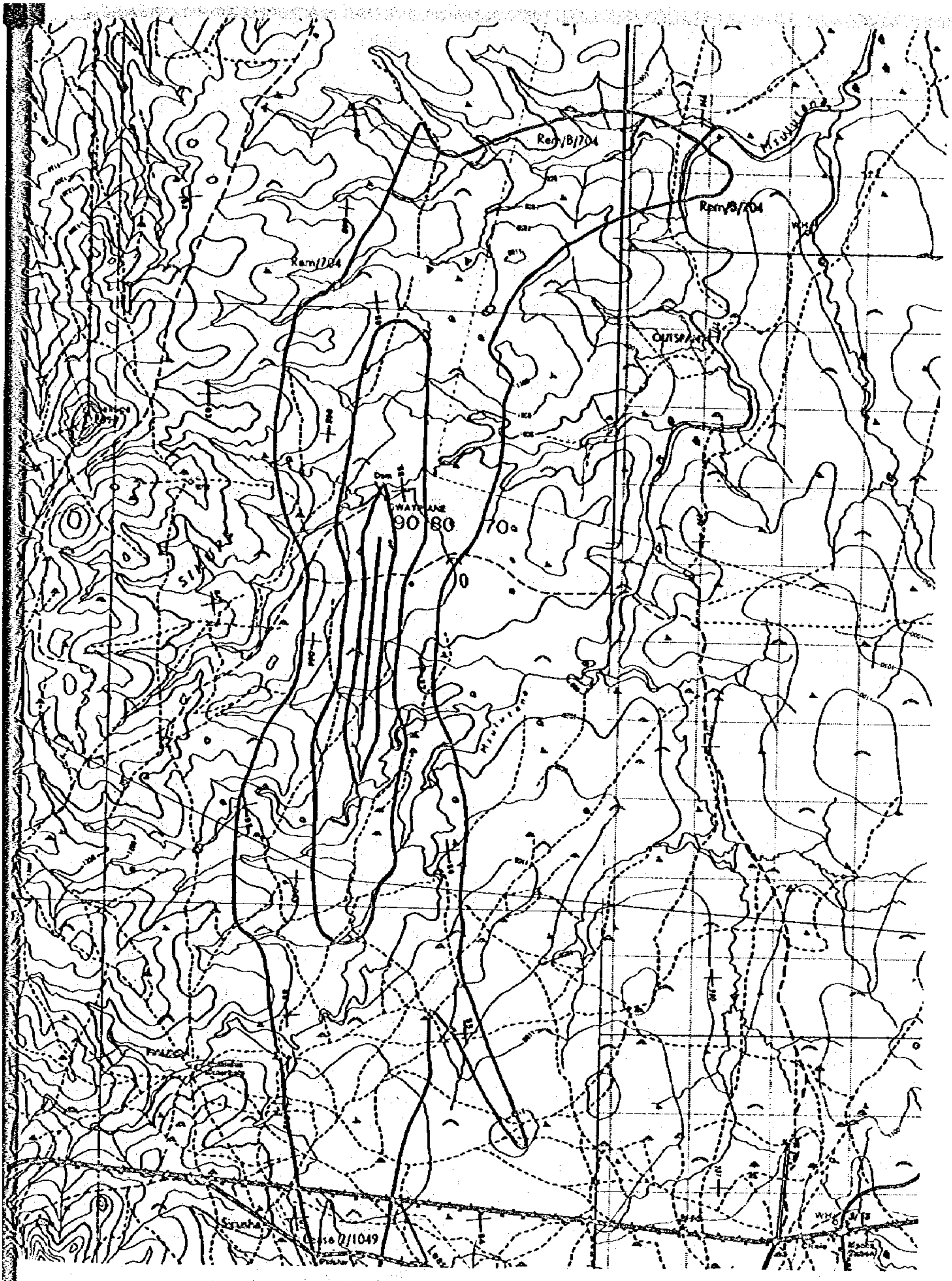


Fig.5.15 WECPNL NOISE CONTOURS

(Aircraft Movements:B707=28,B737=44)

CHAPTER 6

CONSTRUCTION SCHEDULE AND COST ESTIMATE

CHAPTER 6 CONSTRUCTION SCHEDULE AND COST ESTIMATE

6.1 Construction Conditions

6.1.1 Soil and Rainfall

1) Soil

The proposed airport site is covered with an average of 1.3 meter thick surface layer of sandy clay, the upper half of which having comparatively higher compressibility than the underlying half. Sand stone encountered at about 1.3 m below ground surface is not well consolidated but will require ripping work for excavation.

The surface soil is stable in its naturally dry condition, but it will easily turn muddy once moistened and disturbed and, therefore, special care should be taken for the earthwork in the wet season.

Appendix 6A shows the results of the soil tests carried out during the field survey period in November 1979.

2) Rainfall

As is clearly seen in Table 6.1, more than 80 percent of the total annual rainfall recorded at Mpaka Climatological station located close to the proposed airport site concentrates in the wet season, the mean monthly rainfall exceeding 100 mm in the months of December, January and February.

The mean daily rainfall on wet days calculated on the basis of the past rainfall records is shown in Table 6.1. Only about 26 days per year are recorded with mean daily rainfall exceeding 10 mm.

Considering the aforesaid soil condition and the number of holidays and rainy days with daily rainfall exceeding 10 mm, the total number of workable days for civil works is estimated to be 75 percent of a calendar year.

The design rainfall intensity of 30 mm per hour for the drainage system design was determined as shown in Fig. 6.2 based on the FAO Study.

6.1.2 Construction Material

1) Aggregate

Sands and rock suitable for use in the proposed airport construction can be locally obtained from such riverbeds and quarry as shown in Fig. 6.3

The Mbuluzane river running toward north-east at a distance of about 10 kilometers to the west of the proposed airport site have abundant deposits of sand and gravel which are actually in use for construction works today.

In order to transport the materials from this source, the existing road should be partially improved.

There are three existing quarries in Swaziland, two of which are located near the proposed airport site as shown in Fig. 6.3.

These quarries can supply enough quantity of crushed rock for the airport construction but some geological exploration and test should be made to ascertain the suitability of quality of the material.

2) Cement

The portland cement is locally produced and available in sufficient quantities for the airport construction.

3) Asphalt and Steel Material

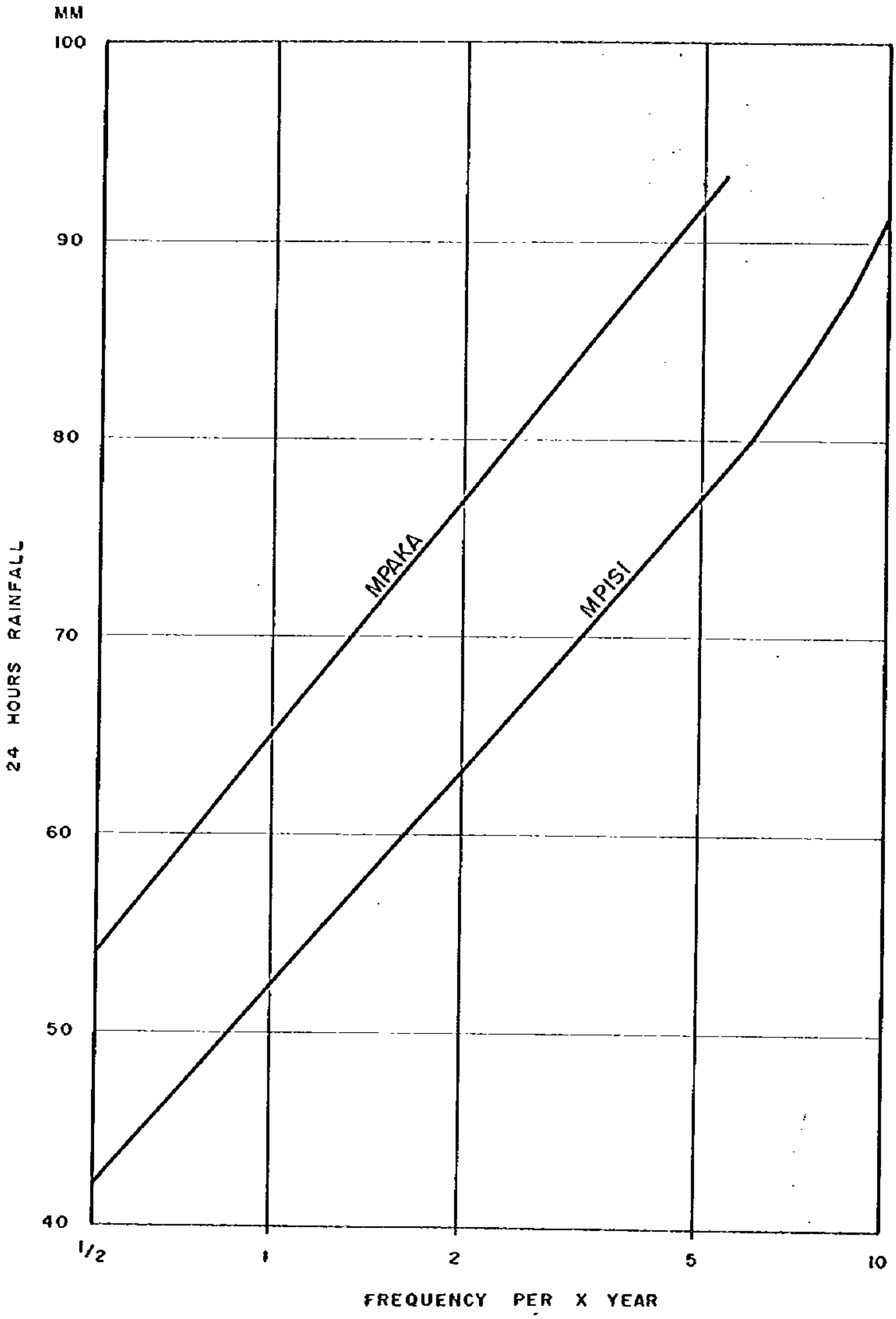
Since majority of asphalt and steel materials are generally being imported from Republic of South Africa and other countries, the quantities required for the new airport construction are also assumed to be imported.

Table 6.1 Mean Monthly Rainfall at Mpaka

	Month	Rainfall (mm)		Wet Days (days)	Mean Daily Rainfall (mm/day)
Dry season	April	53.4	157.5 (19%)	8	6.7
	May	27.0		6	4.5
	June	5.2		2	2.6
	July	10.5		3	3.5
	August	28.9		4	7.2
	September	32.5		6	5.4
Wet season	October	76.5	673.0 (81%)	11	7.0
	November	94.2		13	7.2
	December	149.1		13	11.5
	January	121.4		15	8.1
	February	148.7		13	11.4
	March	83.1		11	7.6
	Annual	830.5	(100%)	105	7.9

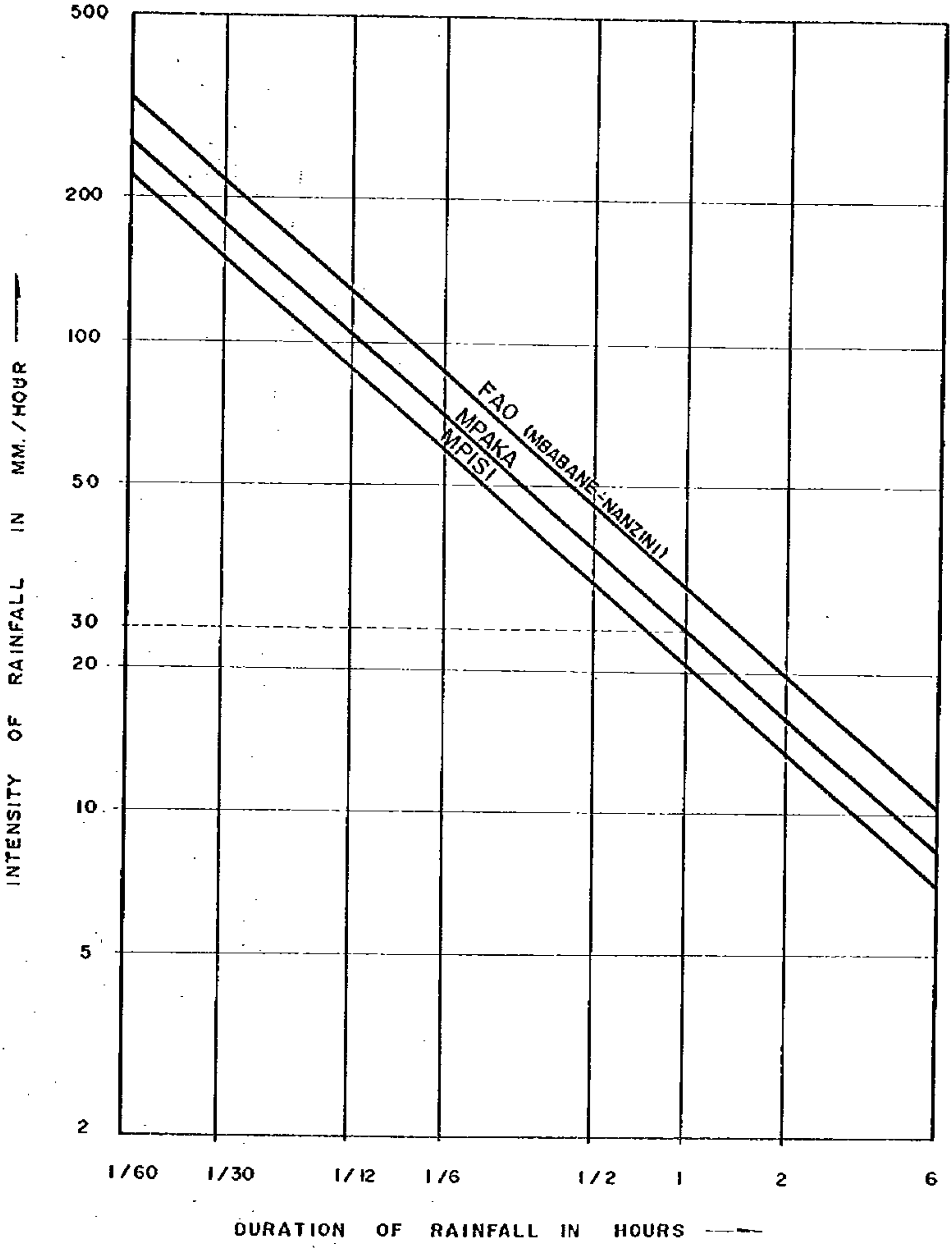
Note: Mean Values for a Nine-Year Period of 1969 - 1977.

Source: "RAINFALL RECORD" at MPAKA Climatological Station.



Source ; " AIRPORT STUDY SWAZILAND FEASIBILITY AND SITE SELECTION REPORT. 1975 " BY NACO B.V.

Fig 6.1 FREQUENCY OF OCCURRENCE OF DAILY RAINFALL



Source ; "AIRPORT STUDY SWAZILAND FEASIBILITY AND SITE SELECTION REPORT. 1975" BY NACO B.V.

Fig. 6.2 RAINFALL INTENSITY-DURATION CURVE

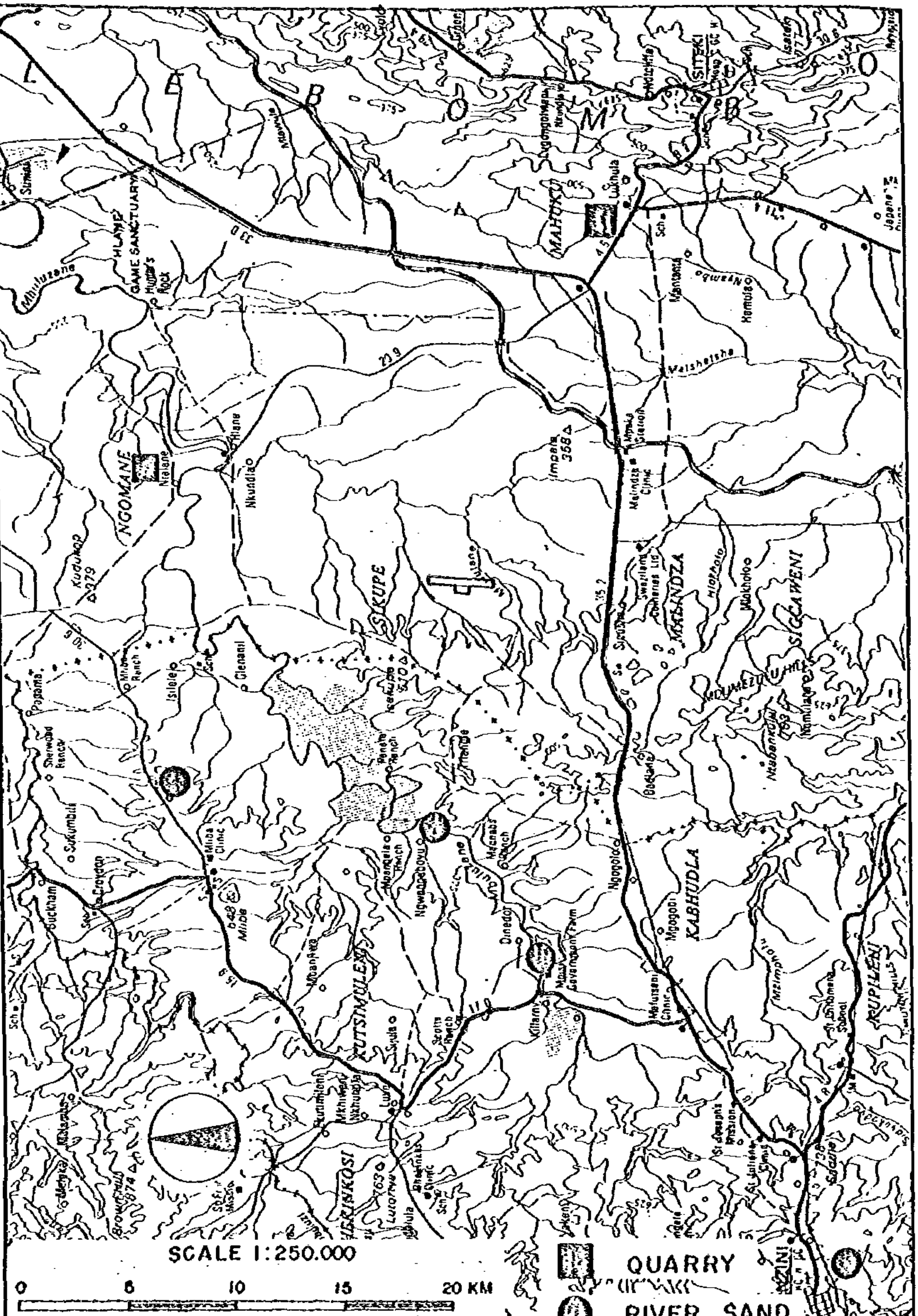


Fig. 6. 3 LOCATION OF QUARRY AND RIVER SAND

6.2 Civil Works

6.2.1 Grading

For the sake of efficient and economical execution of the earthwork, all grading works required for the development of the entire facilities of the new airport through the ultimate stage shall be made in Stage I construction.

1) Determination of Formation Level

Search was made by electronic computer for an optimum formation level of the new airport that would give closest possible balance between cuts and fills and minimized total quantity of earthworks. Calculation of the optimum formation level was made by unit area of 100-meter grids drawn throughout the entire area of the proposed airport premises.

The quantity of required earthwork resulting from the determined formation level is estimated at about 1,908,000 m^3, 65% of which will be of sand stone.

2) Earthmoving Quantities by Hauling Distance

Excavation work is classified into the following three categories by type of construction equipment to be used depending on the hauling distance of earth.

Table 6.2 Classification of Excavation Work by Equipment

Work Categories	Hauling Distance	Soil	Equipment Used
Short Distance Work (1)	Less than 50 m	Sandy Clay / Sand Stone	Bulldozer
Medium Distance Work (2)	50 m or more and less than 500 m	Sandy Clay	Motor Scraper
		Sand Stone	Bulldozer and Motor Scraper
Long Distance Work (3)	500 m or more	Sandy Clay / Sand Stone	Bulldozer, Tractor Shovel and Dump Truck

The total earthmoving volume was classified into the above three categories so as to minimize the hauling distance, with the results as summarized in Table 6.3. The distribution diagram of earthworks is shown in Appendix 6D.

Table 6.3 Earthmoving Quantities by Distance

Works	Quantities ('000 m^3)	Average Hauling Distance (m)
Earthmoving (1)	66	30
Earthmoving (2)	1,032	310
Earthmoving (3)	810	690

3) Method of Earthwork

As the topsoil will easily turn muddy once wetted and disturbed, special care should be taken for the actual execution of the earthwork during the wet season, and earthwork scheduling must be worked out duly taking this condition into account.

Sand stone of the site to be excavated will require ripping work by 30 ton class bulldozer.

Loose surface of the embankment work shall be compacted and smoothed out without delay to prevent penetration of the rain water.

Use of tamping roller and/or tire roller is considered suitable for compaction of the sand stone embankment.

6.2.2 Pavement

1) Bearing Strength of Subgrade

The pavement structure was designed on the basis of the bearing strength of subgrade of each area to be paved.

The entire area to be paved was classified into the following two categories according to the formation of subgrade.

a. Cut Area

CBR value of the subgrade consisting of the sand stone in the cut area is assumed at 25%.

b. Filled Area

The subgrade in the filled area formed with crushed sand stone compacted by tamping roller and tire roller is expected to have a CBR value of around 20%. The design CBR value of the subgrade in the filled area is, however, assumed to be 15%, allowing for the possible variances in the construction conditions.

2) Pavement Surface Material

Comparative analyses were made of the characteristics of the two types of pavement presently being applied on airports, namely the asphalt concrete pavement and the cement concrete pavement, with the results as shown in Table 6.4.

As a result of this comparison, the asphalt concrete pavement has been adopted on account of economy and ease of construction, maintenance and repair, for all pavement surfaces of the proposed new airport.

3) Pavement Thickness

The thickness of the pavement was determined based on the following design factors. Pavement design curve of B707 and standard structure of the pavement is shown in Appendix 6E and 6F respectively.

Design load	B707
Repetition of design load	5,000 times
CBR of subgrade in the cut area	25%
CBR of subgrade in the filled area	15%

4) Pavement Construction Method

As already mentioned, care should be taken not to let the subgrade in the filled area exposed to rain. Therefore, as soon as the subgrading work is completed, the subbase shall be laid without delay. If and when the pavement work takes place during the rainy season, a prime coating shall be applied on top of the subgrade. If, on the other hand, the circumstances should not permit such prompt execution of the subgrade work, the formation level of the subgrade shall be finished slightly higher than the design level in order to allow for removal of the moistened surplus earth on the subgrade surface by grader just before the subbase work is actually executed.

Volumes of sand stone expected to come out of the site to be excavated are to be used as the subbase course material mixed with crushed aggregate. Bituminous base course and/or aggregate base course are to be laid as shown in Appendix 6F.

Table 6.4 Comparison of Asphalt Concrete Pavement and Cement Concrete Pavement

	Asphalt	Cement
Thickness	Thick	Thin
Load Bearing Characteristics	Surface may be rutted depending on load	Can accommodate variety of loads without rutting
Joint	Not needed	Needed between panels to absorb effects of temperature variation
Weathering & Temperature	Do not much affect the bearing strength	Do not affect the bearing strength
Cost	About 17 E/m^2 (CBR = 25%)	About 33 E/m^2 (K_{75} = 10 kg/cm^3)
Construction Period	Rather short and suitable for surfacing of extensive area	Longer
Maintenance and Repair	Easier because spot repair is possible	Difficult, because it requires breaking up of concrete slabs and long curing period

6.2.3 Airport Drainage System

1) Basic Design Consideration

The proposed airport site is naturally drained by the three small rivers, one running by the north end of the site and the other two crossing the site. The drainage system of the new airport is designed basically so as not to disturb this natural drainage after completion of the airport. The overall drainage system of the proposed new airport is shown in Fig. 6.4.

2) Estimated Discharge

The following rational formula was used to estimate the design discharge to be accommodated by the new airport drainage system.

$$Q = CiA/360$$

Where,

Q	:	design discharge (m^3/sec)	
C	:	runoff coefficient by FAA criteria	
		for asphalt pavement	0.95
		for sodding area	0.5
		for other areas	0.3
i	:	rainfall intensity	30 mm/hr
A	:	drainage area (ha)	

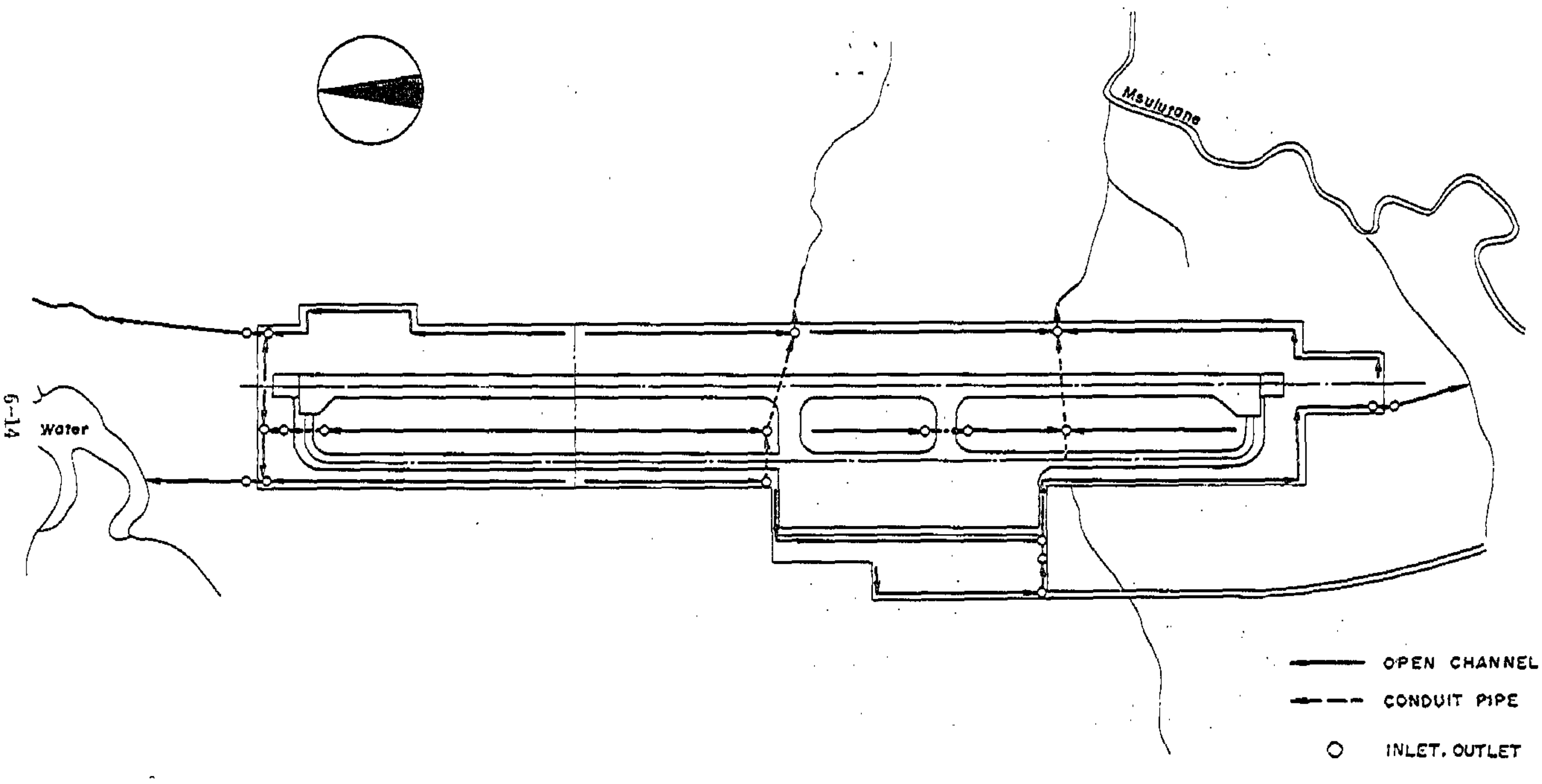


Fig. 6.4 DRAINAGE SYSTEM OF NEW SIKUPE AIRPORT

6.3 Building Works

6.3.1 Building Structure

All buildings of the new airport will be of reinforced concrete structure except for the cargo building and the fire-fighting vehicle housing which will be of steel frame structure.

6.3.2 Foundation of Buildings

Judging from the results of the soil test, an isolated spread foundation is considered suitable for the airport buildings.

6.4 Construction Schedule

The Stage I construction schedule based on the airport plan and construction conditions discussed above is shown in Fig. 6.5.

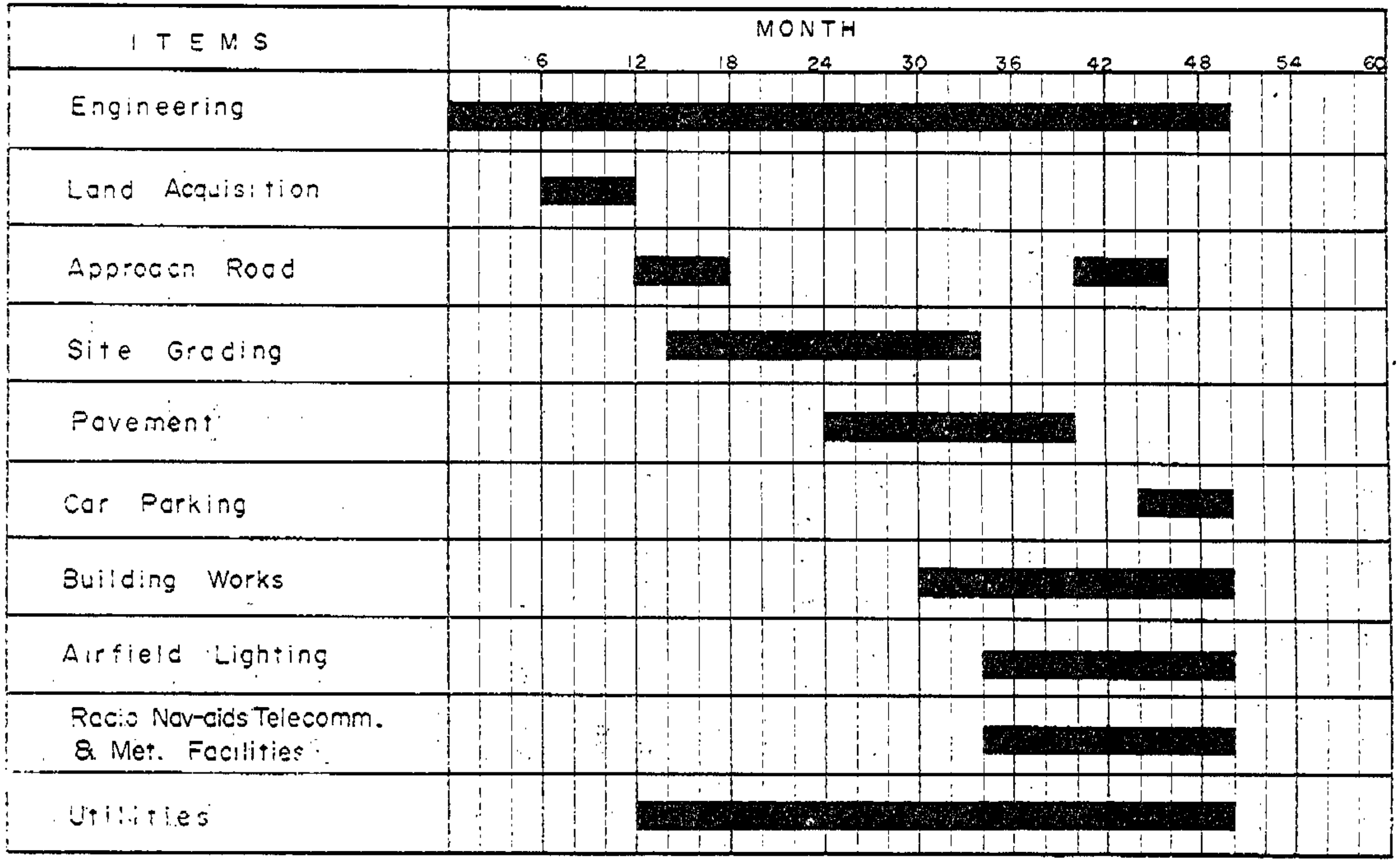
The total period of Stage I development is estimated to be 50 months based on the 9-hour work days.

Construction period of Stage II development is estimated to be 2 years from 1994 through 1995 including the period required for equipment manufacturing.

6.5 Construction Cost Estimate

Construction cost of the new airport by development stage is estimated as tabulated in Table 6.5, and the breakdown by year of the construction cost based on the construction schedule as per Fig. 6.5 is shown in Table 6.6. It is assumed that Stage I construction will be started in the middle of 1980.

Fig. 6.5 CONSTRUCTION SCHEDULE OF NEW AIRPORT - STAGE I



It should be noted that the construction cost of the Head of State Building, staff housing, aircraft maintenance hanger and purchase and installation costs of the airport maintenance equipment and of the aircraft ground support equipment are not included in this cost estimation.

The present cost estimate is based on the following conditions.

1) Unit prices used in the cost estimate are based on the data collected by the JICA Study Team in October and November 1979.

2) Foreign currency portion of the construction cost includes the following items:

a. Operating cost of construction equipment excluding wages of operators.

b. Cost of imported materials and equipment such as steel, asphalt, fuel, airfield lighting and navigational aid facilities, etc. including customs duty.

c. Wages of foreign labor.

3) Local currency portion of the cost includes the following items:

a. Construction materials procured in Swaziland such as cement, aggregate and wooden materials.

b. Wages of local labor.

c. Land acquisition cost.

4) Engineering fee is estimated at 10% of the total cost of works.

5) Physical contingency is estimated at 10% of the sum of the total cost of works, engineering fee and the cost of land acquisition.

6) Conversion between US Dollar, Emalangeni and Yen is based on the exchange rate as of November 1979 of US$1.0 = E. 0.83 = ¥240.

Table 6.5 Construction Cost Estimate of New Airport

(Unit: Thousand E.)

Cost Items	Stage I			Stage II		
	Foreign Portion	Local Portion	Total	Foreign Portion	Local Portion	Total
1. Civil Works	10,135	3,252	13,387	1,975	847	2,822
2. Building Works	2,407	1,034	3,441	572	232	804
3. Airfield Lighting	1,508	655	2,163	651	144	795
4. Radio Nav-aids, Telecommunication & Meteorological Facilities	1,706	259	1,965	669	255	924
5. Utilities	3,525	427	3,952	267	20	287
6. Total of Works	19,281	5,627	24,908	4,134	1,498	5,632
7. Engineering	1,928	563	2,491	413	150	563
8. Land Acquisition	-	7	7	-	-	-
9. Physical Contingency	2,121	620	2,741	455	165	620
10. Grand Total	23,330	6,817	30,147	5,002	1,813	6,815

Table 6.6 Annual Construction Cost Estimate

(Unit: Thousand E.)

Year	Foreign Portion	Local Portion	Total
First Year (1980)	0	62	62
Second Year (1981)	3,852	1,040	4,892
Third Year (1982)	5,659	1,635	7,294
Fourth Year (1983)	8,379	2,497	10,876
Fifth Year (1984)	5,440	1,583	7,023
Stage I Total	23,330	6,817	30,147
1994	2,402	904	3,306
1995	2,600	909	3,509
Stage II Total	5,002	1,813	6,815

Construction cost estimated above does not include any provisions for future inflation. Presented for reference purposes in Tables 6.7 through 6.11 are the construction costs of Stage I development estimated with assumed rates of inflation based on the assumption that Stage I construction will be started in the middle of 1980.

Table 6.7 Annual Construction Cost Estimate for Stage I with Cost Escalation at 7% per Annum

(Unit: Thousand E.)

Year	Foreign Portion	Local Portion	Total
1980	0	66	66
1981	4,266	1,152	5,418
1982	6,706	1,937	8,643
1983	10,624	3,166	13,790
1984	7,380	2,148	9,528
Stage I Total	28,976	8,469	37,445

Table 6.8 Annual Construction Cost Estimate for Stage I with Cost Escalation at 9% per Annum

(Unit: Thousand E.)

Year	Foreign Portion	Local Portion	Total
1980	0	68	68
1981	4,388	1,184	5,572
1982	7,026	2,030	9,056
1983	11,339	3,379	14,718
1984	8,025	2,335	10,360
Stage I Total	30,778	8,996	39,774

Table 6.9 Annual Construction Cost Estimate for Stage I with Cost Escalation at 11% per Annum

(Unit: Thousand E.)

Year	Foreign Portion	Local Portion	Total
1980	0	69	69
1981	4,511	1,218	5,729
1982	7,356	2,125	9,481
1983	12,090	3,603	15,693
1984	8,713	2,535	11,248
Stage I Total	32,670	9,550	42,220

Table 6.10 Annual Construction Cost Estimate for Stage I with Cost Escalation at 13% per Annum

(Unit: Thousand E.)

Year	Foreign Portion	Local Portion	Total
1980	0	70	70
1981	4,636	1,252	5,888
1982	7,696	2,223	9,919
1983	12,876	3,837	16,713
1984	9,446	2,749	12,195
Stage I Total	34,654	10,131	44,785

Table 6.11 Annual Construction Cost Estimate for Stage I with Cost Escalation at 15% per Annum

(Unit: Thousand E.)

Year	Foreign Portion	Local Portion	Total
1980	0	71	71
1981	4,762	1,286	6,048
1982	8,046	2,324	10,370
1983	13,699	4,082	17,781
1984	10,228	2,977	13,205
Stage I Total	36,735	10,740	47,475

CHAPTER 7

FINANCIAL ANALYSIS

CHAPTER 7 FINANCIAL ANALYSIS

7.1 General

Financial analysis was made to examine the financial profitability of the New International Airport Construction Project based on the assumption that the new airport will be administered on a self-supporting accounting principle. The evaluation was made in terms of the financial internal rate of return (FIRR) derived from the financial cost-benefit analysis which was made with the cash flow of the financial costs and the financial benefits. Projected cash flow table for the first 10 years of the project was also to help visualize the funds situation of the project.

7.2 Estimate of Financial Costs

7.2.1 Construction Costs

The annual construction cost of the project shown in Table 6.6 of Chapter 6 is based on the market prices, and was, therefore, used as financial cost of the construction in the present analysis.

7.2.2 Maintenance and Operation Cost

Estimate of the annual maintenance and operation costs of the proposed new airport are shown in Table 7-1. The calculation of these costs was made in the following manner.

1) Annual maintenance cost, including repair works of runway, taxiway, apron, approach road and car parking:

   Estimated at 1% of the respective construction costs including the costs of pavement and drainage works but excluding the cost of grading works.

Table 7.1 Maintenance and Operation Costs

(Unit: Thousand E.)

Year	Maintenance				Salaries & Wages	Others	Total
	Civil Works	Building & Utilities	Nav. Aids & Com. Equipment	Sub Total			
1985	74	74	206	354	260	31	645
1986	74	74	206	354	268	31	653
1987	74	74	206	354	276	32	662
1988	74	74	206	354	285	32	671
1989	74	74	206	354	293	32	679
1990	74	74	206	354	302	33	687
1991	74	74	206	354	311	33	698
1992	74	74	206	354	320	34	708
1993	74	74	206	354	330	34	718
1994	74	74	206	354	340	35	729
1995	74	74	206	354	350	35	739
1996	102	85	292	479	431	46	956
1997	102	85	292	479	444	46	969
1998	102	85	292	479	457	47	983
1999	102	85	292	479	471	48	998
2000	102	85	292	479	484	48	1,011
2001	102	85	292	479	499	49	1,027
2002	102	85	292	479	514	50	1,043
2003	102	85	292	479	530	50	1,059
2004	102	85	292	479	546	51	1,076
2005	102	85	292	479	562	52	1,093

2) Maintenance cost of the buildings and of the airport utilities, including repair works cost:
   Estimated at 1% of the respective construction costs.

3) Maintenance cost of the navigational aids, communication equipments and airfield lighting facilities including repair works:
   Estimated at 5% of respective purchases and installation cost.

4) Salaries and wages:
   Estimated based on the present wage rates of Swaziland governmental employees and on the manning program of the New Swaziland International Airport Administration recommended in Chapter 9 as shown in Table 9.1.

5) Other operating costs:
   Estimated at 5% of the sum of the total annual maintenance and personnel costs itemized under 1) through 4) hereinabove.

7.3 Estimate of Financial Benefits

7.3.1 Airport Tariff Structure

The financial benefits of the New International Airport Construction Project comprise the operating revenues based on the new tariff structure recommended hereunder for consideration of the Government of Swaziland who is planning on a major modification in airport tariffs in time for the opening of the airport. The only landing charges are currently being levied at the existing Matsapa International Airport.

The proposed new airport tariff structure comprises the following items:

a. Landing charges
b. Aircraft parking charges
c. Lighting charges

d. Aviation fuel service charges
e. Land rental
f. Terminal rental
g. Passenger service charges
h. Concession fees
i. Car parking charges
j. Entrance fees

a. Landing charge

Basic fee	E6.0 per landing
Weight fee	E4.5 per 1,000kg of the maximum takeoff weight

b. Aircraft parking charge

Aircraft parking charge is levied on aircraft parked beyond 6 hours at the rate of 7% of the respective landing charge for every 24 hours.

c. Lighting charge

Levied on each landing and takeoff of aircraft between sunset and sunrise at the rate of 5% of the respective landing charges.

d. Aviation fuel service charge

Levied at the rate of E5.0 for each thousand litre of fuel supplied.

e. Land rental

Chargeable on land used for airline's hangar, general aviation hanger, aircraft fuel supply facilities and other purposes authorized by the Government at the unit rate of E0.75 per square meter per annum.

f. Terminal rental

Chargeable on office space, cargo storage, bar-restaurant, shops, etc. at the unit rate of E70.0 per square meter per annum.

g. Passenger service charge

Levied at E6.00 on each departing passenger.

h. Concession fee

Levied at 10% of the sales.

i. Car parking charge

E0.5 per car per parking.

j. Entrance fee

Levied on the entrance to the roof top deck of passenger terminal building at E0.5 per person.

7.3.2 Estimate of airport revenues

Calculation of the expected airport revenues of the new airport based on the above proposed airport tariff was made in the following manner with results as shown in Table 7.2.

Table 7.2 Estimated Airport Revenues

Item	1985	1990	1995	2000	2005
Landing Charge	246	443	747	1,329	2,307
Parking Charge	24	31	32	53	59
Lighting Charge	13	13	13	34	56
Land Rental	10	10	10	10	10
Terminal Rental	151	151	151	198	198
Fuel Service Charge	19	37	74	113	195
Passenger Service Charge	301	514	878	1,499	2,561
Concession Fee	51	102	203	405	808
Car Parking Charge	14	24	41	70	119
Entrance Fee	7	11	20	33	57
Total Revenues	836	1,336	2,169	3,744	6,370

1) Landing charge

Annual aircraft landings by type are estimated as shown in Table 7.3, and the landing fee for each aircraft type calculated according to the respective maximum takeoff weight presented in Jane's "ALL THE WORLD'S AIRCRAFT" is shown in parenthesis.

Table 7.3 Landing Fees and Annual Landing Times by Type of Aircraft

	B707 (E686.9)	B737 (E241.8)	F27 (E97.8)	DHC-6 (E31.7)	Small aircraft (E13.6)
1985	133	534	92	52	1,000
1990	332	781	56	87	1,200
1995	565	1,335	95	150	1,500
2000	1,160	2,105	-	-	1,650
2005	2,060	3,580	-	-	1,800

2) Aircraft parking charge

Annual number of parked aircraft is estimated as shown in Table 7.4. Figures in parenthesis show the parking fee by type for each 24 hours.

Table 7.4 Parked Aircraft by Type

	B707 (E48.1)	B737 (E16.9)	Small Aircraft (E1.0)
1985	365	365	3,000
1990	365	730	3,600
1995	365	730	4,500
2000	730	1,095	5,000
2005	1,095	1,095	5,400

3) Lighting charge

Annual number of night operations by type is estimated as shown in Table 7.5, with the corresponding charge per movement shown in parenthesis.

Table 7.5 Night Operations by Type

	B707 (E43.4)	B737 (E12.1)	Small Aircraft (E0.7)
1985	365	0	200
1990	365	0	310
1995	365	0	450
2000	730	730	560
2005	1,095	1,460	720

4) Aviation fuel service charge

Annual aviation fuel consumption is estimated as shown below.

Table 7.6 Aviation Fuel Consumption

('000 litre)

	1985	1990	1995	2000	2005
Volume	3,800	7,400	14,700	22,600	38,900

5) Land rental

Table 7.7 shows the rentable land of the new airport.

Table 7. 7 Rentable Land Area

Airline Hanger	7,000 m^2
G.A. Hanger	3,500 m^2
Fuel Storage	3,400 m^2
Total	13,900 m^2

6) Terminal rental

Rentable terminal building area is shown below.

Table 7. 8 Rentable Building Area

Items	Stage I	Stage II
Airline Office	760 m^2	1,090 m^2
Bar & Restaurant	800 "	880 "
Shops	250 "	340 "
Bank	40 "	40 "
Post Office	30 "	30 "
Cargo Storage	270 "	450 "
Total	2,150 m^2	2,830 m^2

7) Concession fee

Concession sales of E5.0 per passenger are assumed in 1985 and to increase at an annual rate of 3% in real terms.

8) Car parking fee

Annual number of parking car is estimated as shown below.

Table 7.9 Parked Cars

1985	1990	1995	2000	2005
29,900	47,600	81,400	139,000	237,500

9) Observation deck entrance fee

20% of wellwishers estimated at 67% of total embarking and disembarking passengers are assumed to enter the roof top observation deck.

7.4 Results of Financial Cost-Benefit Analysis

The Financial internal rate of return (FIRR) of the New International Airport Construction Project which has resulted from the financial cost-benefit analysis based on the cash flow of the financial costs and the financial benefits is 1.4% as shown in Table 7.10

To obtain a higher FIRR value it is necessary either to reduce the financial costs, especially the initial construction costs, or to increase the airport revenues. In the light of the global inflation observed it would be impractical to expect any reduction in the construction cost. On the other hand, in order to increase the revenue, airport tariffs should be raised beyond the levels recommended in section 7.3 hereinabove which were established with due consideration, and any decision for upward adjustment for the levels of the neighboring countries, in the tariff would require careful deliberation as to its rate and timing so as not to cause reduction in the airport revenue by discouraging foreign airlines from serving the new airport.

Even if the tariff was raised to a maximum practicable level, there expected to be some shortage of funds to balance the project cash flow that has to be satisfied one way or the other, by equity issuance, for example. To help visualize the funds requirement situations two cases of project funds flow table were prepared as shown in Tables 7.11 and 7.12 with an assumed 50-50 combination of a hard and a soft loan as an example with the following conditions:

Loan A : 8% interest rate, 20 years repayment with 5 years grace period inclusive;

Loan B : 4% interest rate, 30 years repayment with 10 years grace period inclusive.

Calculation was also made, as a reference, of the FIRR values in several alternative cases of tariff level charges, showing that raising of the tariff level by 20%, 50% and 100% would yield FIRR values of 2.8%, 4.6% and 7.1% respectively.

Table 7.10 Projected Revenues and Expenditures

(Thousand E. in 1979 price)

	Expenditure			Revenue											Balance
	Construction Cost	Maint/Ops Cost	Total Cost	Landing Charge	Aircraft Parking Charge	Lighting Charge	Land Rental	Building Rental	Aviation Fuel Charge	Passenger Service Charge	Concession Fee	Car Parking Charge	Entrance Fee	Total Revenue	
1980	62	0	62	0	0	0	0	0	0	0	0	0	0	0	-62
1981	4,892	0	4,892	0	0	0	0	0	0	0	0	0	0	0	-4,892
1982	7,294	0	7,294	0	0	0	0	0	0	0	0	0	0	0	-7,294
1983	10,876	0	10,876	0	0	0	0	0	0	0	0	0	0	0	-10,876
1984	7,023	0	7,023	0	0	0	0	0	0	0	0	0	0	0	-7,023
1985		645	645	246	24	13	10	151	19	301	51	14	7	836	191
1986		653	653	277	24	13	10	151	22	335	59	15	7	913	260
1987		662	662	311	24	13	10	151	25	373	68	17	8	1,000	338
1988		671	671	350	24	13	10	151	29	415	78	19	9	1,098	427
1989		679	679	394	24	13	10	151	33	462	89	21	10	1,207	528
1990		689	689	443	31	13	10	151	37	514	102	24	11	1,336	647
1991		698	698	492	31	13	10	151	43	572	117	27	13	1,469	771
1992		708	708	546	31	13	10	151	49	637	134	30	14	1,615	907
1993		718	718	606	31	13	10	151	56	709	154	33	16	1,779	1,061
1994	3,306	729	4,035	673	31	13	10	151	64	789	177	37	18	1,963	-2,072
1995	3,509	739	4,248	747	32	13	10	151	74	878	203	41	20	2,169	-2,079
1996		956	956	838	32	17	10	198	81	977	233	45	22	2,453	1,497
1997		969	969	941	32	21	10	198	88	1,087	268	50	24	2,719	1,750
1998		983	983	1,055	32	25	10	198	96	1,210	308	56	27	3,017	2,034
1999		998	998	1,184	32	29	10	198	104	1,347	354	63	30	3,351	2,353
2000		1,011	1,011	1,329	53	34	10	198	113	1,499	405	70	33	3,744	2,733
2001		1,027	1,027	1,484	53	38	10	198	126	1,668	465	77	37	4,156	3,129
2002		1,043	1,043	1,657	53	43	10	198	140	1,857	534	86	41	4,619	3,576
2003		1,059	1,059	1,850	53	47	10	198	156	2,067	613	96	46	5,136	4,077
2004		1,076	1,076	2,066	53	52	10	198	174	2,301	704	107	51	5,716	4,640
2005		1,093	1,093	2,307	59	56	10	198	195	2,561	808	119	57	6,370	5,277

Table 7.11 Projected Funds Flow - Stage I

(Thousand E. in 1979 Constant Price)

Year Ended December 31	Source of Funds						Application of Funds			
	Operating Surplus	Loans		Gvt. Equity		Total Cash Available	Capital Investment	Loan Repayment		Total Cash Required
		(A)	(B)	Project	Non-Project			Principal	Interest	
1980	-	-	-	62	-	62	62	-	-	62
1981	-	1,926	1,926	1,040	-	4,892	4,892	-	-	4,892
1982	-	2,830	2,829	1,635	231	7,525	7,294	-	231	7,525
1983	-	4,189	4,190	2,497	570	11,446	10,876	-	570	11,446
1984	-	2,720	2,720	1,583	1,074	8,097	7,023	-	1,074	8,097
1985	191	-	-	-	1,209	1,400	-	-	1,400	1,400
1986	260	-	-	-	1,140	1,400	-	-	1,400	1,400
1987	338	-	-	-	1,180	1,518	-	128	1,390	1,518
1988	427	-	-	-	1,253	1,680	-	317	1,363	1,680
1989	528	-	-	-	1,385	1,913	-	596	1,317	1,913
1990	647	-	-	-	1,386	2,033	-	778	1,255	2,033
1991	771	-	-	-	1,199	1,970	-	778	1,192	1,970
1992	907	-	-	-	1,097	2,004	-	874	1,130	2,004
1993	1,061	-	-	-	1,067	2,128	-	1,016	1,112	2,128

Note: Loan conditions:
Loan (A) : 8% interest rate, 20 years repayment with 5 years grace period inclusive.
Loan (B) : 4% interest rate, 30 years repayment with 10 years grace period inclusive.

Table 7.12 Projected Funds Flow - Stage I

(Thousand E. with 11% construction cost increase p.a.)

Year Ended December 31	Source of Funds						Application of Funds			
	Operating Surplus	Loans		Gvt. Equity		Total Cash Available	Capital Investment	Loan Repayment		Total Cash Required
		(A)	(B)	Project	Non-Project			Principal	Interest	
1980	-	-	-	69	-	69	69	-	-	69
1981	-	2,256	2,255	1,218	-	5,729	5,729	-	-	5,729
1982	-	3,678	3,678	2,125	270	9,751	9,481	-	270	9,751
1983	-	6,045	6,045	3,603	712	16,405	15,693	-	712	16,405
1984	-	4,356	4,357	2,535	1,437	12,685	11,248	-	1,437	12,685
1985	49	-	-	-	1,911	1,960	-	-	1,960	1,960
1986	118	-	-	-	1,842	1,960	-	-	1,960	1,960
1987	196	-	-	-	1,914	2,110	-	150	1,960	2,110
1988	285	-	-	-	2,059	2,344	-	396	1,948	2,344
1989	386	-	-	-	2,329	2,715	-	799	1,916	2,715
1990	505	-	-	-	2,436	2,941	-	1,089	1,852	2,941
1991	629	-	-	-	2,225	2,854	-	1,089	1,765	2,854
1992	765	-	-	-	2,115	2,880	-	1,202	1,678	2,880
1993	919	-	-	-	1,967	2,886	-	1,386	1,500	2,886

Note: Loan conditions:
Loan (A) : 8% interest rate, 20 years repayment with 5 years grace period inclusive
Loan (B) : 4% interest rate, 30 years repayment with 10 years grace period inclusive

CHAPTER 8

ECONOMIC ANALYSIS

CHAPTER 8 ECONOMIC ANALYSIS

8.1 General

Economic analysis in this Chapter is aimed at evaluating the economic feasibility of the New International Airport Construction Project at Sikupe site in terms of the economic return on the investments analysed from the view point of national economy of Swaziland. The economic return is measured by the economic.internal rate of return resultant from the economic cost-benefit analysis which is made with the benefits identified through comparison of the "With-" and "Without-the-Project" cases.

In addition to the above, a similar economic cost-benefit analysis was made with benefits accruing not to Swaziland and Swazis alone but to all conceivable beneficiaries of the Project with no national distinction.

Sensitivity analysis was made for combinations of ±10% fluctuations both in the constructing cost and the air transport demand.

Economic calculation was made for a period of 26 years 1980 - 2005, including 5 years of construction period 1980 - 1984. 1979 constant Emalangeni was used throughout the calculation.

8.2 "Without-the-Project" Case

The "Without-the-Project" case is the case in which the existing Matsapa Airport continues to be used at the existing level of service with no future investments for modification or improvement. The existing service level of the "Without-the-Project" case is identified as follows for the purpose of the present analysis.

1) F28 is the largest aircraft that can be accommodated by the existing 1,500 m runway whose effective length after altitude correction is around 1,300 metres.

2) The existing airport reaches its capacity limit in the year 1985 at the level of 100,000 passengers accommodated a year.

8.3 Economic Costs

8.3.1 Construction Cost

Economic costs of construction were obtained by deducting the various transfers from the financial costs of the Project identified in the previous chapter and converting all prices to the international (or border) prices. Economic costs of goods and services purchased from abroad were obtained by simply deducting the respective import duties from the financial costs. For goods purchased locally their Emalangeni prices after excise taxes were converted to the border prices applying the Standard Conversion Factor (SCF) of 0.92 calculated by the formula shown in the footnote. (*)

Wage component in the local portion of the construction costs was converted to economic wage rate valued by its marginal productivity.

The land earmarked for the new airport construction is not arable and is inhabited only by a few pastoral families. Thus, the marginal and opportunity productivity of the land is regarded very low and, therefore, the economic cost of the land was valued nil.

Resettlement cost is not included either as it is regarded negligible. Marginal productivity of Swazi unskilled labour is said to be around one sixth of the nominal wage(**), and this was adopted as such in the present calculation. As for the local skilled labour and foreign labour, nominal wage rates were used since they are considered to reflect the economic value of such labour.

(*) The Standard Conversion Factor was derived from the following formula.

$$SCF\ (\ ) = \frac{M + X}{M(1+t_m) + X(1-t_x)}$$

where: M = Total amount of imports to Swaziland during 1974-1978

X = The same for exports during the same period

t_m = Ad Valorem taxes on imports to Swaziland

t_x = The same for exports

Decomposition to the tradable and non-tradable goods and so on was not applied due to lack of information.

(**) cf.: 1) Swaziland Rural Development Project Appraisal Report, World Bank, 1977

2) Feasibility Studies of Road Improvements in Swaziland, Department of Economics, University of Natal, 1977.

Table 8.1 Economic Costs of Construction

(Unit: Thousand E.)

Stage	Item / Year	Imported Goods & Services	Domestic Goods and Services								Economic Costs Total
			Nominal Value Total	Domestic Goods		Labour			Overhead & Others	Economic Costs	
				Nominal	Border Price	Skilled Labour	Unskilled Nominal	Labour Economic		(4)+(5)+(7)+(8)	(1) + (9)
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	1980	0	62	26	24	10	6	1	20	55	55
	1981	3,688	1,033	432	402	167	106	18	328	915	4,603
I	1982	5,417	1,635	684	629	265	168	28	518	1,440	6,857
	1983	8,023	2,497	1,045	972	404	256	43	792	2,211	10,234
	1984	5,208	1,583	663	617	256	163	27	501	1,401	6,609
	Total	22,336	6,810	2,850	2,644	1,102	699	117	2,159	6,022	28,358
	1994	2,255	904	444	413	101	94	16	265	795	3,050
II	1995	2,440	909	415	415	102	95	16	266	799	3,239
	Total	4,695	1,813	828	828	203	189	32	531	1,594	6,289

8.3.2 Maintenance and Operating Costs

Economic cost of maintenance and operation was calculated in an identical manner as is mentioned in Section 7.2.2 of Chapter 7 on the basis of the economic cost of the construction obtained above.

8.4 Economic Benefits

Economic benefits and disbenefits calculated comprise:

1) Saving in airline flight costs due to the introduction of more efficient aircarft on the existing routes.
2) Saving in time and fare of air passengers on the new direct routes compared with those of the existing indirect routes.
3) Increased foreign exchange receipts from foreign air passengers and airlines.
4) Benefit of passengers overflowing from the existing Matsapa Airport whom the new airport will accommodate.
5) Increased airport access cost and time.

Benefit of the saving in operating costs of the international services at the existing Matsapa Airport that would result from the opening of the new international airport was not counted because the amount was considered rather small.

Disbenefit of the costs related to the counter-noise measures was not counted because the noise problem was considered virtually non-existent in the present study.

8.4.1 Saving in Airline Flight Costs

The new airport will enable the airlines to operate larger and more efficient aircraft than F28 that can be accommodated by the existing airport. This benefit was calculated on the four existing air routes of Johannesburg, Durban, Lusaka and Mauritius presently being served by F28. Nairobi route was not included in the calculation because direct flights to Nairobi from the existing Matsapa Airport was considered not practicable. B737 and B707 were selected for the calculation as they are considered to be the optimum aircraft for the services on these routes after the opening of the new airport.

Calculation of the transport cost differences was made with seat-statute mile costs of E.0.0761, E.0.0597 and E.0.0586 for F-28, B-737 and B-707 respectively. Load factor of aircraft was taken at 60%. The total saving in 1985 amounted to E.570,000 for aircraft of all flags and E.285,000 for national flag aircraft as shown in column (1) of Table 8.2 and Table 8.3. The ratio of national and foreign flag carriers was assumed at 1:1.

8.4.2 Saving in Time and Fare of Air Passengers

Seven new direct routes will be opened when the new airport is constructed, and the passengers will enjoy reduced time and cost of air trip by no longer having to fly via Johannesburg. Weighted average of the estimated trip cost saving amounted to at E.6.42 per trip and that of time saving to 1.415 hours. Time value was estimated by referring to per capita GDP and other factors at E.2.42 per hour for the Swazis and E.4.83 for the non-Swazis. The results of calculation are shown in column 2 and 3.

8.4.3 Increased Foreign Exchange Receipts

With the construction of the new airport, increased airport revenues from foreign airlinens and spending in Swaziland by foreign visitors by air, both defined to be an export element in the present study, are expected to make substantial contributions. Calculation was made in the following manner with the results shown in column 8.

a) Airport revenue from foreign flag airlines

Among the various airport revenues such as landing charges, lighting fees, and other service charges, etc., only the landing charges were counted in this analysis. Landing charges accruing from the raised tariff as discussed in chapter 7 are regarded from the economic point of view to represent the tariff that the foreign airlines is willing to pay for the use of the new airport and was, therefore, used as the benefits of this category. The ratio of foreign and national flag aircraft was assumed at 1:1 as above. The results are shown in Column 8 of the Tables 8.2 and 8.3

b) Net income from the consumption in Swaziland by foreign visitors by air

Visitors to Swaziland are expected to spend E.35 per day and stay for four days in one trip. E.18 or 51% of the daily consumption of E.35 was taken as net income per passenger in this category and was assumed to increase at 3% p.a. throughout the period of calculation.

8.4.4 Benefits of Overflowing Passengers whom the new airport will accommodate.

The existing Matsapa Airport is expected to reach its passenger handling capacity in 1985 and any forecast increment in passenger traffic beyond that capacity will theoretically overflow.

In fact, a certain part of the so-called overflowing passengers will make the intended trip via the second best means, i.e., by combined air and surface transport through Johannesburg, at a greater cost of time and fare necessitated by the detour course. Such cost increment incurred in the detour will be saved when the new airport is constructed, and is, therefore, considered to represent an element of benefits attributable to the Project. This benefit is graphically expressed as area (A) in Fig. 8.1 and its value is tabulated in column 10.

The balance of the overflowing passengers will simply give up the intended trip until the new airport is constructed and satisfies his trip demand at the cost of the direct air trip time and fare.

The trapezoid $D_1P_1P_2D_2$ in Fig.8.1 illustrates the aggregate benefits enjoyed by each of the passengers in this second group of overflowing passengers. For the first passenger of this second group, his total benefit or utility is expressed by the linear quantity very close but not exactly equal to D_1P_1 which represents the utility enjoyed by the last man of the first group. In other words, to get the almost identical utility, the latter pays the greater cost of detour C_2, while the former pays only C_1 which is the direct air trip cost. The difference between C_2 and C_1 can, therefore, be termed the "consumer's surplus" of the first man of the second group, which is the extra benefit he gets beyond what he actually pays for. This surplus is considered to diminish gradually from the case of the first man to the second, second to the third, etc., until in the case of the last man of the second group

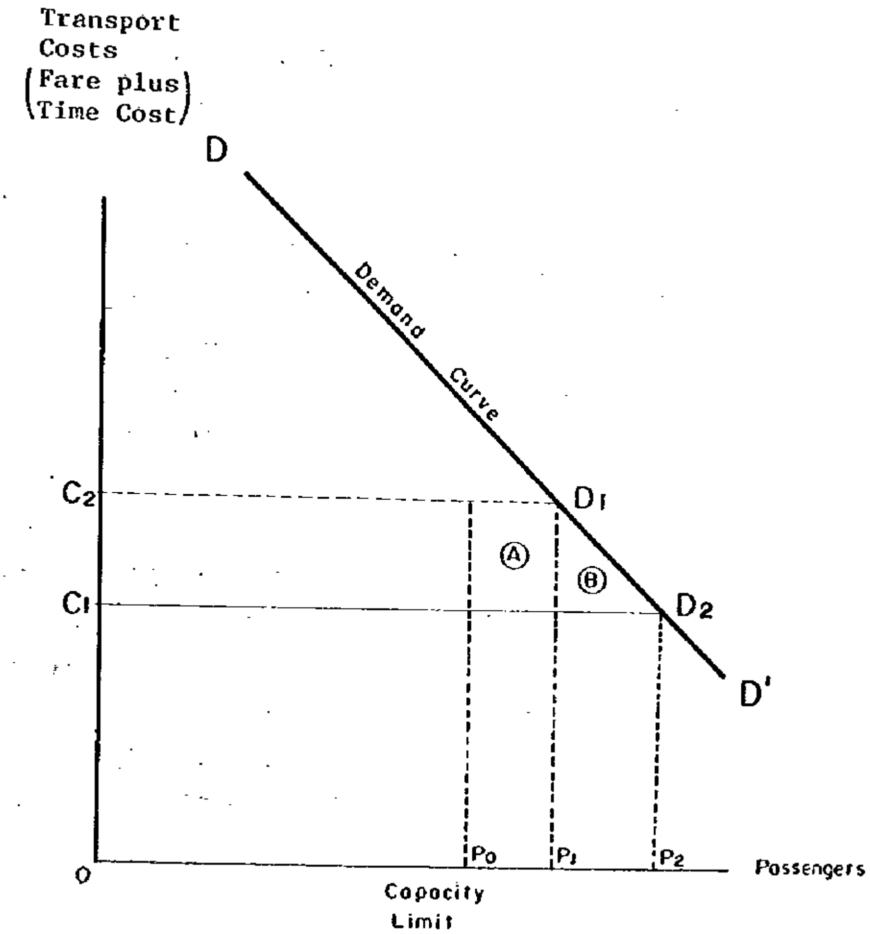


FIG.8.1 OVERFLOWING PASSENGERS' BENEFITS

his consumer's surplus is redueed to nil. This explains how the triangular area (B) represents the aggregate consumers' surplus of the second overflowing passenger group, which is counted as another element of the benefits attributable to the Project in the present study. The value of this benefit is tabulated in Column 11.

8.4.5 Disbenefits of Increased Airport Access Cost and Time

The new airport site is located 45 km farther than the Matsapa Airport from Ezulwini Valley located between Mbabane and Matsapa, which is considered to be the centre of gravity of demand for passengers' surface transport. The increased time and transport cost incurred by passengers and wellwishers were calculated on an assumption that vehicles are driven at 60 km per hour. Time values mentioned in 2) above were used in this calculation. The ratio of the number of passengers vs wellwishers was taken at 2:3. 70% of passengers and wellwishers were assumed to use private cars or taxis, each carrying 3 passengers/wellwishers and costing E. 0.10 per km, and the balance to use buses carrying 30 and costing E.0.12 per km. The calculated disbenefits appear in Columns 4 through 7.

8.5 Overall Economic Evaluation

Economic Internal Rate of Return (EIRR) of the Project derived from the cash flow of economic costs and benefits as shown in Tables 8.2 and 8.3 which were analysed from the viewpoint of national economy of Swaziland amounted to 10.5%. This value indicates that the Project is economically justified in view of the fact that the 1980 opportunity cost of capital of Swaziland is in the range of 9.5 - 10.0% per annum according to the Department of Economic Planning and Statistics.

Furthermore, the EIRR value resultant from the analysis involving the beneficiaries without national distinction showed as high a value as 17.4%.

Besides the quantified benefits of the Project as discussed above, there are, of course, intangible direct or indirect benefits of the Project, such as increased air safety, increased amenity and convenience, increased employment opportunity, spillover effect on national economy, increased national prestige, development of information and cultural exchange, and increased incentive to economic development, etc.

Among those listed above, increased air safety, increased employment opportunity and induced economic demand are the very important benefits of the Project which should not be overlooked. As for the air safety, the new airport will solve all such problems of the existing Matsapa Airport that are due to 1) insufficient runway length for jet operation; 2) unsatisfactory aircraft operation procedures due to obstructive terrain and existing obstacle of the control tower to transitional surface; and 3) insufficient clearance between edges of runway and apron. As for the employment opportunity, the Project is expected to require about 230 thousand and 60 thousand labourers in the first and the second stages of construction respectively. Furthermore, when the new airport goes into operation the number of employment created on the airport proper will amount at least to 150 in 1985, which is expected to increase to 900 in 2005. Employment opportunity outside of the airport could also be expected to increase due to the repercussion effects of the new airport activities. As for the spillover effects on national economy, there would be the repercussion effects on industries, and demands created of consumption by the labourers related to the new airport construction and by the increasing number of air passengers and airport employees after the new airport goes into operation.

Table 8.2 Economic Costs and Benefits Cash Flow
(With Benefits to Swazis only)

(Unit: Thousand E.)

Year	Costs			Benefits											
	Construction Costs	Maintenance & Operation Costs	Total Costs	Airline Flight Cost Saving	Air Pax. Saving		Increased Airport Access				Export of Service		Overflowing Pax. Benefits		
							Passengers		Wellwishers						
					Time	Fare	Time	Fare	Time	Fare	Airlines	Visitors	Detour Cost Saved (A)	Consumers' Surplus (B)	Total Benefit
	(I)	(II)	(III)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
1980	55	0	55	0	0	0	0	0	0	0	0	0	0	0	0
1981	4,603	0	4,603	0	0	0	0	0	0	0	0	0	0	0	0
1982	6,857	0	6,857	0	0	0	0	0	0	0	0	0	0	0	0
1983	10,234	0	10,234	0	0	0	0	0	0	0	0	0	0	0	0
1984	6,609	0	6,609	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	621	621	285	79	128	-37	-25	-60	-82	123	21	0	0	433
1986	0	630	630	285	82	128	-38	-25	-61	-82	139	776	0	19	1,222
1987	0	638	638	285	84	128	-39	-25	-63	-82	156	1,650	0	81	2,174
1988	0	647	647	285	87	128	-40	-25	-65	-82	175	2,656	0	203	3,321
1989	0	656	656	285	89	128	-42	-25	-67	-82	197	3,037	131	255	3,906
1990	0	666	666	285	92	128	-43	-25	-69	-82	222	3,104	338	257	4,206
1991	0	675	675	285	95	128	-44	-25	-71	-82	246	3,172	571	259	4,534
1992	0	685	685	285	98	128	-46	-25	-73	-82	273	3,243	833	261	4,894
1993	0	695	695	285	101	128	-47	-25	-76	-82	303	3,315	1,127	263	5,292
1994	3,050	706	3,756	285	104	128	-48	-25	-78	-82	337	3,389	1,457	265	5,731
1995	3,239	716	3,955	285	107	128	-50	-25	-80	-82	374	3,464	1,828	267	6,215
1996	0	919	919	285	110	128	-51	-25	-83	-82	419	3,542	2,245	269	6,756
1997	0	933	933	285	113	128	-53	-25	-85	-82	471	3,621	2,712	271	7,356
1998	0	946	946	285	117	128	-54	-25	-88	-82	528	3,703	3,237	273	8,021
1999	0	961	961	285	120	128	-56	-25	-90	-82	592	3,786	3,827	275	8,760
2000	0	976	976	285	124	128	-58	-25	-93	-82	665	3,872	4,489	278	9,582
2001	0	991	991	285	127	128	-59	-25	-96	-82	742	3,959	5,232	280	10,492
2002	0	1,006	1,006	285	131	128	-61	-25	-99	-82	829	4,049	6,067	283	11,505
2003	0	1,023	1,023	285	135	128	-63	-25	-102	-82	925	4,141	7,005	285	12,633
2004	0	1,039	1,039	285	139	128	-65	-25	-105	-82	1,033	4,236	8,058	288	13,891
2005	0	1,057	1,057	285	143	128	-67	-25	-108	-82	1,154	4,332	9,241	291	15,293
Total	34,647	17,186	51,833	5,985	2,277	2,696	-1,062	-521	-1,712	-1,730	9,898	67,068	58,400	4,921	146,220

Note: Breakdown figures are rounded and, therefore, do not necessarily add up strictly to the respective totals.

Table 8.3 Economic Costs and Benefits Cash Flow
(With Benefits to Swazis and Non-Swazis)

(Unit: Thousand E.)

Year	Costs			Benefits									
	Construction Costs	Maintenance & Operation Costs	Total Costs	Airline Flight Costs Saving	Air Pax. Saving		Increased Airport Access				Overflowing Pax. Benefits		Total Benefit
					Time	Fare	Passengers Time	Passengers Fare	Wellwishers Time	Wellwishers Fare	Detour Cost Saved (A)	Consumers' Surplus (B)	
	(I)	(II)	(III)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(10)	(11)	(12)
1980	55	0	55	0	0	0	0	0	0	0	0	0	0
1981	4,603	0	4,603	0	0	0	0	0	0	0	0	0	0
1982	6,857	0	6,857	0	0	0	0	0	0	0	0	0	0
1983	10,234	0	10,234	0	0	0	0	0	0	0	0	0	0
1984	6,609	0	6,609	0	0	0	0	0	0	0	0	0	0
1985	0	621	621	570	714	642	-333	-124	-77	-83	0	0	1,309
1986	0	630	630	570	735	642	-343	-124	-79	-83	0	99	1,417
1987	0	638	638	570	757	642	-353	-124	-81	-83	0	433	1,761
1988	0	647	647	570	780	642	-364	-124	-84	-83	0	1,085	2,422
1989	0	656	656	570	803	642	-375	-124	-86	-83	571	1,512	3,450
1990	0	666	666	570	827	642	-386	-124	-89	-83	1,760	1,528	4,646
1991	0	675	675	570	852	642	-397	-124	-92	-83	3,082	1,545	5,995
1992	0	685	685	570	878	642	-409	-124	-94	-83	4,575	1,562	7,515
1993	0	695	695	570	904	642	-422	-124	-97	-83	6,260	1,580	9,230
1994	3,050	706	3,756	570	931	642	-434	-124	-100	-83	8,163	1,598	11,162
1995	3,239	716	3,955	570	959	642	-447	-124	-103	-83	10,310	1,617	13,340
1996	0	919	919	570	988	642	-461	-124	-106	-83	12,733	1,636	15,795
1997	0	933	933	570	1,017	642	-475	-124	-109	-83	15,468	1,656	18,562
1998	0	946	946	570	1,048	642	-489	-124	-113	-83	18,553	1,677	21,681
1999	0	961	961	570	1,079	642	-503	-124	-116	-83	22,033	1,699	25,197
2000	0	976	976	570	1,112	642	-519	-124	-119	-83	25,960	1,721	29,159
2001	0	991	991	570	1,145	642	-534	-124	-123	-83	30,390	1,744	33,626
2002	0	1,006	1,006	570	1,179	642	-550	-124	-127	-83	35,387	1,767	38,662
2003	0	1,023	1,023	570	1,215	642	-567	-124	-131	-83	41,025	1,792	44,339
2004	0	1,039	1,039	570	1,251	642	-584	-124	-134	-83	47,386	1,817	50,740
2005	0	1,057	1,057	570	1,289	642	-601	-124	-138	-83	54,562	1,843	57,958
Total	34,647	17,186	51,833	11,970	20,462	13,482	-9,544	-2,606	2,198	29,909	338,237	29,909	397,967

Note: Breakdown figures are rounded and, therefore, do not necessarily add up strictly to the respective totals.

Supplementary Economic Consideration

The results of the sensitivity analysis made for reference purposes are shown in Tables 8.4 and 8.5. It can be concluded from the results of the analysis that the air transport demand and the cost of the Project have similar sensitivity on the rate of return. The analysis also shows that in the range of changes in the demand and the cost covered, the resultant rates of return are within the feasible area from the economic point of view.

Table 8.4 Sensitivity Analysis on EIRR
(With Benefits to Swazis only)

Project Cost \ Air Transport Demand	-10%	Study Forecast	+10%
-10%	10.3	11.5	12.6
Study Estimate	9.4	10.5	11.6
+10%	8.6	9.6	10.6

Table 8.5 Sensitivity Analysis on EIRR
(With Benefits to Swazis and Non-Swazis)

Project Cost \ Air Transport Demand	+10%	Study Forecast	+10%
-10%	16.8	18.4	19.9
Study Estimate	15.9	17.4	18.9
+10%	15.1	16.6	18.0

CHAPTER 9

PROJECT IMPLEMENTATION ORGANIZATION AND NEW INTERNATIONAL AIRPORT ADMINISTRATION

CHAPTER 9 PROJECT IMPLEMENTATION ORGANIZATION AND NEW INTERNATIONAL AIRPORT ADMINISTRATION

9.1 Project Implementation Organization

To ensure smooth and efficient implementation of the Project it is recommended that an adequate organizational set up be established within the framework of the present governmental organizations centering around the Ministry of Works, Power and Communications. Fig. 9.1 illustrates one such form of recommended organization which is described in some details hereunder.

1) Project Coordinator shall be responsible for overall management of the Project and coordination in all matters involved in its implementation. In the line of order he shall directly report to the Permanent Secretary of MWPC from whom he will receive all such directions, advice and assistance as may be required for the due and satisfactory execution of the duties of the Project Coordinator. As his functions will require positive and all-out cooperation from such MWPC departments as the Planning Unit and the Civil Aviation Branch, as well as from any such other service units as may be involved in the Project implementation, the Project Coordinator's position would be filled best by the Chief Engineer of MWPC.

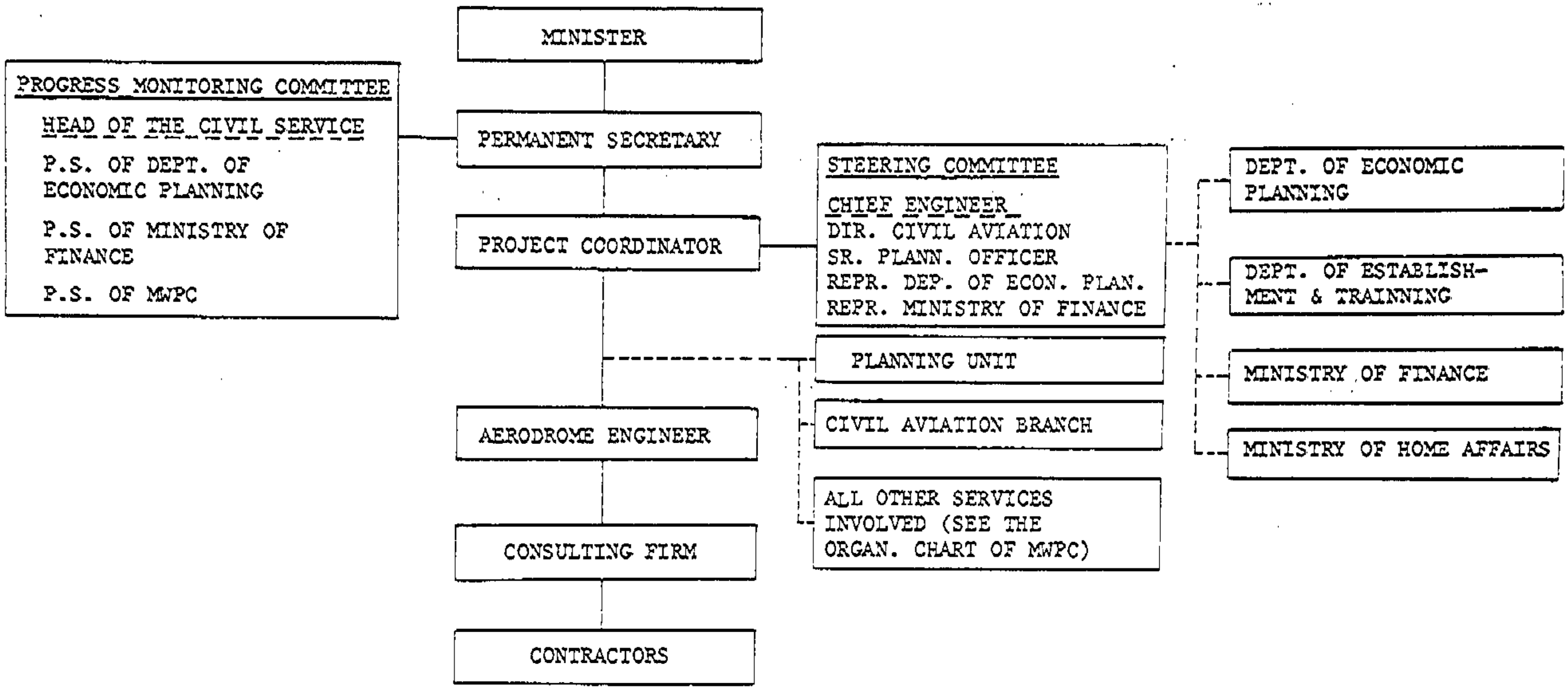
2) Aerodrome Engineer of the Civil Aviation Branch shall be directly responsible to the Project Coordinator in matters related to the implementation of the Project, and shall be in charge of day-to-day coordination, supervision and liaison with the consulting engineer.

3) Steering Committee shall be chaired by the Chief Engineer, and the members shall comprise the Director of Civil Aviation, Senior Planning Officer of MWPC, and one representative each of the Department of Economic Planning and the Ministry of Finance. The Steering Committee shall function virtually as an executing commission and shall meet periodically at a greater frequency during preparatory and initial phases of the Project implementation than in later stages. The agenda of its meetings shall cover all matters necessary for the working level decision making involved in actual implementation of the Project, including inter alia the necessary inter-departmental coordination. Permanent Secretary of MWPC shall periodically be kept informed of the actions taken by the Steering Committee.

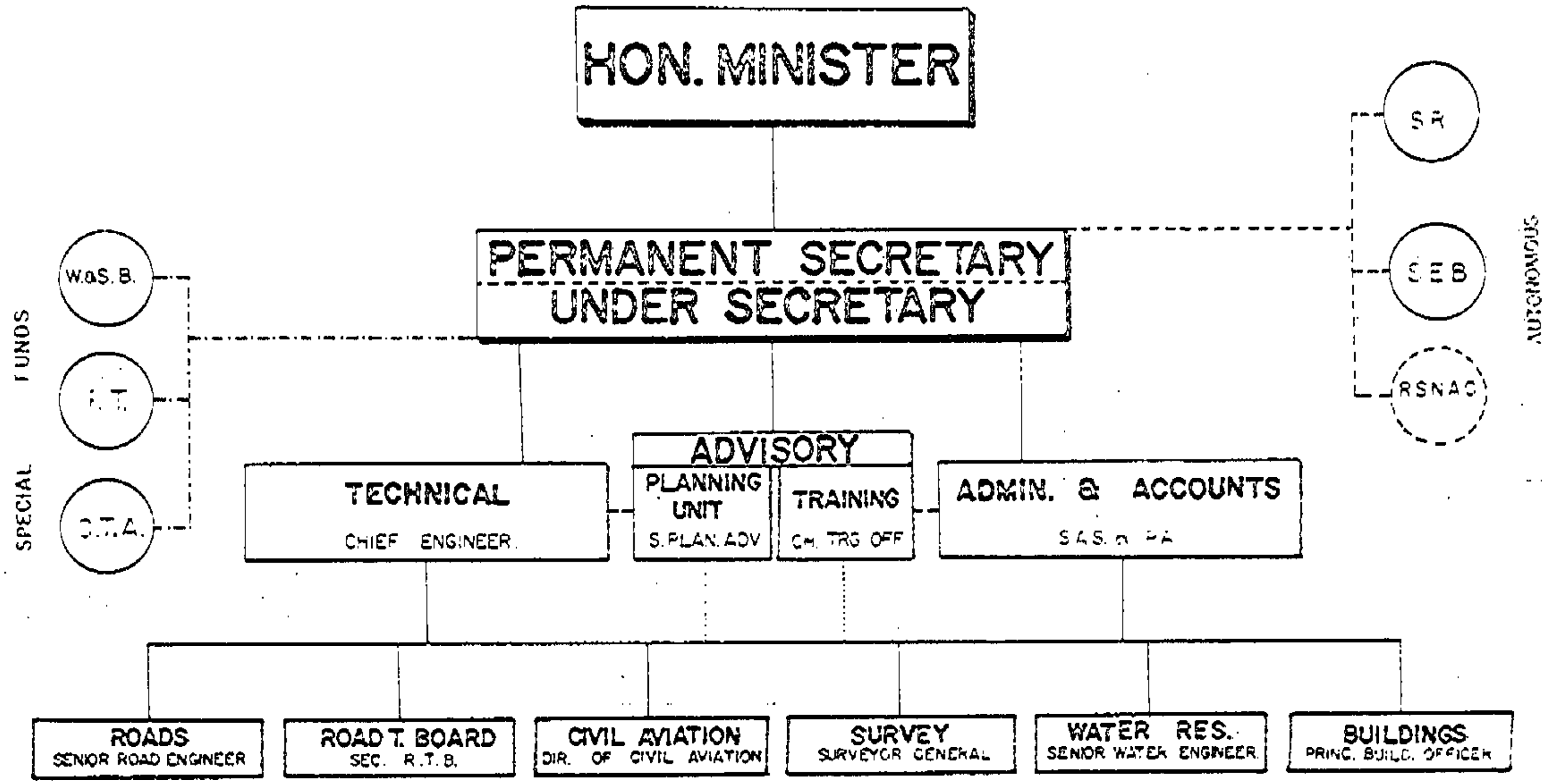
4) Progress Monitoring Committee, whose establishment is recommendable considering the nature and magnitude of the Project, shall comprise the members of such high ranking officials of the Government as the permanent secretaries of the Department of Economic Planning, Ministry of Finance, and MWPC, with the Head of the Civil Service desirably installed as its Chairman. General scope of the functions of the Progress Monitoring Committee shall be to provide all such support necessary to ensure success of the Project as may involve high level governmental decisions, especially in matters

Fig. 9.1 PROJECT IMPLEMENTATION ORGANIZATION CHART

(Within The Ministry of Works, Power and Communications)



MINISTRY OF WORKS, POWER AND COMMUNICATIONS



W.& S. B. Water & Sewerage Board
P.T. Post & Telecommunications
C.T.A. Central Transport Administration

S.R. Swaziland Railway
S.E.B. Swaziland Electricity Board
R.S.N.A.C. Royal Swazi National Airway Corporation

Fig. 9.2 ORGANIZATION CHART OF MINISTRY OF WORKS, POWER AND COMMUNICATIONS