8.4 Evaluation of the Possible New Airport Sites

Possible sites by alternative for new airport development shown in Figs. 8.3.1 through 8.3.3 were assessed and evaluated based on the following considerations:

(i) Aircraft Operations:

- Obstacle limitation surfaces, i.e., approach surface, transitional surface and inner horizontal surface defined in Annex 14, ICAO.

- Possibility of establishing flight procedures such as standard instrument departure, ILS approach, VOR straight-in approach, etc.

- Weather conditions (Wind coverage)
  Meteorological data at Surakarta airport for the Klaten area, and that at Yogyakarta airport for the Wonosari and Bantul areas, were used respectively due to the unavailability of wind data at each selected new airport site.

* Since all the possible new airport sites are located within the training area of existing Yogyakarta airport, the conditions of compatibility with the existing airspace use are considered the same for all sites.

(ii) Airport Development:

- Airport accessibility (access distance and time from/to Yogyakarta and Surakarta cities)

- Compatibility with the road network
  Necessity of the new access road connecting the major existing roads and availability of existing road network was assessed.

- Expansibility for terminal area
  Future expansibility for terminal area was assessed in terms of geographical restriction, existence of villages, and so on.

(iii) Social Factors:

- Aircraft noise influence
  The degree of aircraft noise which affects the major villages and cities was evaluated for the sites and relatively graded.

- Land use
  The compatibility with both present and future land use planned by local governments was taken into account.

- Compensation cost (for relocation of houses required by land acquisition for the new airport)

(iv) Construction Conditions:

- Topography and special measurs to be taken.

- Construction cost (only for the items which will cause big differences among the sites, i.e., land acquisition cost, site preparation cost, etc.)

Table 8.4.1 shows the comparative evaluation of the possible sites for the new airport combining two existing airports, and Table 8.4.2 for the new airport sites to replace the existing Yogyakarta airport. In these tables, "X" indicates greater disadvantage or poorer performance.

Based on this evaluation study, Site K1 was selected among the 3 possible sites (K1 through K3) as the new airport site combining both Yogyakarta and Surakarta airport.

The major reasons for selection are discussed below:

- Both Sites K2 and K3 require a higher construction cost than K1. This is mainly because of higher cost for land acquisition and site preparation works.

- The existing land of K2 is used as a rice field which is an important resource in this region. Therefore, Site K2 is considered an inadequate location from the viewpoint of land use.

- Main disadvantage of Site K1 is poor accessibility from/to Yogyakarta city. However, this is not considered to be an outstanding disadvantage because the maximum difference in access time among the three possible sites is only 15 minutes.

Among the five possible sites (W1 to W3, B1 and B2), Site W1 in the Wonosari area was considered the most feasible site for the airport to replace the existing Yogyakarta airport due to the following reasons:

- Site B2 has a serious disadvantage concerning safe aircraft operations.

- For sites W3, B1 and B2, aircraft noise pollution is anticipated to a great extent compared with Sites W1 and W2.

- Sites W3, B1 and B2 require 1.2 - 1.4 times the construction costs compared with the other sites, which is mainly due to the huge quantity of earthwork to be carried out.

- Comparing sites W1 and W2, W1 is considered superior to W2 in terms of accessibility, construction economy and ease of land acquisition.

Table 8.4.1 Comparative Evaluation of New Airport Sites - Klaten Area

SITE	K1	K2	K3
Location	Tappakkembang (40km Northeast of Yogyakarta, 17km Southwest of Surakarta)	Tegalrejo (38km Northeast of Yogyakarta, 23km Southwest of Surakarta)	Selodaran (28km Northeast of Yogyakarta, 30km Southwest of Surakarta)
Runway Orientation	N 115°E	N 75°E	N 100°E
Airport Elevation	112m	105m	140m
I. AIRCRAFT OPERATIONAL CONSIDERATIONS.			
1. Obstacle Limitation Surfaces			
a. Approach Surface	No obstructions	No obstructions	No obstructions
b. Transitional Surface	No obstructions	No obstructions	No obstructions
c. Inner Horizontal Surface	No obstrucitons	x Obstruction x - Mt. Tugu on the southwest (85m high above the surface). - RRI antenna on the east adjacent to the transitional surface.	x Obstructions - Mt. Tugu, Mt. Kebo and Mt. Konang on the South.
2. Possibility of Establishing Flight Procedures			
a. Standard Instrument Departures.	Possible for both directions without any terrain constraints.	Same as left	Same as left
b. ILS Approach	Possible from east direction without any terrain constraints.	Same as left	Same as left
c. VOR/DME straight-in approach	Possible for both directions without any terrain constraints.	Same as left	Same as left
3. Weather			
a. Wind Coverage (based on the wind data at Surakarta Airport)	99.7% (20kt cross wind) 98.4% (13kt cross wind)	99.8% (20kt) 98.5% (13kt)	99.7% (20kt) 98.3% (13kt)
MAIN DISADVANTAGES OF THE SITE.		x Circling limited to x northside only..	x Circling limited to northsdie only.

Table 8.4.1 (Cont'd)

SITE	K1	K2	K3
II. AIRPORT DEVELOPMENT CONSIDERATIONS.			
1. Airport Accessibility			
a. From/to Yogyakarta city	x 47km (60 min.)	42km (50 min.)	35km (45 min.)
b. From/to Surakarta city	29km (35 min.)	36km (45 min.)	42km (50 min.)
2. Compatibility with Road Network	New access road of 5km to be constructed.	New access road of 1km to be constructed.	New access road of 5km to be constructed.
3. Expansibility of Terminal Area	Ample space for future extension.	Same as left	Relocation of houses to be required for future extension.
MAIN DISADVANTAGE OF THE SITE.	x Far from Yogyakarta city compared with the sites K2 and K3.	No problems	No problmes
III. SOCIAL CONSIDERATIONS			
1. Aircraft Noise	Several villages will be affected by aircraft noise	Same as left	Same as left
2. Land Use			
a. Existing Land Use	Formerly there was a military air strip at the airport site. The existing land is well cultivated as crop filed.	x All of the existing land is used as rice field.	Most of the existing land is underdeveloped, partially used as coconut plantation.
b. Compatibility with Future Land Use Plan	Future Land Use Plan not available.	Same as left	Same as left
3. Compensation Cost			
a. Relocation cost for houses in the new airport property area	(0) houses x (Mil. Rp. 1.0)/house = (Rp. 0)	(8) houses x (Mil. Rp. 1.0)/house = (Mil. Rp. 8.0)	x (70) houses x x (Mil. Rp. 1.0)/house = (Mil. Rp. 70.0)
MAIN DISADVANTAGES OF THE SITE.	No problems	x Rice field is important resouce in this region. Inadequate location from the view point of land use.	x Compensation for relocation of houses is costly x compared with the sites K1 and K2.
IV. CONSTRUCTION CONSIDERATIONS			
1. Topography and Special Measures to be taken.		Existing 3-4 irrigation channels to be diverted. Pavement subgrade will be 1m above the existing ground level in paddy rice field area.	Maximum difference in elevation is 25m in the airport property area.

Table 8.4.1 (Cont'd)

SITE	K1	K2	K3
2. Estimated Construction Cost of Civil Works (Unit : million Rp.)			
- Land Acquistion	8,059	17,655	11,275
- Compensation (Refer III.3.a)	0	8	70
- Site preparation (Earthwork Volume)	8,290 (1.0 mil. m^3)	13,200 (0.7 mil. m^3)	21,683 (3.0 mil. m^3)
- Pavement	19,461	23,514	19,461
- Access Road	1,620	210	1,050
Total	37,430	54,587	53,539
MAIN DISADVANTAGES OF THE SITE.		x Construction cost is highest.	

Table 8.4.2 Comparative Evaluation of New Airport Sites - Wonosari and Bantul Areas

SITE	W 1	W 2	W 3	B 1	B 2
Location	Gading (28 Km Southeast of Yogyakarta, 44 Km Southwest of Surakarta)	Djeruk (32 Km Southeast of Yogyakarta, 49 Km Southwest of Surakarta)	Wareng (30 Km Southeast of Yogyakarta, 55 Km Southwest of Surakarta)	Kentolan (10 Km southwest of Yogyakarta, 66 Km Southwest of Surakarta)	Ngrandu (15 Km southwest of Yogyakarta, 72 Km southwest of Surakarta)
Runway Orientation	N 110° E	N 100° E	N 70° E	N 20°E	N 140°E
Airport Elevation	200 m	190 m	175 m	120 m	60 m
I. AIRCRAFT OPERATIONAL CONSIDERATIONS 1. Obstacle Limitation Surfaces a. Approach Surface.	No obstructions	No obstructions	No obstructions	No obstructions	x x Obstruction - Mountainous terrain on the the northwest (110 m high above the surface)
b. Transitional Surface	No obstructions	No obstructions	No obstructions	No obstructions	No obstructions
c. Inner Horizontal Surface	No obstructions	No obstructions	No obstructions	No obstructions	No obstructions
2. Possibility of Establishing Flight Procedures. a. Standard Instrument Departures.	Possible for both directions without any terrain constraints.	Same as left	Same as left	Same as left	Possible for SE direction without any terrain constraints. Possible for NW direction turning to the right/left within 3 NM
b. ILS Approach	Possible from east direction without any terrain constraints.	Same as left	Same as left	Possible from north direction without any terrain constraints.	x x Impossible from NW direction due to the mountainous terrain on the NW.
c. VOR/DME straight-in Approach	Possible from both directions without any terrain constraints.		Same as left		x Possible from SE direction. Impracticable from NW direction due to the mountainous terrain.
3. Weather a. Wind Coverage (based on the wind data at Yogyakarta Airport)	99.8 % (20 kt cross wind) 97.5 % (13 kt cross wind)	99.8 % (20 kt) 97.7 % (13 kt)	99.8 % (20 kt) 98.4 % (13 kt)	99.8 % (20 kt 98.2 % (13 kt	99.8 % (20 kt) 98.6 % (13 kt)

Table 8.4.2 (Cont'd)

SITE	W 1	W 2	W 3	B 1	B 2
MAIN DISADVANTAGES OF THE SITE	No problems	No problems	No problems	No problems	x x x x x Impossible from safe aircraft operational view point
II. AIRPORT DEVELOPMENT CONSIDERATIONS 1. Airport Accessibility a. From/to Yogyakarta city	30 Km (40 min.)	37 Km (45 min.)	x 41 Km (50 min.)	13 Km (20 min.)	23 Km (35 min.)
b. From/to Surakarta city	69 Km (85 min.)	63 Km (80 min.)	67 Km (85 min.)	79 Km (95 min.)	89 Km (105 min.)
2. Compatibility with Road Network	x New access road of 1 Km to be constructed. Some 10 Km of existing road on the mountainous terrain to be diverted in order to secure adequate radious of curvature.	x New access road of 1 Km to be constructed. x Same as left	x New access road of 5 Km to be constructed. x Same as left	New access road of 3 Km to be constructed.	x New access road of 4 Km to be constructed. The existing bridge over Progo river to be widened.
3. Expansibility for Terminal Area	Ample space for future expansion.	Same as left	Same as left	Same as left	Same as left
MAIN DISADVANTAGE OF THE SITE	x	x	x Far from Yogyakarta city compared with the other sites. x		x
III. SOCIAL CONSIDERATIONS 1. Aircraft Noise	Southeastern villages will be affected by aircraft noise.	Both southeastern and northwestern villages will be affected.	x Wonosari town will be directly affected. x	x Yogyakarta city will be affected by aircraft noise x	x Villages along the Progo river on the southeast will be directly affected. x
2. Land Use a. Existing Land Use	The existing land use at the airport site consists of air strip now occasionally in use by Indonesian Air Force and well developed crop field.	Most of the existing land is underdeveloped.	The existing land was well cultivated as crop field during the period of PELITA III.	Most of the existing land at the airport site is underdeveloped.	Training area for trans-migration (National Plan)
b. Compatibility with Future Land Use Plan	Simple irrigation plan in REPELITA IV.	No future plan in REPELITA IV.	Same as left	Same as left	Irrigation plan in REPELITA IV.

Table 8.4.2 (Cont'd)

SITE	W 1	W 2	W 3	B 1	B 2
3. Compensation Cost. a. Relocation cost for houses in the new airport property area.	(4) houses x (mil. Rp. 1.0)/house =(mil. Rp. 4.0)	(15) houses x (mil. Rp. 1.0)/house =(mil. Rp. 15.0)	(2) houses x (mil. Rp. 1.0)/house =(mil. Rp. 2.0)	(1) house x (mil. Rp. 1.0)/house =(mil. Rp. 1.0)	x (25) house x (mil. Rp. 1.0) =(mil. Rp. 25.0)
MAIN DISADVANTAGES OF THE SITE.			x Inadequate location from the viewpoint of aircraft noise.	x Same as left	x Inadequate location from the viewpoint of aircraft noise. x Compensation cost for relocation of houses is highest.
IV. CONSTRUCTION CONSIDERATIONS 1. Topography and Special Measurement to be taken	The soil at the site will be composed of hard limestone under thin topsoil.	Same as left	Same as left Box culvert is necessary for the river across the eastern end of runway	The soil at the site will be composed of fragile limestone.	Same as left Max. height of Approach Lighting System : 20 m
2. Estimated Construction Cost of Civil Works (unit: Million Rp.)					
-Land Acquisition	9,225	11,275	11,275	9,625	10,650
-Compensation (Refer III.3.a.)	4	15	2	1	25
-Site Preparation (Earthwork Volume)	11,231 ($1.2mil.m^3$)	11,633 ($1.5mil.m^3$)	16,323 ($2.2mil.m^3$)	25,703 ($3.6mil.m^3$)	23,693 ($3.3mil.m^3$)
-Pavement	17,651	17,651	17,651	17,651	17,651
-Access Road	3,880	3,880	4,720	630	840
Total	41,991	44,454	49,971	53,610	52,859
MAIN DISADVANTAGES OF THE SITE				x Construction cost is the highest	

CHAPTER 9 ESTABLISHMENT OF ALTERNATIVE CONCEPTS FOR AIRPORTS DEVELOPMENT

CHAPTER 9 ESTABLISHMENT OF ALTERNATIVE CONCEPTS FOR AIRPORTS DEVELOPMENT

Seven alternatives have been listed for the airport development concepts in this Study area, i.e., Central Java and D.I. Yogyakarta, as described in Chapter 6.

Among these concepts, Concepts A, C and F were considered to be viable for further study based on the following reasons:

- As the result of study in Chapter 5, "Evaluation of Existing Airport" and Chapter 7, "Redevelopment Plans of Existing Airports", it was revealed that the existing Surakarta airport can easily be redeveloped without any major problems, thus, the new airport to replace the existing airport is not considered necessary.

  Therefore, Concepts B and D which involve the new airport for Surakarta are considered inadequate.

- Concept-E, in which all airport function concerning civil air transport at the existing Surakarta airport will be transferred to the existing Yogyakarta airport, is considered neither economical due to the easy expansibility of Surakarta airport, nor preferable to the passengers who utilize the existing Surakarta airport at present.

- Concept-G is the opposite of Concept-E. All of the airport functions at Yogyakarta airport concerning civil air transport will be transferred to the existing Surakarta airport in Concept-G. This Concept is also considered inadequate for further study, because the air traffic demand as well as the potential as a tourist resort obviously centers on Yogyakarta city.

Therefore, the following Concepts together with the results of Chapter 8, "Site Selection of New Airports" will be further studied as the concepts for airports development in Central Java and D.I. Yogyakarta:

Table 9.1.1 Selected Alternative Concept of the Airports Development for Detailed Study

Airport / Development Concept	Yogyakarta		Surakarta		Semarang
	Redeve-lopment	New Airport	New Airport	Redeve-lopment	Redeve-lopment
Concept-A	X (Y4)			X (S1)	X
Concept-C		X (W1) Wonosari Area		X (S1)	X
Concept-F	X (K1) Klaten Area				X

Note: "X" indicates development policy in each concept.

CHAPTER 10 PRELIMINALY PLANNING FOR THE ALTERNATIVE AIRPORTS DEVELOPMENT CONCEPTS

CHAPTER 10 PRELIMINARY PLANNING FOR THE ALTERNATIVE AIRPORTS DEVELOPMENT CONCEPTS

10.1 General

This chapter describes the preliminary planning for each airport development plan which constitutes the alternative concepts selected in previous Chapter 9. The results of this study are reflected on the comparative evaluation in the following Chapter 11.

The study was made for the long-term development plan with the target year of 2010, and the study items are as follows:

- Preliminary airport layout and facilities planning
- Preliminary estimates of aircraft noise influence
- Preliminary construction cost estimates
- Economic analysis

The location of airports is summarized in Fig. 10.1.1, except for Semarang airport which is excluded from this preliminary study.

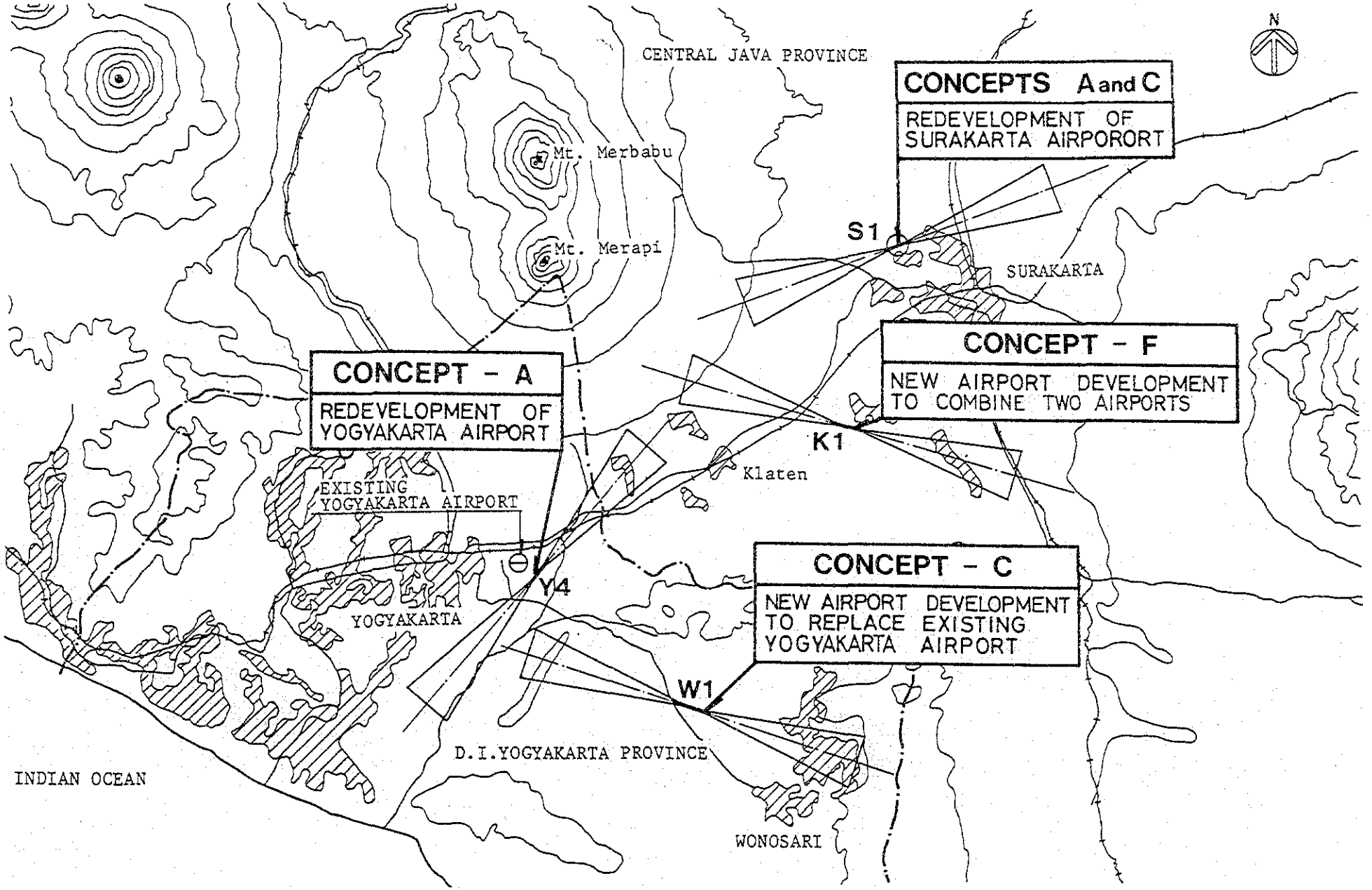

Fig. 10.1.1 Location of Airports in Alternative Concepts

10.2 Outline of Selected Alternatives

10.2.1 Redevelopment Plan of Yogyakarta Airport (Y4)

Fig. 10.2.1 shows the preliminary airport layout plan of ALT. Y4 in Concept-A.

In the selected redevelopment plan of Yogyakarta airport (Y4), a new 2,500 m long runway is laid out in the adjacent area on the southwest of the existing airport property area.

Runway direction was set at an angle of about 45° with the existing runway. Wind coverage is more than 99 % at a crosswind speed of 20 kt. There are no obstacles except for some trees on the approach and take-off climb surfaces for both runway ends.

Proposed site is mainly used for agricultural and residential purposes. Tepus River, about 10 m wide and 3 m depth, which supplies the surrounding rice field with irrigational water at present, and passes through the new airport site, will be diverted as an open channel.

The terminal area was planned at the west of the new runway, that is, in-between both new and existing runways, providing for the possibility of utilization of the existing runway together with the new runway for civil use in the distant future.

Air navigation aids were planned to meet the aircraft operational category, viz., precision approach CAT-I.

ILS and approach lighting system were provisionally planned for the Runway 22 approach, since the prevailing wind direction is southwest. Main approach direction will be carefully studied in the Feasibility Study stage taking into account the air route structures and the prevailing wind direction under the meteorological conditions below weather minima.

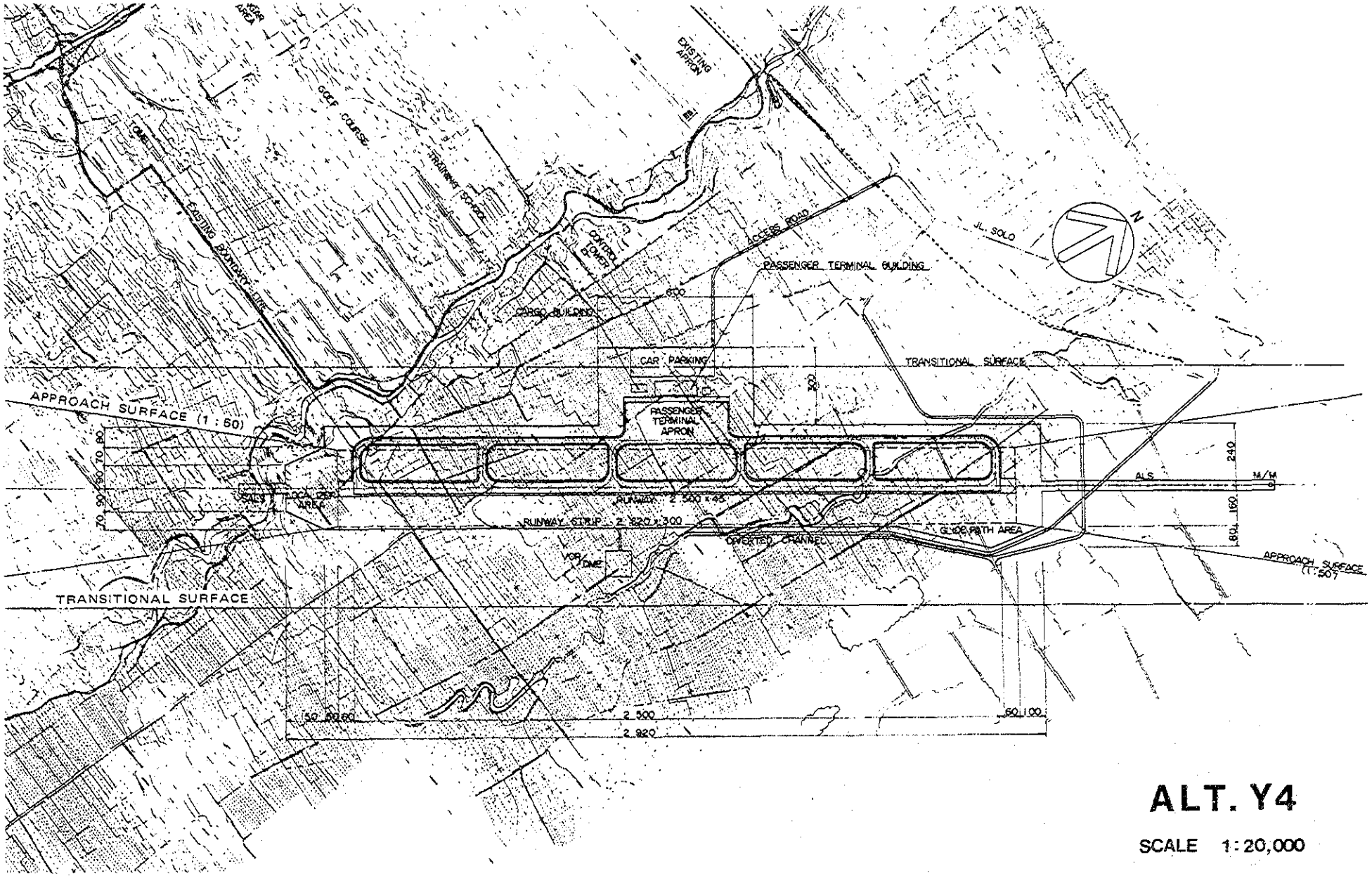

Fig. 10.2.1 Airport Layout Plan - Yogyakarta Airport

10.2.2 Redevelopment Plan of Surakarta Airport (S1)

The redevelopment plan of Surakarta airport mainly consists of the extension of the existing runway and the relocation of the terminal area.

A runway was planned to be extended up to 2,150 m. A river forms a deep valley on the southwest of the airport. Thus, Runway 08 threshold is to be displaced to the east as shown in Fig. 10.2.2 so as to ensure the localizer area and to avoid a great volume of earthwork.

A terminal area will be located on the opposite side of the existing terminal area because of insufficient space for expansion at the existing location. A passenger terminal apron was planned to accommodate B-767/A310 class jet aircraft and other smaller types in the year 2010 by utilizing the existing transmigration apron.

The access road will be constructed along the east boundary of the airport and connected to the existing road to Surakarta city.

Air navigation aids were planned to meet the aircraft operational category, precision approach CAT-I. ILS and approach lighting system were planned for the Runway 26 approach.

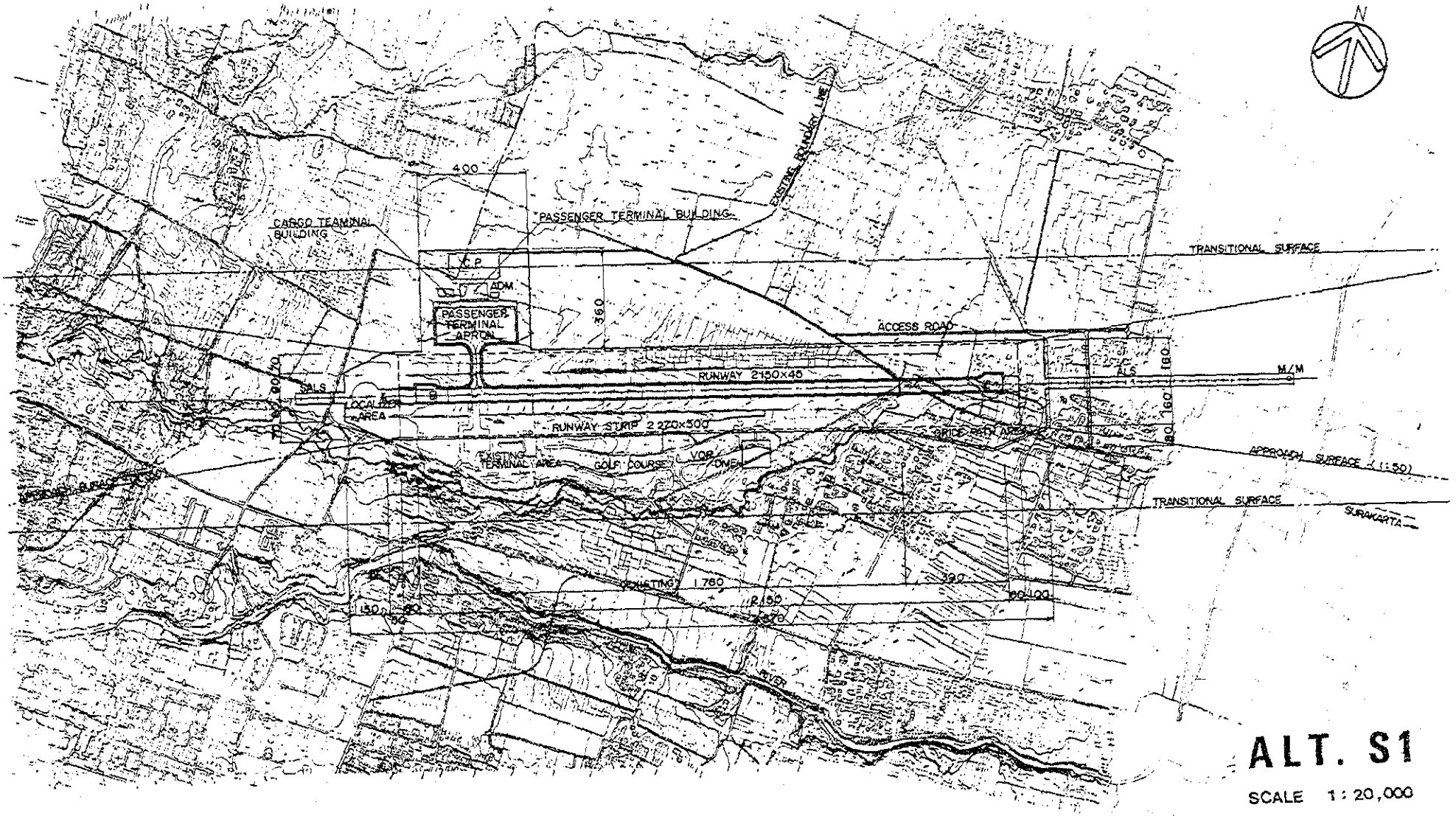

Fig. 10.2.2 Airport Layout Plan - Surakarta

10.2.3 New Airport Development Plan for Yogyakarta Airport (W1)

Preliminary layout plan of new airport in Wonosari (W1), which is planned to replace the existing Yogyakarta airport, is shown in Fig. 10.2.3.

As explained in Chapter 8, the proposed site is used partly for an airstrip by Indonesian Air Force, and partly as a crop field. Some villages are scattered around the proposed site. The new runway and a terminal area will, therefore, be located so as to avoid these villages.

Runway direction was set at N 110° E. Wind coverage is more than 99 % at the crosswind speed of 20 kt. There are no obstructions which protrude upon the obstacle limitation surfaces.

A passenger apron which can accommodate the wide-body jets and other smaller type aircraft was planned to be located at the south of the runway.

Approximately a 1 km long access road will be constructed to connect the terminal area to the existing Yogyakarta - Wonosari trunk road. In addition, some 10 km of the existing Yogyakarta - Wonosari road is to be upgraded with respect to a horizontal alignment for the portion of mountain side.

Air navigation aids were planned to meet the aircraft operational category, precision approach CAT-I. ILS and approach lighting system were planned for the Runway 29 approach.

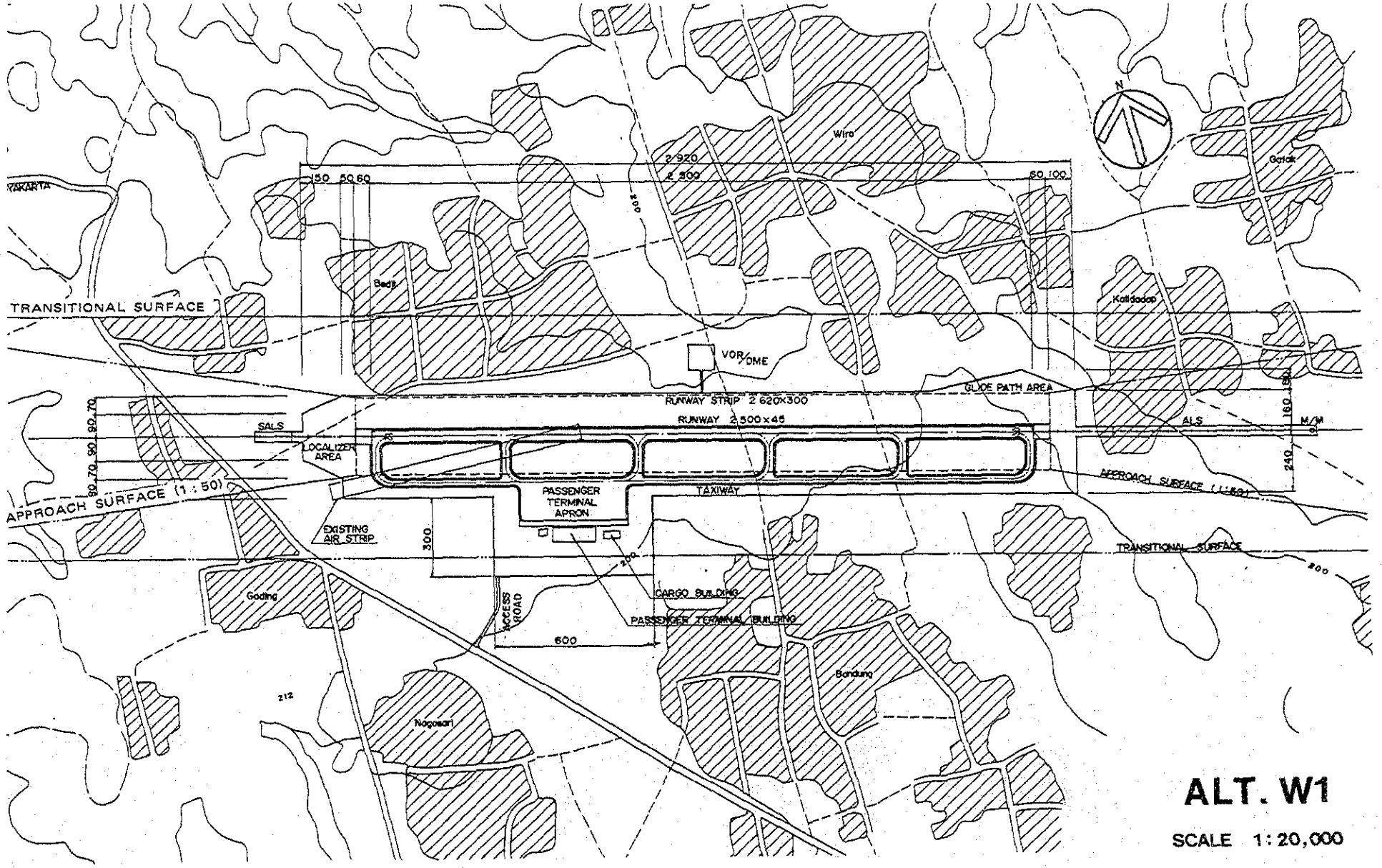

Fig. 10.2.3 Layout Plan of New Yogyakarta Airport - Wonosari

10.2.4 New Airport Development Plan (K1)

The new airport site is located in Klaten at a distance of 5 km from the Yogyakarta-Surakarta road (Solo road). Existing land use of the new site is a crop field where a military airstrip was located formerly. Small villages are scattered around the site.

Runway direction is nearly east-west and wind coverage is more than 99 % at a crosswind speed of 20 kt. There are no obstructions to obstacle limitation surfaces.

The new runway is 2,500 m in length with a parallel taxiway as shown in Fig. 10.2.4. A terminal area is located on the south of the runway in order to avoid the residential areas, and connected to the existing road by a new access road of which length is about 300 m. The existing road between Solo road and the new access road is to be widened and upgraded.

A passenger apron was planned to accommodate four B-747s and other smaller type aircraft.

Air navigation aids were planned to meet the aircraft operational category, precision approach CAT-I. ILS and approach lighting system were planned for the Runway 30 approach.

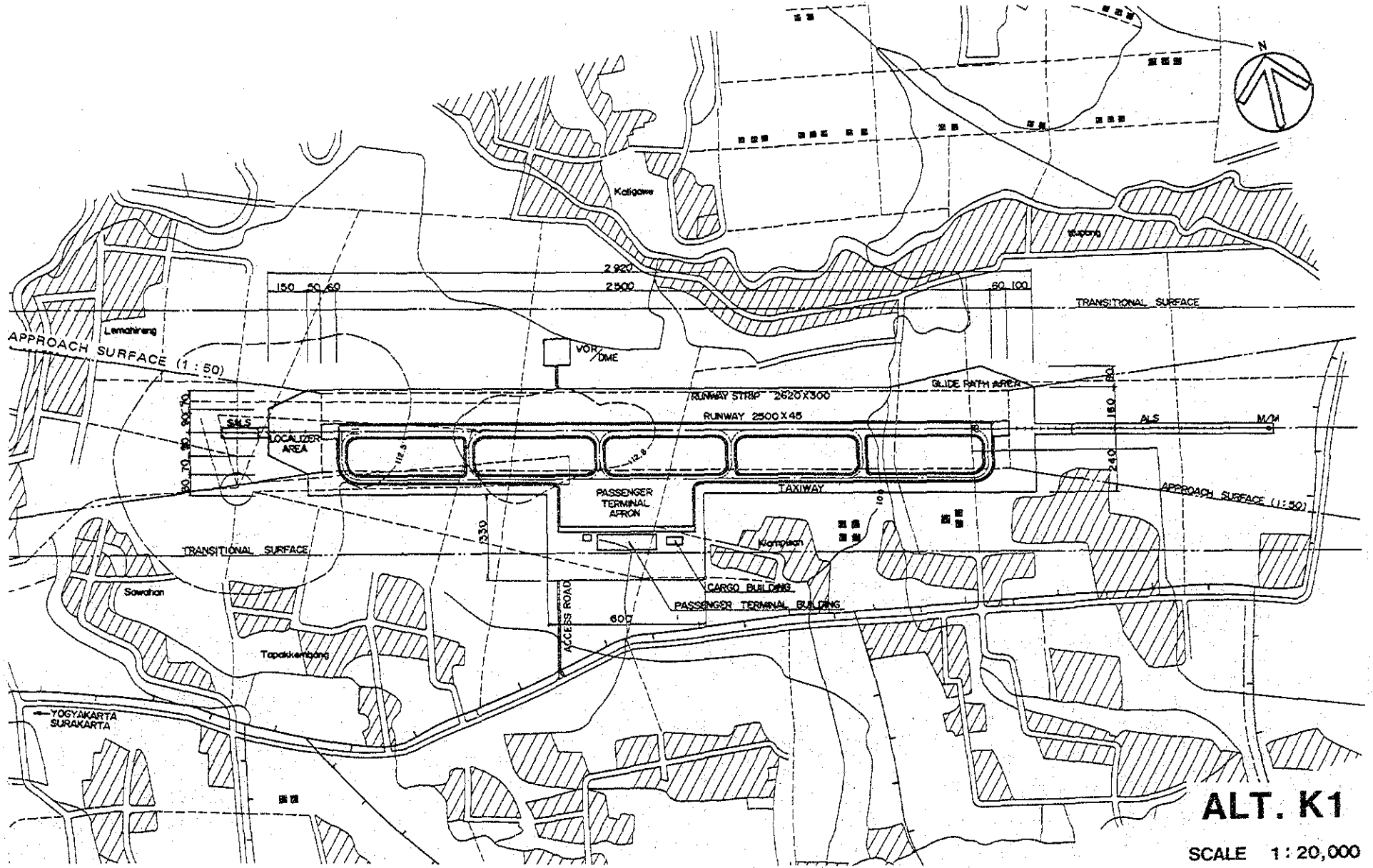

Fig. 10.2.4 Layout Plan of New Airport - Klaten

10.3 Aircraft Noise Influence

In order to compare the environmental impact, aircraft noise was calculated and its influence was analyzed and evaluated for each alternative.

The aircraft noise was calculated in WECPNL (Weighted Equivalent Continuous Perceived Noise Level) which is basically obtained from ECPNL defined by ICAO and applied in Japan for aircraft noise evaluation.

The following figures indicate the respective aircraft noise contours estimated in the year 2010, based on the anticipated aircraft movements, flight tracks, noise levels by aircraft type, etc. (As for Semarang airport, refer to Appendix I-10)

Fig. 10.3.1	Yogyakarta airport	(ALT. Y4)
Fig. 10.3.2	Surakarta airport	(ALT. S1)
Fig. 10.3.3	New Yogykarta airport	(ALT. W1)
Fig. 10.3.4	New Airport	(ALT. K1)

The area covered by noise contour WECPNL 70, where is not considered suitable for comfortable living and community services, such as hospitals, schools, etc., is the largest in ALT. K1. This is mainly because the large aircraft like B-747s are to be introduced to handle the total air traffic demand of both Yogyakarta and Surakarta airports with one airport.

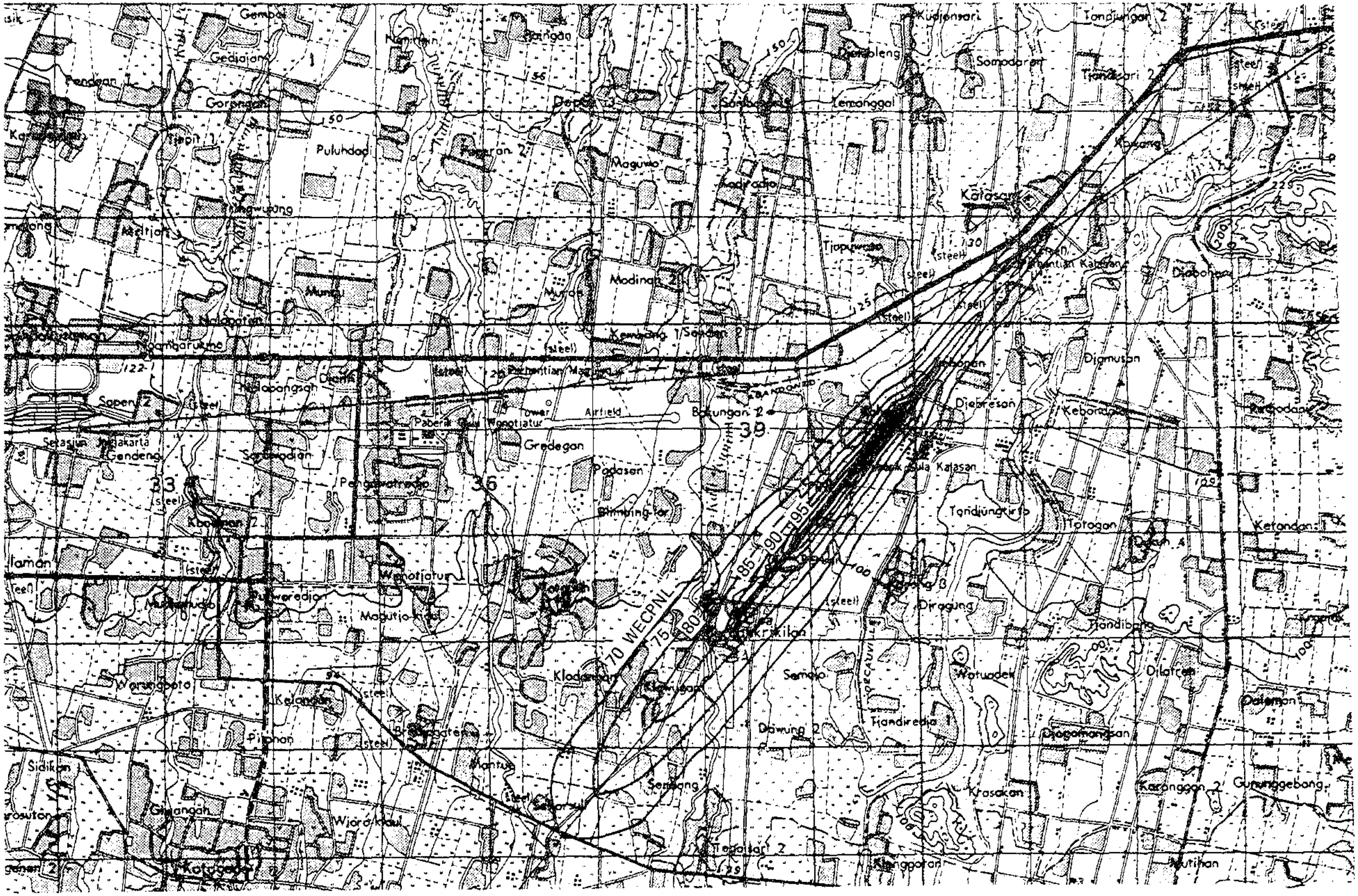

Fig. 10.3.1 Area Affected by Aircraft Noise in ALT. Y4 S = 1:50,000

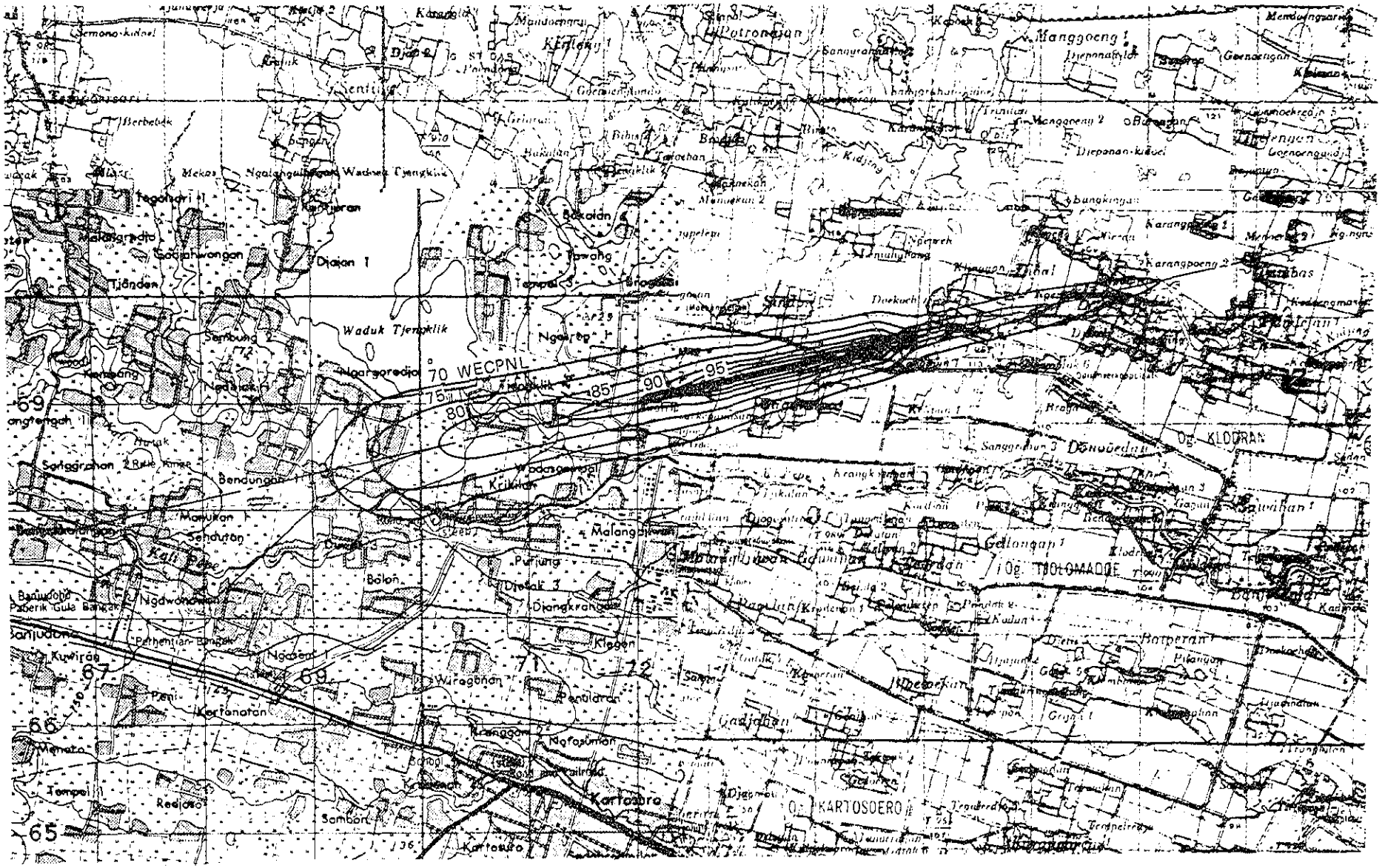

Fig. 10.3.2 Area Affected by Aircraft Noise in ALT. S1 S = 1:50,000

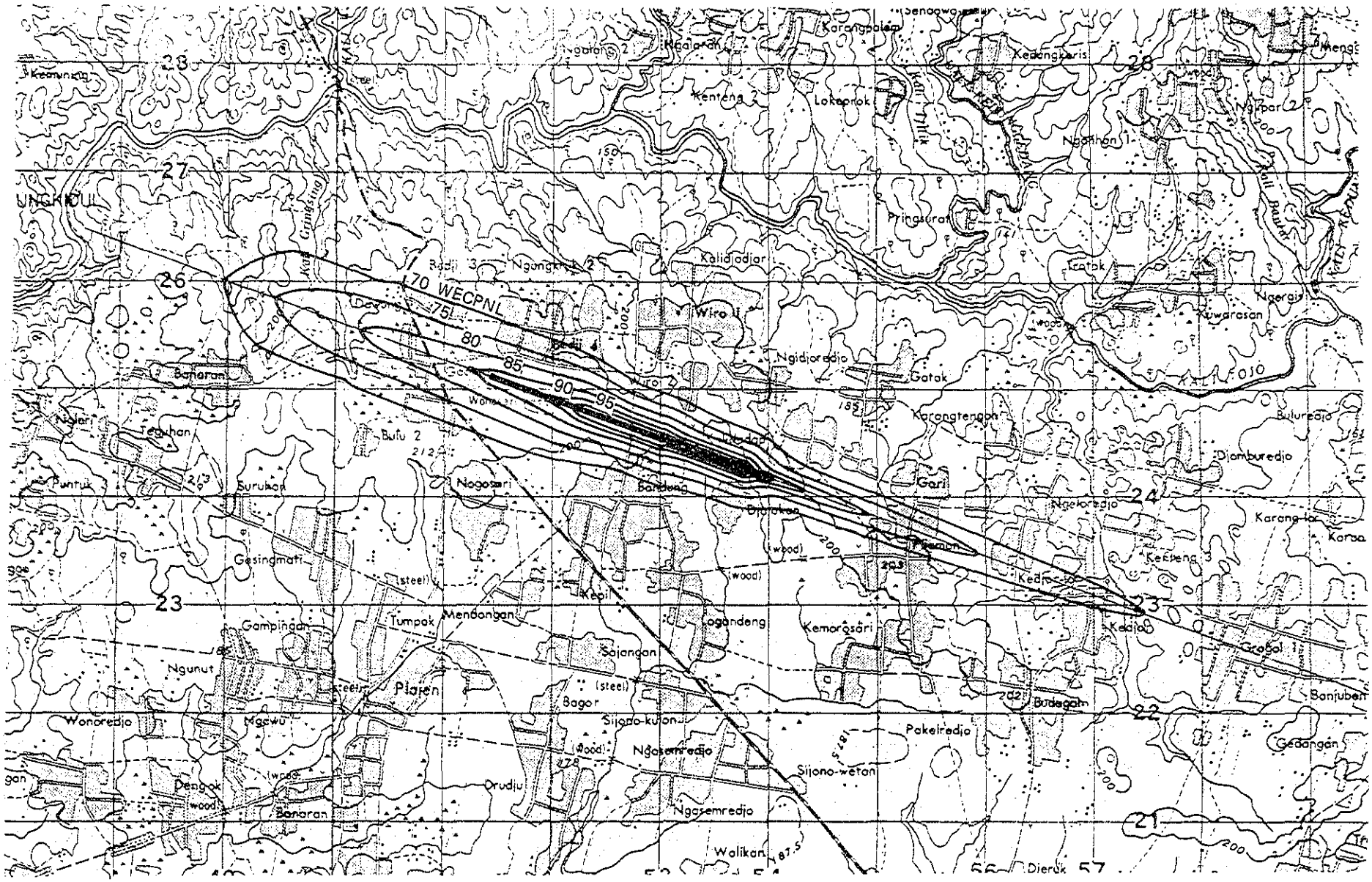

Fig. 10.3.3 Area Affected by Aircraft Noise in ALT. W1 S = 1:50,000

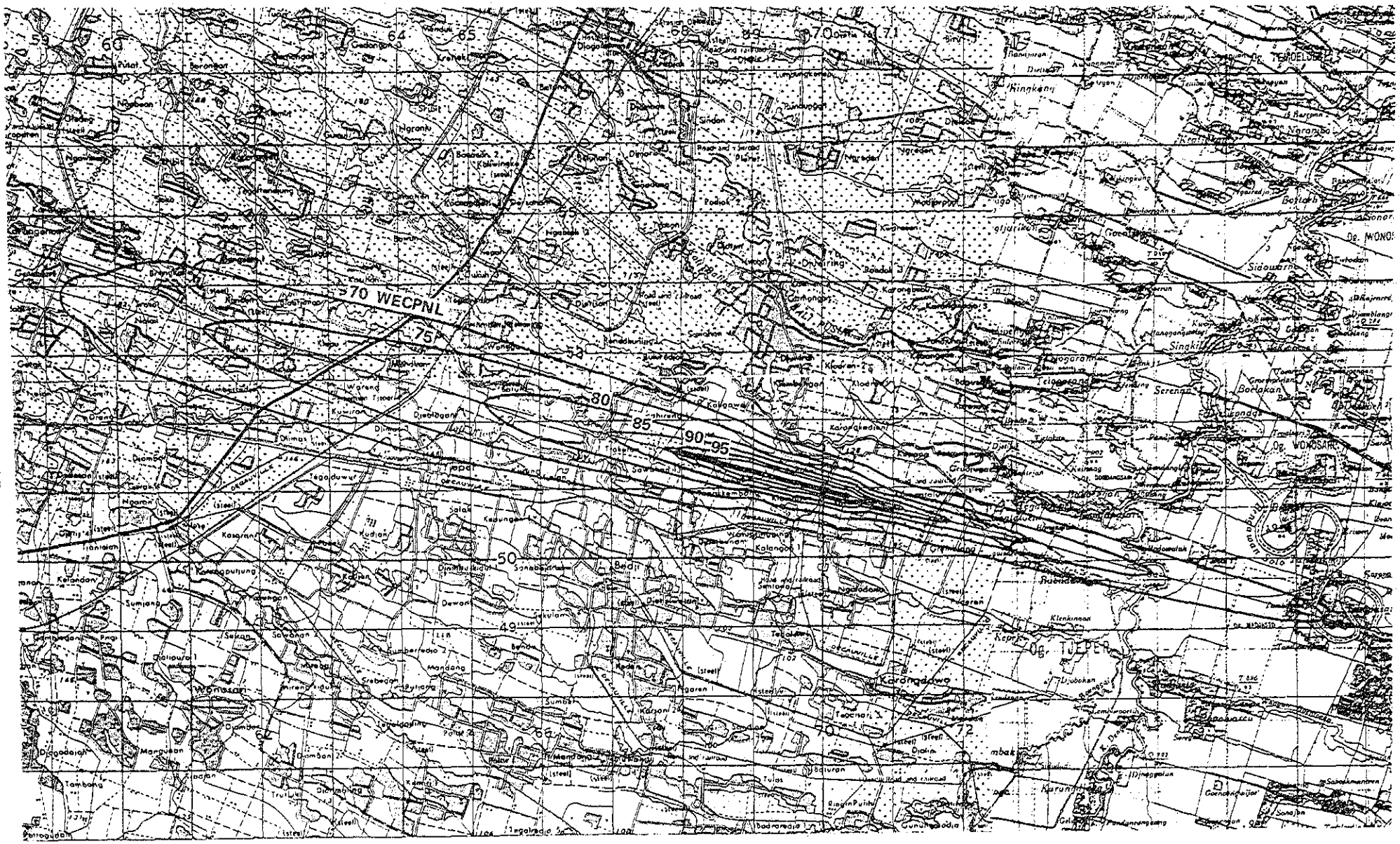

Fig. 10.3.4 Area Affected by Aircraft Noise in ALT. K1 S = 1:75,000

10.4 Preliminary Construction Cost Estimates

Construction costs of the selected alternatives were estimated as shown in Table 10.4.1 based on the following assumptions:

- Unit prices are based on the data and information collected in Indonesia by the Study Team.

- Exchange rates are set at US$ 1.00 = Rp. 1,125 = ¥ 200.

Cost of Rp. 11,844 million for upgrading existing road between Klaten and Yogyakarta was not included in the construction cost for Concept-F.

Table 10.4.1 Estimated Construction Costs

(unit: million Rp.)

Items \ Concept		Concept - A			Concept - C			Concept - F
		Y4	S1	Sub Total	W1	S1	Sub Total	K1
Land Acquisition		13,594	1,789	15,383	9,225	1,789	11,014	8,059
House Relocation		280	60	340	4	60	64	-
Civil Works	Site Preparation	6,100	2,317	8,417	11,231	2,317	13,548	8,290
	Pavement	20,560	9,341	29,901	17,651	9,341	26,992	19,461
	Access Road	745	822	1,567	3,880	822	4,702	1,620
	Sub Total	27,405	12,480	39,885	32,762	12,480	45,242	29,371
Architectural Works	Buildings	16,893	7,710	24,603	16,893	7,710	24,603	22,806
	Special Equipment	5,415	1,492	6,907	5,415	1,492	6,907	5,963
	Sub Total	22,308	9,202	31,510	22,308	9,202	31,510	28,769
Air Navigation Aids Works		34,792	19,504	54,296	34,792	19,504	54,296	34,792
Utilities Works		4,454	4,368	8,822	4,454	4,368	8,822	6,057
TOTAL		102,833	47,403	150,236	103,545	47,403	150,948	107,048

10.5 Economic Analysis

10.5.1 General

The objective of the economic analysis is to identify and estimate the economic costs and benefits arising from a project and compare them to assess the net contribution to the national economy.

Since the economic analysis made in this section is used to evaluate and compare the selected 3 alternative airports development concepts, Concepts A, C and F, the economic costs and benefits are considered the total of those arising from the respective airport projects which constitute each concept.

10.5.2 Methodology

The economic analysis is to be made by comparing costs and benefits in the situation "With Project" with those "Without Project (WOP)". This is to measure additional benefits to the national economy which will be realized by investing and utilizing additional resources.

As concluded in Chapter 5, it is estimated that the existing Yogyakarta airport will be saturated in 1994 and Surakarta airport in 1993, respectively. It is, therefore, assumed that in the WOP case, the passenger traffic at Yogyakarta airport will remain constant after 1995, and Surakarta after 1994.

Although economic costs and benefits in the economic analysis have to be valued at economic prices, financial prices were used in this analysis because the study simply aims at the relative priority of each alternative.

The economic evaluation in this study was made by the following 2 indicators:

a) Economic Internal Rate of Return (EIRR)

EIRR is defined as the discount rate (r) which will realize the following equation.

$$\sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} = 0$$

where,

n : Time span for project evaluation

CF_t : Cash flow in year (t), $CF_t = B_t - C_t$

B_t : Social benefit in year (t)

C_t : Social cost in year (t)

r : Discount rate

A project will be judged feasible when the EIRR exceeds the opportunity cost of capital.

b) Net Present Value (NPV)

NPV is defined as the difference of the present value of benefits and that of costs.

$$NPV = \sum_{t=1}^{n} \frac{CF_t}{(1+r_o)^t}$$

where,

r_o : Opportunity cost of capital
(It was set at 12 % in this study based on the other airport projects in Indonesia.)

A project will be judged feasible when NPV is a positive number.

Both for EIRR and NPV, the time span for project evaluation and the depreciation period were assumed to be 25 and 40 years, respectively.

10.5.3 Social Costs

The social costs consist of construction cost, and operation and maintenance costs.

The construction cost is composed of the following items.

- Land Acquisition
- Compensation
- Civil Works
  - Site Preparation, Pavement, Access Road
- Architectural Works
  - Buildings, Special equipment
- Air Navigation Aids Works
- Utilities Works

These costs including the renewal cost for navigational aids are shown in Table 10.4.1. They were split into a yearly basis taking into consideration the expected construction schedule.

The operation and maintenance costs are composed of the followings.

- Operation Cost
  - Personnel, Materials, Utilities
- Maintenance Cost
  - Civil and Architectural Facilities
  - Equipment

The operation and maintenance costs in the "With Project" were estimated in this item. Hence, those in WOP case are defined as the benefits as explained hereafter.

It is noted the operation and maintenance costs related to the air force academy training were excluded from this estimate.

10.5.4 Social Benefits

Various items are considered for the social benefits as listed below.

Only the direct and tangible benefits were measured in this analysis. Each item and its estimation procedure are explained briefly hereafter.

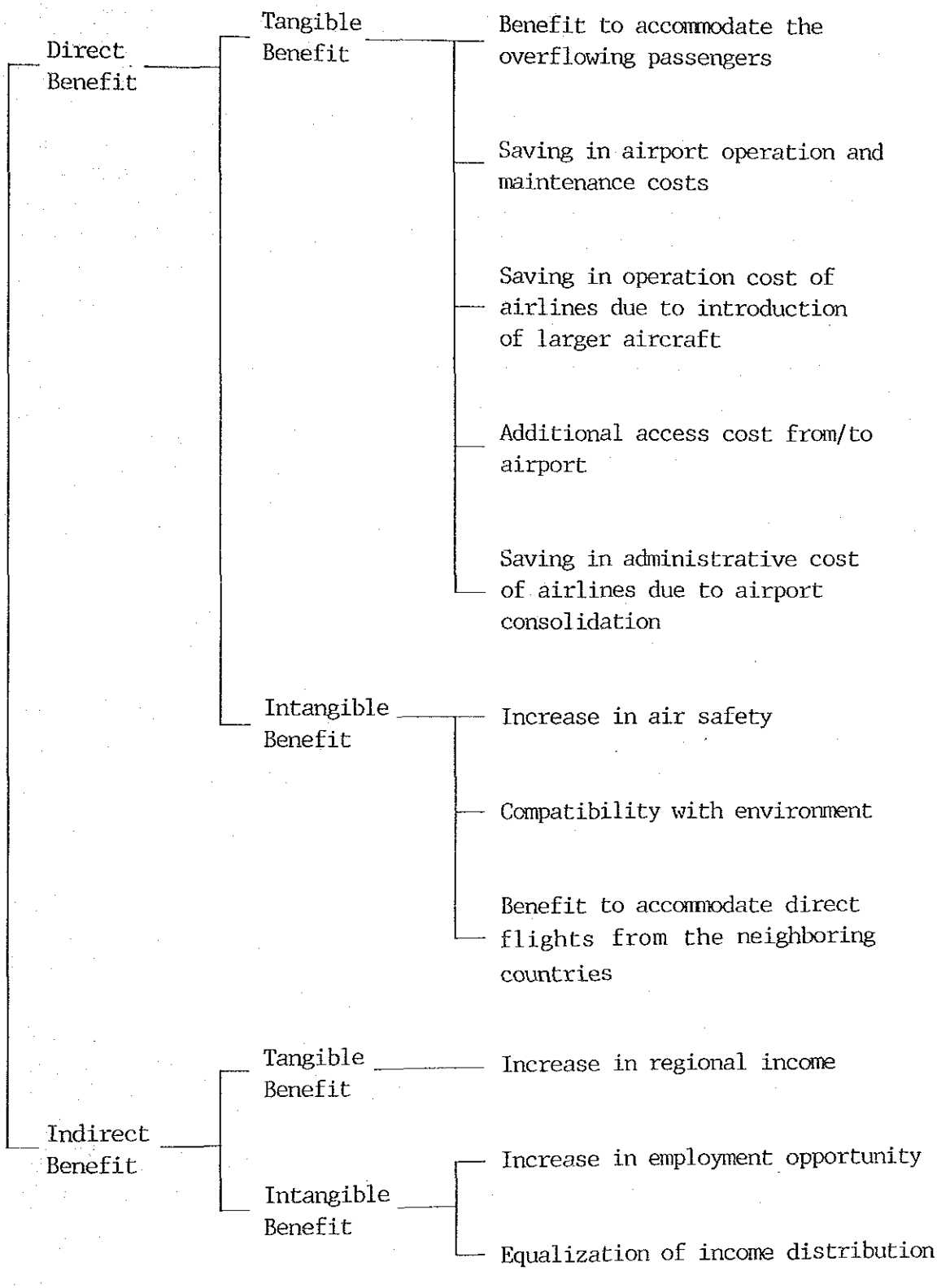

Fig. 10.5.1 Benefits of the Project

The benefit from cargo traffic was neglected because its amount is supposed to be negligibly small.

(1) Benefit to Accommodate the Overflowing Passengers

The projected passenger traffic will exceed the capacities of existing Yogyakarta and Surakarta airports after 1995 and 1994, respectively. Hence, the passengers which exceed the capacity cannot enjoy the air transport service in WOP case, and are supposed to be diverted to other means of transportation.

This benefit was estimated as follows:

$$BOP_t = \sum_i OVIP_{ti} \cdot \{ VT_t \cdot (BST_i - AT_i) + (BSF_i - AF_i) \}$$

where,

BOP_t : Benefit to accommodate the overflowing passengers in year (t)

$OVIP_{ti}$: Overflowing passengers in year (t) on route (i) (Indonesians only)

VT_t : Average time value of overflowing air passengers in year (t)

BST_i : Trip time by bus and/or ship on route (i)

AT_i : Trip time by aircraft on route (i)

BSF_i : Bus and/or ship charge on route (i)

AF_i : Airfare on route (i)

(2) Saving in Airport Operation and Maintenance Costs

Since the operation and maintenance costs in the "With Project" case were measured as costs in previous section, that in the WOP case will arise as a benefit.

(3) Saving in Operation Cost of Airlines due to Introduction of Larger Aircraft

In "With Project" case, airlines will be able to introduce larger-size aircraft. As a result, the operation cost per passenger which includes personnel, fuel, and capital depreciation will be reduced. From the viewpoint of the national economy, the saving in operation cost for the airlines is evaluated as one of the benefits of this project.

This benefit was measured by the following equation.

$$SC_t = \sum_i WP_{ti} \cdot (WOPC_i - WPC_i)$$

where,

SC_t : Saving in operation cost of airlines due to the introduction of larger-size aircraft in year (t)

WP_{ti} : Passenger traffic demand in "With Project" case in year (t) on route (i)

$WOPC_i$: Operation cost per passenger in the WOP case on route (i)

WPC_i : Operation cost per passenger in the "With Project" case on route (i)

(4) Additional Access Cost from/to Airport(s)

Both in Concepts C and F, the passengers utilizing the new airports will be compelled to travel a longer access distance than that to/from the existing airport. This incurs additional time and travelling cost and is measured as disbenefit. This disbenefit is expressed as shown in the following equation.

$$BAC_t = \sum_j PI_{tj} \cdot \{ VT_t \cdot (WOT_j - WT_j) + (WOC_j - WC_j) \}$$

where,

BAC_t : Additional access cost in year (t)

PI_{tj} : Passengers originating in zone (j) in year (t) (Indonesians only)

VT_t : Average time value of air passengers in year (t)

WOT_j : Access time in the WOP case from/to zone (j)

WT_j : Access time in the "With Project" case from/to zone (j)

WOC_j : Access cost in the WOP case from/to zone (j)

WC_j : Access cost in the "With Project" case from/to zone (j)

(5) Saving in Administrative Cost of Airlines due to Airport Consolidation

Administrative cost of airlines which consists mainly of personnel and office rental costs can be reduced by combining both Yogyakarta and Surakarta airports in Concept-F. This benefit was measured by the difference between the cost for the 2 airports in the WOP case and the cost in the "With Project" case, based on the actual expenditures in the 2 airports.

10.5.5 Economic Evaluation

The economic cash flow for each alternative is shown in Tables 10.5.1 through 10.5.3. All figures are evaluated in 1985 price. EIRR and NPV for each alternative were calculated as follows:

Indicators	Concept-A	Concept-C	Concept-F
EIRR	15.5 %	15.0 %	16.2 %
NPV (12 % discount rate) (Million Rp.)	39,735	32,387	35,863

Comparing the EIRRs and NPVs of the each concept, it is obvious that the Concept-C is the worst in terms of national economy although all the 3 concepts are judged economically feasible.

There are no considerable differences between Concepts A and F in spite of the cheapest construction cost in Concept-F. This is mainly due to the great disadvantage arising from the additional travelling time and cost in Concept-F.

Table 10.5.1 Economic Cash Flow for Concept-A

YEAR	INVEST-MENT	MA-INTENANCE AND AD-MINISTRA-TION COST	TOTAL COST	BENEFIT	RESIDUAL VALUE	TOTAL BENEFIT	TOTAL COST IN PRES-ENT VALUE	TOTAL BENEFIT IN PRES-ENT VALUE
1987	2651	0	2651	0	2651	0	2651	0
1988	2651	0	2651	0	5236	0	2297	0
1989	2651	0	2651	0	7754	0	1991	0
1990	3575	0	3575	0	11130	0	2326	0
1991	8961	0	8961	0	19803	0	5053	0
1992	31719	1273	32992	714	51010	714	16121	349
1993	59329	1333	60662	780	109034	780	25685	330
1994	31133	1392	32525	847	137378	847	11934	311
1995	0	3731	3731	6479	133812	6479	1186	2060
1996	0	3865	3865	9834	130245	9834	1065	2709
1997	0	3998	3998	13189	126678	13189	955	3149
1998	0	4132	4132	16545	123111	16545	855	3423
1999	5844	4264	10108	19900	125389	19900	1812	3568
2000	18737	4398	23135	23255	140413	23255	3594	3613
2001	12893	4775	17668	33983	149124	33983	2379	4575
2002	0	5478	5478	44712	144621	44712	639	5216
2003	0	5666	5666	55440	140117	55440	573	5604
2004	0	5853	5853	66168	135614	66168	513	5796
2005	0	6040	6040	76896	131110	76896	458	5837
2006	0	6243	6243	91147	126606	91147	411	5996
2007	0	6447	6447	105398	122103	105398	367	6008
2008	0	6650	6650	119649	117599	119649	328	5910
2009	0	6854	6854	133901	113096	133901	293	5731
2010	0	7057	7057	148152	108592	148152	262	5495
2011	0	7263	7263	165320	104088	269408	233	8659
TOTAL							83981	84339

EB/EC= 1.00427 EIRR = 15.525 %

Table 10.5.2 Economic Cash Flow for Concept-C

YEAR	INVEST-MENT	MA-INTENANCE AND AD-MINISTRA-TION COST	TOTAL COST	BENEFIT	RESIDUAL VALUE	TOTAL BENEFIT	IN ENT	TOTAL COST PRES-VALUE	TOTAL BENEFIT IN PRES-ENT VALUE
1987	1881	0	1881	0	1881	0		1881	0
1988	1881	0	1881	0	3715	0		1647	0
1989	1881	0	1881	0	5502	0		1442	0
1990	2805	0	2805	0	8166	0		1883	0
1991	8124	0	8124	0	16079	0		4776	0
1992	36549	1273	37822	714	52213	714		19472	368
1993	60036	1333	61369	780	110921	780		27666	352
1994	30762	1392	32154	847	138854	847		12693	334
1995	0	3761	3761	4297	135256	4297		1300	1485
1996	0	3891	3891	7361	131658	7361		1178	2228
1997	0	4020	4020	10425	128060	10425		1066	2763
1998	0	4151	4151	13488	124463	13488		963	3131
1999	5844	4280	10124	16552	126709	16552		2058	3364
2000	19395	4410	23805	19616	142359	19616		4237	3491
2001	13550	4805	18355	29716	151680	29716		2860	4631
2002	0	5508	5508	39817	147113	39817		752	5433
2003	0	5683	5683	49918	142545	49918		679	5965
2004	0	5856	5856	60018	137977	60018		613	6280
2005	0	6030	6030	70119	133410	70119		552	6425
2006	0	6241	6241	83625	128842	83625		501	6709
2007	0	6453	6453	97132	124274	97132		453	6824
2008	0	6663	6663	110638	119707	110638		410	6806
2009	0	6875	6875	124145	115139	124145		370	6688
2010	0	7086	7086	137651	110571	137651		334	6493
2011	0	7297	7297	153971	106003	259975		301	10739
TOTAL								90089	90509

EB/EC= 1.00466 EIRR = 14.976 %

Table 10.5.3 Economic Cash Flow for Concept-F

YEAR	INVEST-MENT	MA-INTENANCE AND AD-MINISTRA-TION COST	TOTAL COST	BENEFIT	RESIDUAL VALUE	TOTAL BENEFIT	TOTAL COST IN PRES-ENT VALUE	TOTAL BENEFIT IN PRES-ENT VALUE
1987	1322	0	1322	0	1322	0	1322	0
1988	1322	0	1322	0	2611	0	1137	0
1989	1322	0	1322	0	3867	0	978	0
1990	1322	0	1322	0	5090	0	842	0
1991	3660	0	3660	0	8618	0	2005	0
1992	12590	0	12590	0	20984	0	5934	0
1993	51244	0	51244	0	71689	0	20778	0
1994	40643	0	40643	0	110513	0	14178	0
1995	0	2440	2440	4403	107677	4403	732	1321
1996	0	2520	2520	7029	104842	7029	651	1815
1997	0	2599	2599	9656	102006	9656	577	2145
1998	0	2679	2679	12282	99170	12282	512	2347
1999	0	2759	2759	14908	96335	14908	454	2451
2000	15217	2838	18055	17535	108716	17535	2554	2480
2001	15217	2918	18135	26070	120717	26070	2207	3172
2002	0	3567	3567	34605	117121	34605	373	3623
2003	0	3681	3681	43140	113524	43140	332	3885
2004	0	3796	3796	51675	109928	51675	294	4004
2005	0	3910	3910	60211	106331	60211	261	4014
2006	0	4025	4025	72035	102735	72035	231	4131
2007	0	4139	4139	83860	99138	83860	204	4138
2008	0	4253	4253	95685	95542	95685	181	4062
2009	0	4368	4368	107510	91945	107510	160	3926
2010	0	4482	4482	119335	88349	119335	141	3749
2011	0	4596	4596	133526	84752	218279	124	5900
TOTAL							57160	57162

EB/EC= 1.00005 EIRR = 16.237 %