# CHAPTER 9 ESTABLISHMENT OF LONG TERM DEVELOPMENT PLAN

# CHAPTER 9 ESTABLISHMENT OF LONG TERM DEVELOPMENT PLAN

## 9.1 SUMMARY

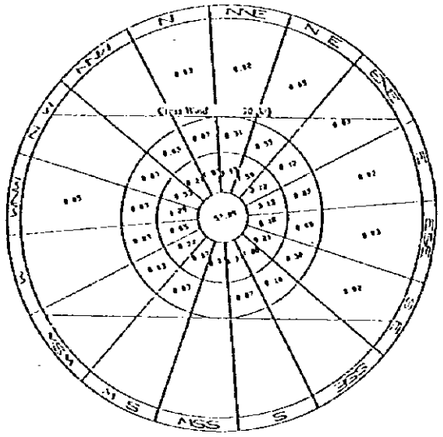
The long-term development plan was prepared during the Second Field Survey in Vietnam. This chapter discusses the preparation of the long-term development plan under the following headings:

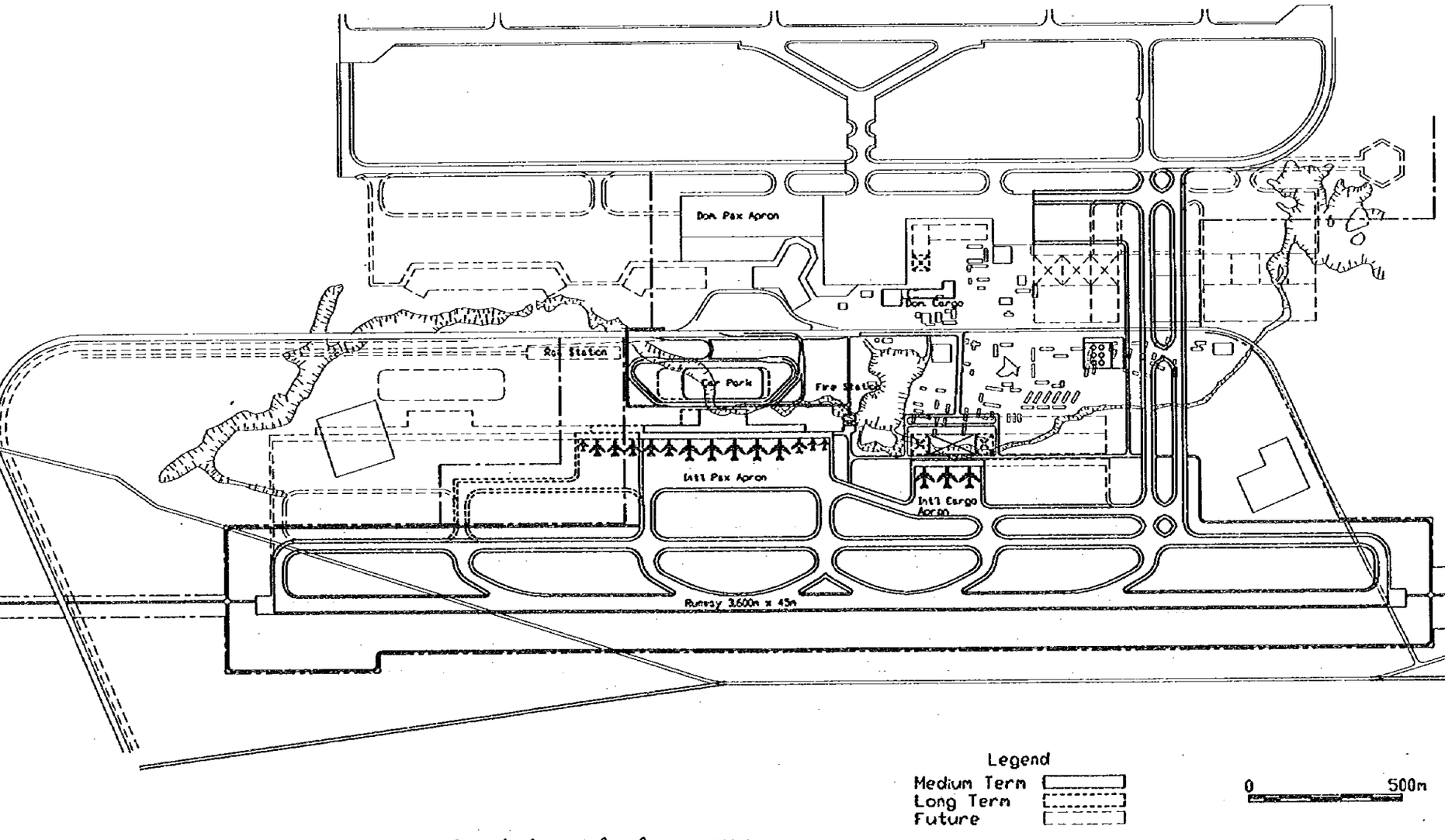
a) Alternative Development Plans
b) Planning of Airspace Use
c) Preliminary Cost Estimates
d) Initial Environmental Evaluations
e) Selection of an Optimum Development Plan
f) Financial Analysis of the Optimum Development Plan
g) Economic Analysis of the Optimum Development Plan
h) Appraisal of the Optimum Development Plan

As a result of the study, the long-term development plan, including the phased development plan to the year 2015 shown in Figure 9.1.1, is recommended as the best development plan for the southern area development. It should be noted that further development of the northern area (the existing airport side) was not included in this study, although it was considered to be a possible option for the development of the NBIA as shown in the CAAV's Master Plan. This is in accordance with the statement in the Scope of Work agreed between the CAAV and JICA, i.e. "the Study Shall be conducted solely for the civil aviation purpose".

| AERODROME DATA | |
|---|---|
| NAME OF AIRPORT | NOI BAI INTERNATIONAL AIRPORT |
| ICAO REFERENCE CODE | 4E |
| REFERENCE POINT | 21° 13' 16" N, 105° 48' 16" E |
| ELEVATION | 12 m |
| REFERENCE TEMPERATURE | 32.9° |
| MAGNETIC VARIATION | 1° W |

| AIRCRAFT OPERATION DATA | |
|---|---|
| WIND COVERAGE | 99.89% (20KT CROSS WIND) |
| OPERATIONAL CATEGORY | PRECISION APPROACH CATEGORY-I & II |
| **RUNWAY DATA** | |
| DESIGNATION | 11R/29L, 11L/29R |
| TRUE BEARING | 106° 52' 48" / 286° 51' 12" |
| DIMENSION | 3,600m X 45m, 3,200m X 45m |




Note: CAAV's development plans for the existing airport area are indicated as future developments for reference purposes.

Figure 9.1.1 Long Term Development Plan of Noi Bai International Airport

## 9.2 ALTERNATIVE DEVELOPMENT PLANS

### 9.2.1 General Considerations

#### 1) Prerequisites for Preparation of Alternatives

The principles of the New Development Plan of Hanoi International Airport are defined in the Terms of Reference for the Study (refer to Appendix 1.1.1). On the bases of the Terms of Reference, CAAV's Master Plan for Development of the NBIA and discussions with the Vietnamese Counterparts, the following were identified as prerequisites for preparing alternative development plans.

a) Joint use of the existing runway by civil and military aircraft will continue for some time to come.

b) Civil facilities are located in the south area of the existing runway, and military facilities are to the north. This zoning will remain unchanged.

c) The area to the south of the existing airport shall be developed mainly for the international services.

d) The second runway, if it is constructed, shall be in parallel with the existing runway with sufficient separation distance to allow independent operations under IFR (open parallel runways).

e) Current development projects, that is the extension of parallel taxiway, expansion of apron A1 and construction of new control tower, new aircraft maintenance hangar and new passenger terminal T1, are expected to be completed by 1997, and are outside of the scope of the new development plan, for which this Feasibility Study is conducted.

Based on the Scope of Work agreed between the CAAV and JICA, the Study excluded any further development of the area west of the existing terminal area (after the T1 project) shown in the CAAV's Master Plan.

#### 2) Target Years

The target years for phased development are shown in table 9.2.1 taking into account the airport's capacity after the completion of the current development projects (especially construction of T1) and the period of time for implementation of the Medium Term

Development. The target years for facility sizing are set at five years after the completion of the development so that major expansion and/or renovation will not be necessary for at least several years after completion.

Table 9.2.1 Target Years of the Study

| | Target Year of Inauguration | Target Year for Facility Sizing |
|---|---|---|
| Medium Term Development | 2005 | 2010 |
| Long Term Development | 2010 | 2015 |

**3) Second Runway**

1) Runway Length

In the CAAV's Master Plan, the second runway appears to be an auxiliary facility being shorter than the north runway which is planned to be extended by 600 m in the Master Plan. It is, however, more appropriate to have a longer runway to the south in the new alternative development plans for the following reasons.

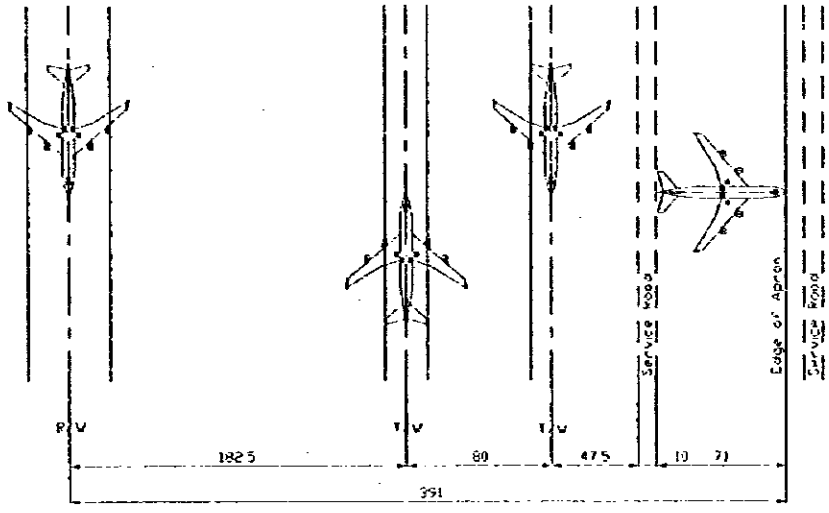
a) Facilities for international services, which require a longer runway, will mainly be located in the southern area in the new alternative plans.

b) The longer runway is not an immediate need since weight restriction of the existing runway is considered not so critical for airline operations.

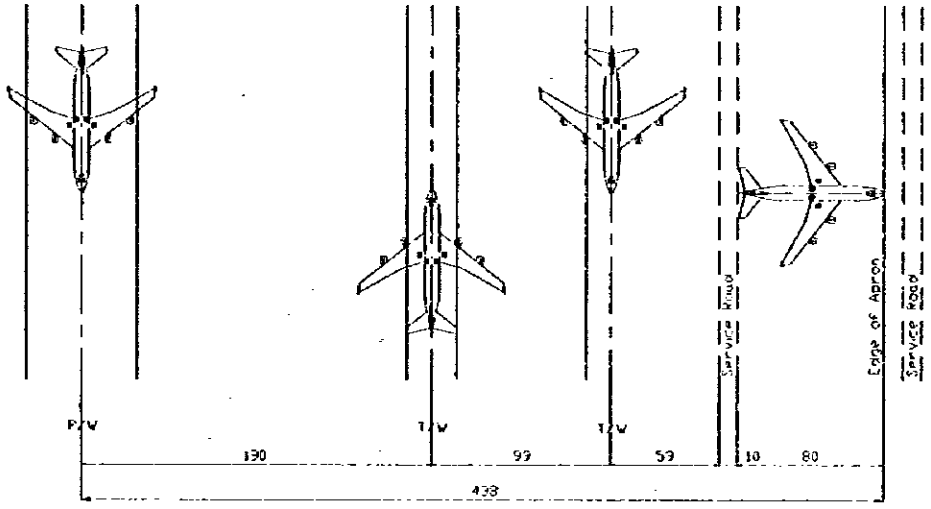
It was planned in this study, therefore, that length of the second runway will be 3,600 m, and the length of the existing runway will remain at 3,200 m.

2) Separation Distance

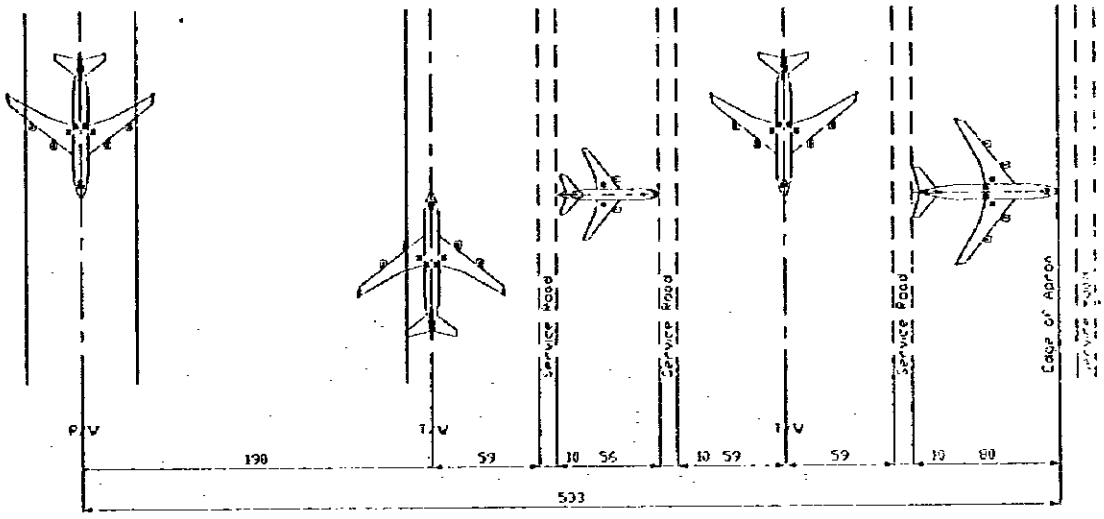
The CAAV's Master Plan locates the second runway 1,750 m south of the existing runway. Although the minimum separation distance for open parallel runways is 1,525 m in ICAO Annex 14, the separation distance in the CAAV's Master Plan is considered a minimum in practice. Since the existing airport access road is located at about 970 m south of the runway, the distance between access road and the second runway in the CAAV's Master Plan is only about 780 m. It is barely enough to provide only one row of aircraft parking positions with dual taxiways in front of the terminal area (the distance between the runway centreline and the landside edge of apron is about 440 m as shown in Figure 9.2.1) plus a passenger terminal building, car park and roads.




In Accordance with Code E, ICAO with Single Row of Parking Positions




In Accordance with Code F with Single Row of Parking Positions




In Accordance with Code F with Remote Parking Space

Figure 9.2.1 Distance between Runway Centreline and Landside Edge of Apron

In order to reserve a space for the second row of parking position (remote aircraft stands as shown in Figure 9.2.1), the separation distance between the two runways is increased by about 100 m to about 1,850 m in this study. Due to this change, required land area will increase by about 40 ha, and total area of land acquisition will increase by about 8%.

3) Location of Threshold

The threshold of the Runway 11R will be located about 500 m away from the Thang Long - Noi Bai Expressway so that the approach surface will not be penetrated by the lighting poles along the expressway. Figure 9.2.2 shows the location of the second runway, with several alternative separation distances described in 2) above.

4) **Space to be Reserved for Airport Access System in the Future**

The ultimate capacity of the terminal area of NBIA (the total of the existing and southern areas of the airport) will be in the order of 40 mppa. Airports of this size usually need railways so as to reduce the pressure on the airport access road and car parking. Provision of a railway is also desirable for the environmental reasons. International experience has shown that a railway can handle 30 to 40% of the air passengers, and the remaining 60 to 70% of the air passengers will use road transport. This road traffic will require 3 to 4 lanes in each direction (6 to 8 lanes in total); therefore, a right-of-way at least 20 m wide must be reserved beside the existing access road for widening of the road in future. For the railway, it would be appropriate to reserve a 10 to 40 m wide right-of-way, depending on embankment height for rail tracks on grade, and a 40 m wide and 300 m long space for a station.

5) **Terminal Concept**

Air traffic demand forecasting is quite difficult for an airport like NBIA where the demand started to increase rapidly in recent years. In such a case, facilities must be planned to be flexible to accommodate unexpected changes in demand in future. In this context, the terminal concept proposed in the CAAV's Master Plan, that is a combination of linear and transporter concept, is considered quite reasonable, and will be used in the Study. Table 9.2.2 shows typical terminal concepts and their general advantages and disadvantages for reference.

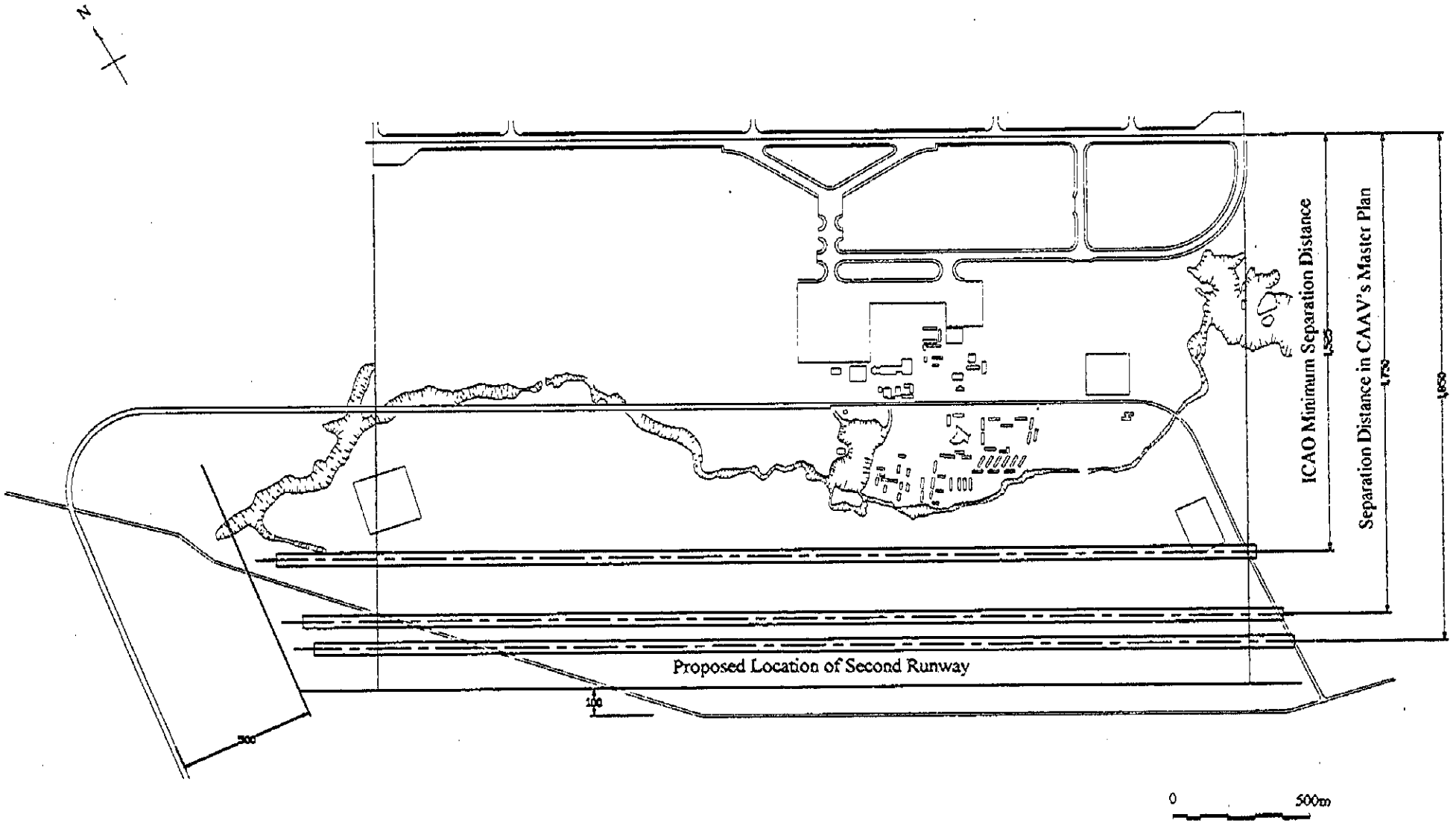
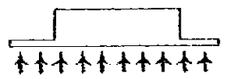
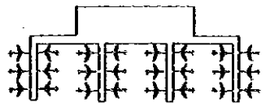
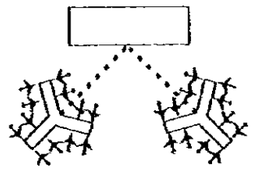
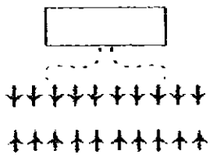



Figure 9.2.2 Layout of Second Runway

Table 9.2.2 Advantages and Disadvantages of Terminal Concept

| | Linear (Centralized) | Linear (Semi Centralized) | Pier (Centralized) | Satellite (Centralized) | Transporter (Centralized) | Module (Semi Centralized) |
|---|---|---|---|---|---|---|
| Typical Concept |  |  |  |  |  including both mobil lounge and ramp bus |  |
| Walking Distance | Long walking distance. | ***Relatively short walking distance.*** | Long walking distance. | Long walking distance. | ***Short walking distance.*** | ***Short walking distance.*** |
| Curb Length | ***Adequate curb length.*** | ***Adequate curb length.*** | Curbside congests in peak hours. | Curbside congests in peak hours. | Curbside congests in peak hours. | ***Adequate curb length.*** |
| Separation of Arriving and Departing Passengers | ***Separation of arriving and departing passengers, if required, is relatively easy by using airside corridor.*** | ***Separation of arriving and departing passengers, if required, is relatively easy by using airside corridor.*** | Three level piers are required if arriving and departing passengers need to be separated. | Separation of arriving and departing passengers is difficult without an additional level. | ***Separation of arriving and departing passengers can easily be achieved.*** | ***Airside corridors can be used for separation of arriving and departing passengers, if it is required.*** |
| Cost for Passenger Moving and Baggage Handling | High capital, operation and maintenance costs for passenger moving and baggage handling, if the size of terminal is large. | ***Reduce cost of baggage handling system.*** | High capital, operation and maintenance costs for passenger moving and baggage handling. | High capital, operation and maintenance costs for passenger moving and baggage handling. | Highest capital, operation and maintenance costs for passenger moving and baggage handling. | ***Reduce cost of baggage handling system within one module. A system is required transferring passenger and baggage between the modules.*** |
| Centralization of Airline and Government Authorities | ***Centralization of airline and government authorities.*** | Duplication of airline and government authorities. | ***Centralization of airline and government authorities.*** | ***Centralization of airline and government authorities.*** | ***Centralization of Airline and Government Authorities*** | Duplication of airline and government authorities. |
| Centralization of Facility and Amenity | ***Centralization of terminal facilities and amenities.*** | Duplication of terminal facilities and amenities. | ***Centralization of terminal facilities and amenities.*** | ***Centralization of terminal facilities and amenities.*** | ***Centralization of Facility and Amenity*** | Duplication of terminal facilities and amenities. |
| Compatibility with Future Larger Aircraft | ***It is possible to rearrange the gate positions to accommodate future larger aircraft.*** | ***It is possible to rearrange the gate positions to accommodate future larger aircraft.*** | Limited compatibility with future larger aircraft. | ***It is possible to rearrange the gate positions to accommodate future larger aircraft.*** | ***Full compatibility with future larger aircraft.*** | ***It is possible to rearrange the gate positions to accommodate future larger aircraft.*** |
| Expandability | ***Relatively easy incremental expansion.*** | ***Relatively easy incremental expansion.*** | Limited expansion capability due to complex building geometry. | Limited phased expansion capability due to complex building geometry. | ***Large expansion capability.*** | Expansion by a module is easy. |
| Applicable Size of Airport | Small to medium size airport. | Medium to large size airport. | Large size airport. | Large size airport. | Medium size airport. | Medium size airport. |

Note: ***Italic bold face*** is used for indicating advantages.

### 6) Alternative Layout of Connecting Taxiways

The CAAV's Master Plan provides for two connecting taxiways, one at the east and the other at the west end of the runways. This configuration will be reasonable if the south runway is built and all terminal facilities are located in the north; however, this lay out will require lowering the access road for grade separation from the connecting taxiways and reducing the flexibility for terminal expansion to some extent, since two connecting taxiways at both ends of the runway create a somewhat confined area.

An alternative connecting taxiway layout could be to relocate the western connecting taxiway next to the eastern connecting taxiway, i.e. to provide dual connecting taxiways at the eastern end of runways. With this arrangement, the west side of the airport along the runways will have no physical constraints for expansion, and lowering of access road will not be required at western side. Figure 9.2.3 shows the original and alternative locations of the connecting taxiways.

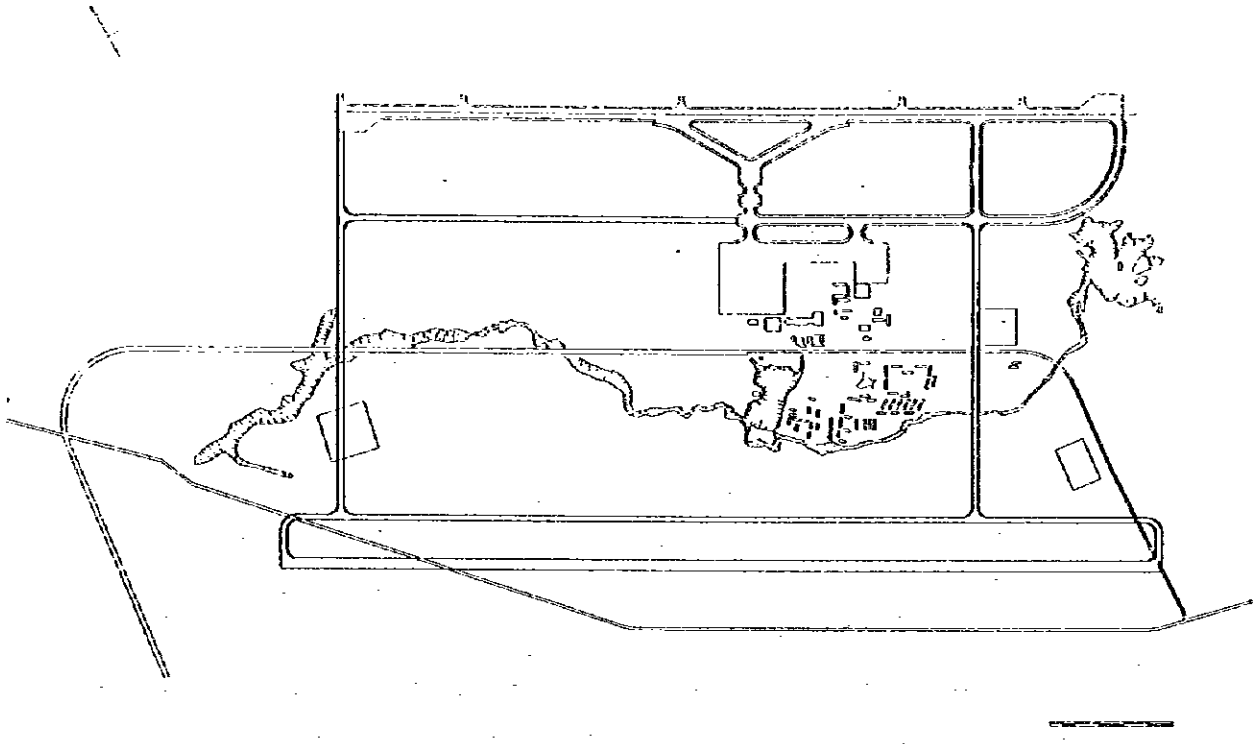
### 7) Considerations on Airport Land Use

On the basis of existing land use at NBIA and its development master plan, the following principles were applied in developing alternative development plans:

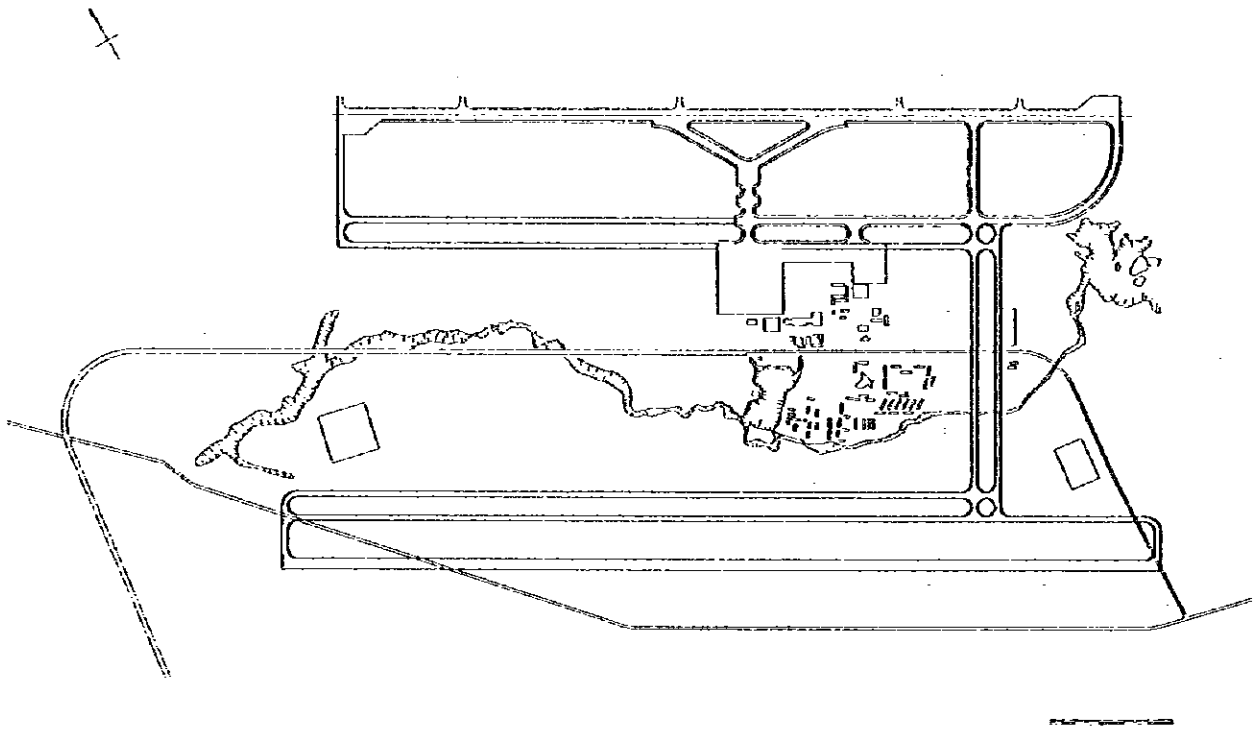
a) The aircraft maintenance area will be expanded from the existing A76 maintenance area toward the east.

b) The existing passenger terminal is to be used as a cargo terminal after completion of T1.

c) The existing Hanoi AACC, Airport Hotel, and Culture Centre should not be affected as far as practicable.



Alternative-1



Alternative-2

Figure 9.2.3 Alternative Layout of Connecting Taxiways

### 9.2.2 General Description of Alternative Development Plans

On the basis of the foregoing considerations, the following four alternatives were developed for the comparison study.

Table 9.2.2 General Concept of Alternative Development Plans

| | Connecting Taxiway at Both Sides | Connecting Taxiway at East Side |
|---|---|---|
| Develop the Southern Area from the Central Area | Alternative-1(a) | Alternative-2(a) |
| Develop the Southern Area from the West Side | Alternative-1(b) | Alternative-2(b) |

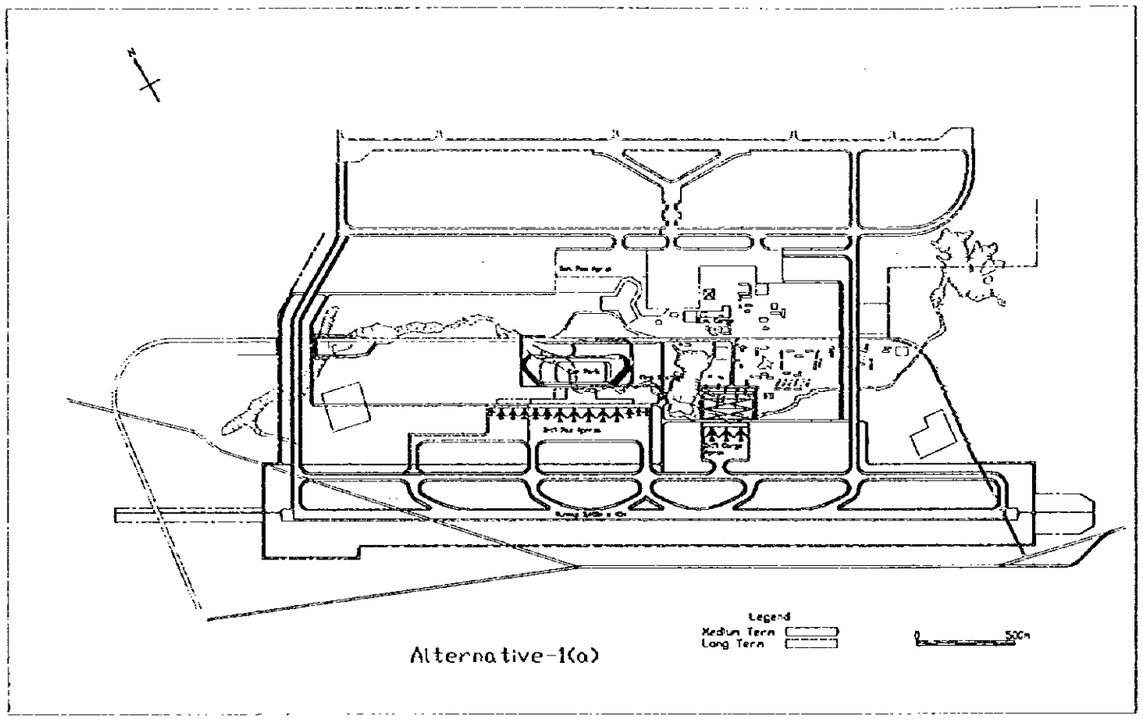
Figures 9.2.4 illustrates the scheme of each alternative development plan.

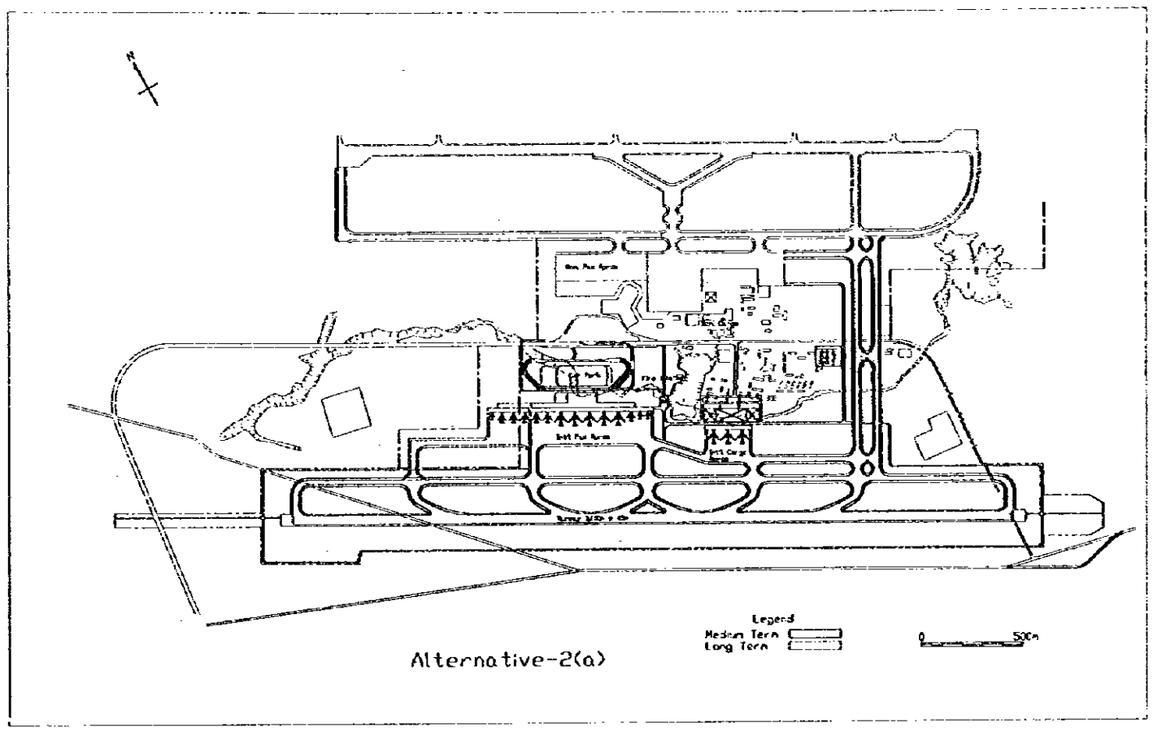
Subsequent sections provide detailed descriptions of each alternative development plan.

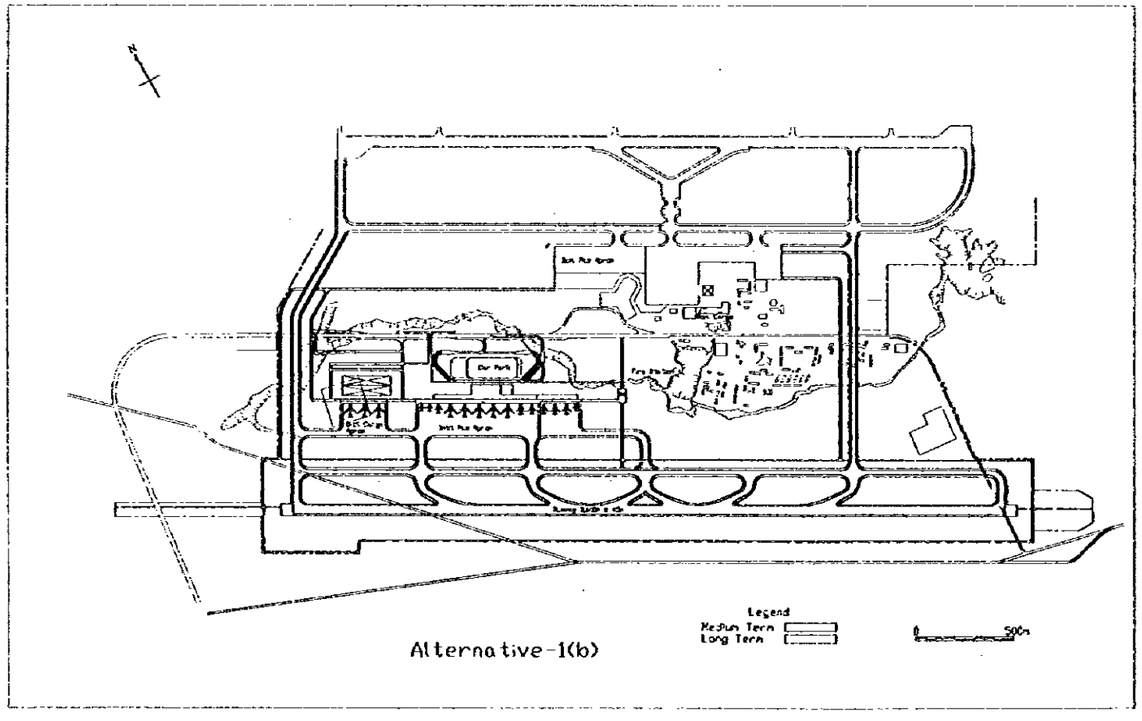
### 9.2.3 Alternative-1(a)

Figure 9.2.5 depicts the layout plan of Alternative-1(a). As seen in the figure Alternative-1(a) has a connecting taxiway at the western end and at about 600 m away from the eastern end of the existing runway. In order to maximise the development potential in the southern area, the west connecting taxiway is bent and connected to the west end of the new runway. The access road will be lowered at the intersection with the western connecting taxiway. The existing fuel storage "N-2" will be relocated so as to clear a space for the eastern connecting taxiway. The main office and housing complex of fuel company will also be relocated to outside the Airport, possibly near the existing main storage "N-1". The existing road in front of the fuel storage "N-2" will be abandoned, since it is not considered economically justifiable to provide grade separation between this road and the new taxiway. The Airport Administration Building needs to be relocated to where good access to/from the major facilities will be possible.

T1 will be used as the domestic passenger terminal, and the existing passenger terminal will be used as the domestic cargo terminal. International passenger and cargo terminals will be constructed in Medium Term Development at the site across the access road and opposite to the domestic passenger and cargo terminals. The land area presently used for customs and immigration complexes and part of the staff housing area will be used for the international cargo terminal. A part of Noi Bai Canal will be diverted so as to clear the site for construction of the passenger and cargo terminals.



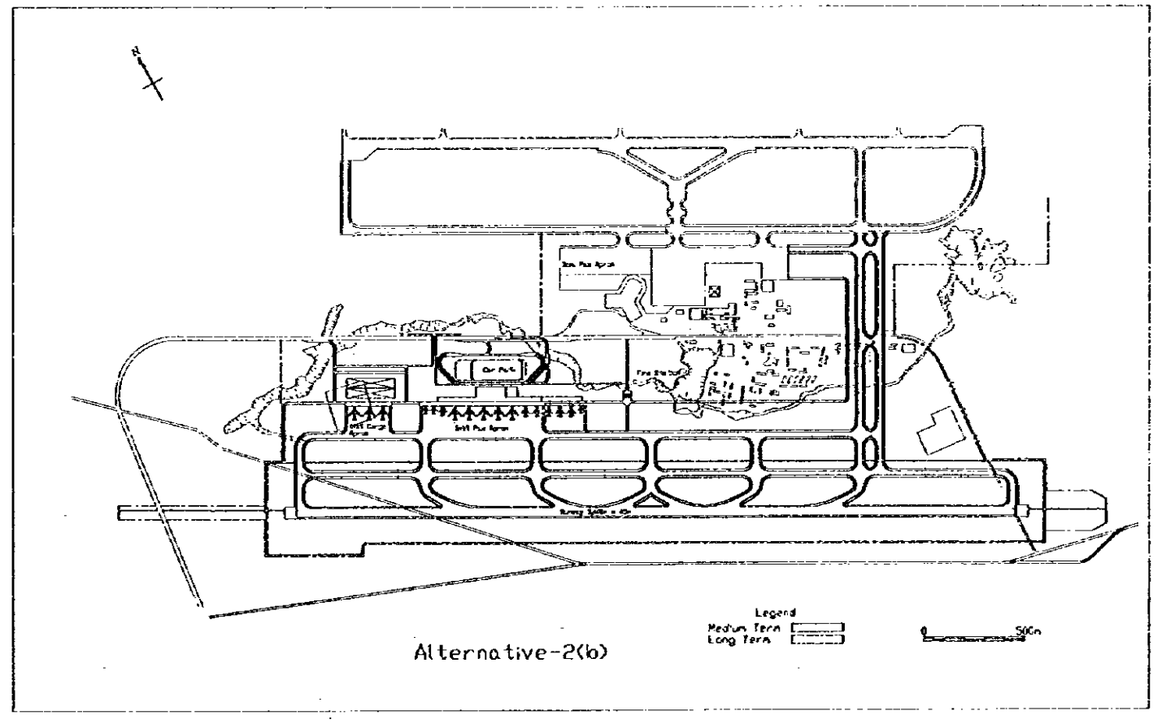




Figure 9.2.4 Scheme of Alternatives

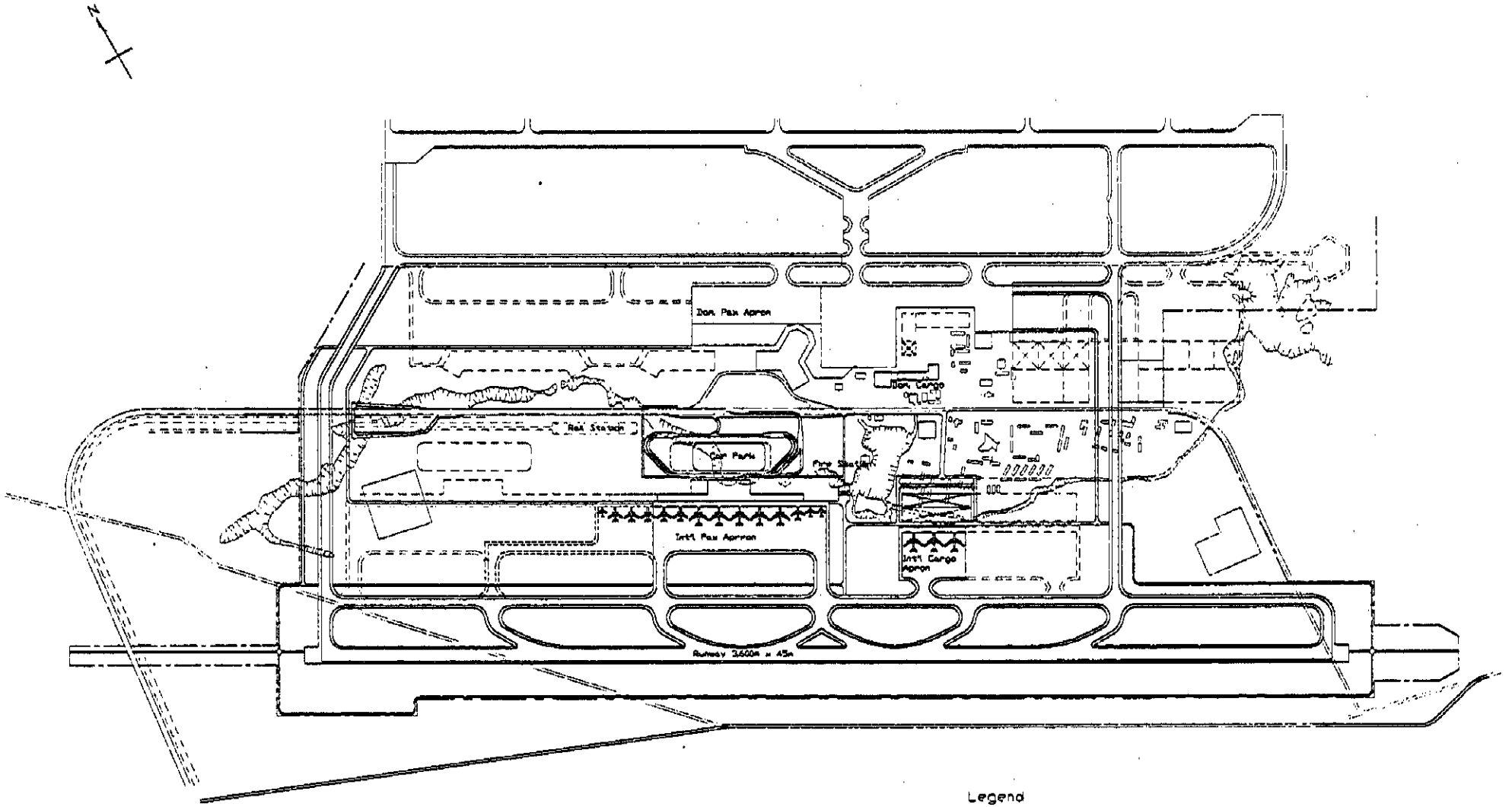



Figure 9.2.5 Facility Layout of Alternative-1(a)

Note: CAAV's development plans for the existing airport area are indicated as future developments for reference purposes.

In Long Term Development and thereafter, the international passenger terminal will be expanded towards the west, and cargo terminal towards the airside. A satellite fire station will be built between the international passenger and cargo terminals in the Medium Term Development.

### 9.2.4 Alternative-1(b)

Figure 9.2.6 illustrates the layout plan of Alternative-1(b). As seen in the figure, the facility layout of Alternative-1(b) is quite similar to that of Alternative-1(a). The difference between the two alternatives is the location of the international passenger and cargo terminals on the southern side of the access road, i.e. in Alternative-1(b), initial development of the terminal zone commences from the western area as opposed to the central area in Alternative-1(a).

Since international cargo and passenger terminals will be constructed near the west end of the new runway (primary approach direction) in the Medium Term Development, it will allow preservation of the existing customs and immigration complexes and staff housing area until after the year 2015. Diversion of Noi Bai Canal will also be reduced in the Medium Term Development. In the Long Term Development, the international passenger terminal will be expanded towards the east, and cargo terminal towards the airside. In the distant future, the existing customs, immigration and other complexes will be converted to a passenger and cargo terminal zone in accordance with the actual traffic demands.

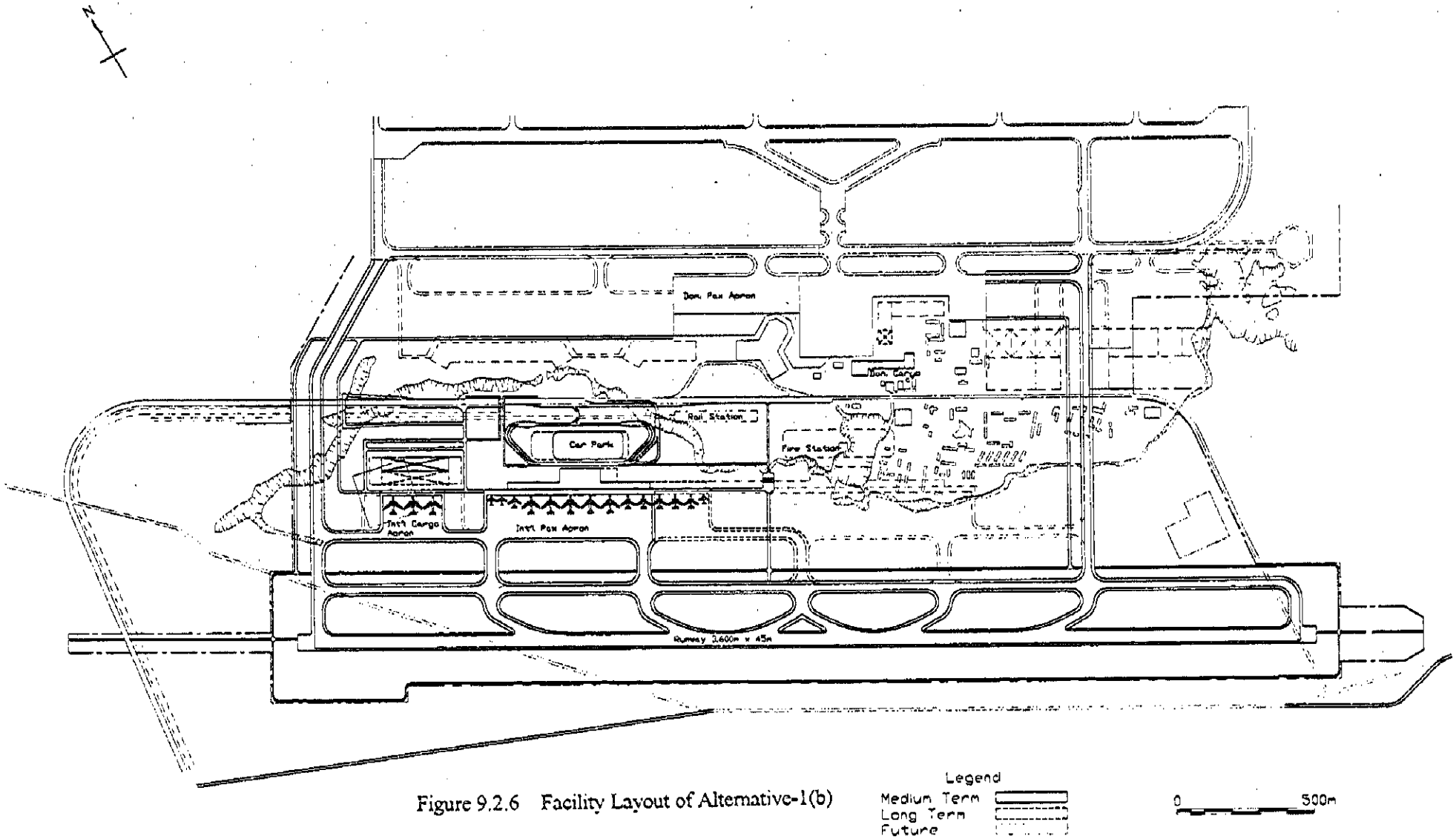



Figure 9.2.6 Facility Layout of Alternative-1(b)

Note: CAAV's development plans for the existing airport area are indicated as future developments for reference purposes.

### 9.2.5 Alternative-2(a)

Figure 9.2.7 illustrates the layout plan of Alternative-2(a). As seen in the figure, Alternative-2(a) has dual connecting taxiways at about 600 m from the east end of the existing runway. The layout of the facilities in the eastern area is similar to the Alternatives-1(a) and 1(b). The differences are (i) configuration of taxiways and (ii) separation distance between the two maintenance areas in the distant future.

The layout of the passenger and cargo terminal areas is similar to Alternative-1(a). The only difference is that Alternative-2(a) is provided with the dual parallel taxiways between the international passenger terminal and the connecting taxiways.

### 9.2.6 Alternative-2(b)

The layout Plan of Alternative-2(b) is shown in Figure 9.2.7. As seen in the figure, the facility layout of Alternative-2(b) is quite similar to that of Alternative-2(a). The differences are (i) location of the international passenger and cargo terminals in the southern area, and (ii) the separation distance between the two parallel taxiways of the second runway at the eastern side. In Alternative-2(b), the separation distance between the two parallel taxiways has been planned to provide straight parallel taxiways. It is, however, possible to locate the cargo terminal at the same location as in Alternative-2(a), if two additional turns are allowed for taxiing along the parallel taxiways.

As is the case in Alternative-1(b), initial development of international cargo and passenger terminals will commence from the west end of the new runway in Medium Term Development so as to preserve the existing staff housing area and other complexes. The diversion of Noi Bai Canal will also be reduced in Medium Term Development. The international passenger terminal will be expanded toward the east, and cargo terminal will be expanded toward the airside in the Long Term Development. The passenger and cargo terminals can be expanded further to the east and west respectively in the distant future. As with Alternative-1(b), the existing customs, immigration and other complexes which remained untouched in the Medium Term Development, will be relocated for the terminal development beyond the Long Term phase.

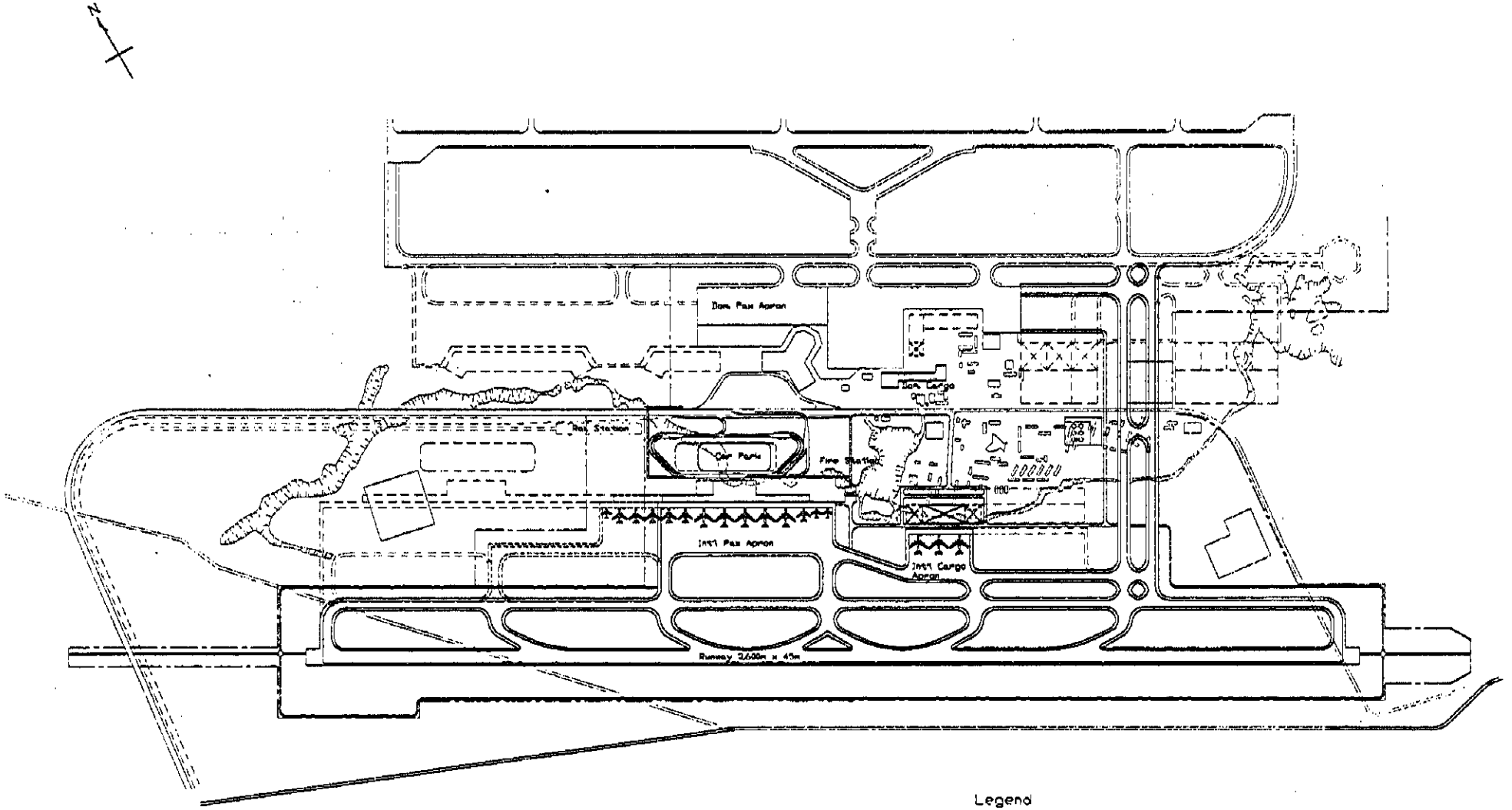



Figure 9.2.7 Facility Layout of Alternative-2(a)

Note: CAAV's development plans for the existing airport area are indicated as future developments for reference purposes.

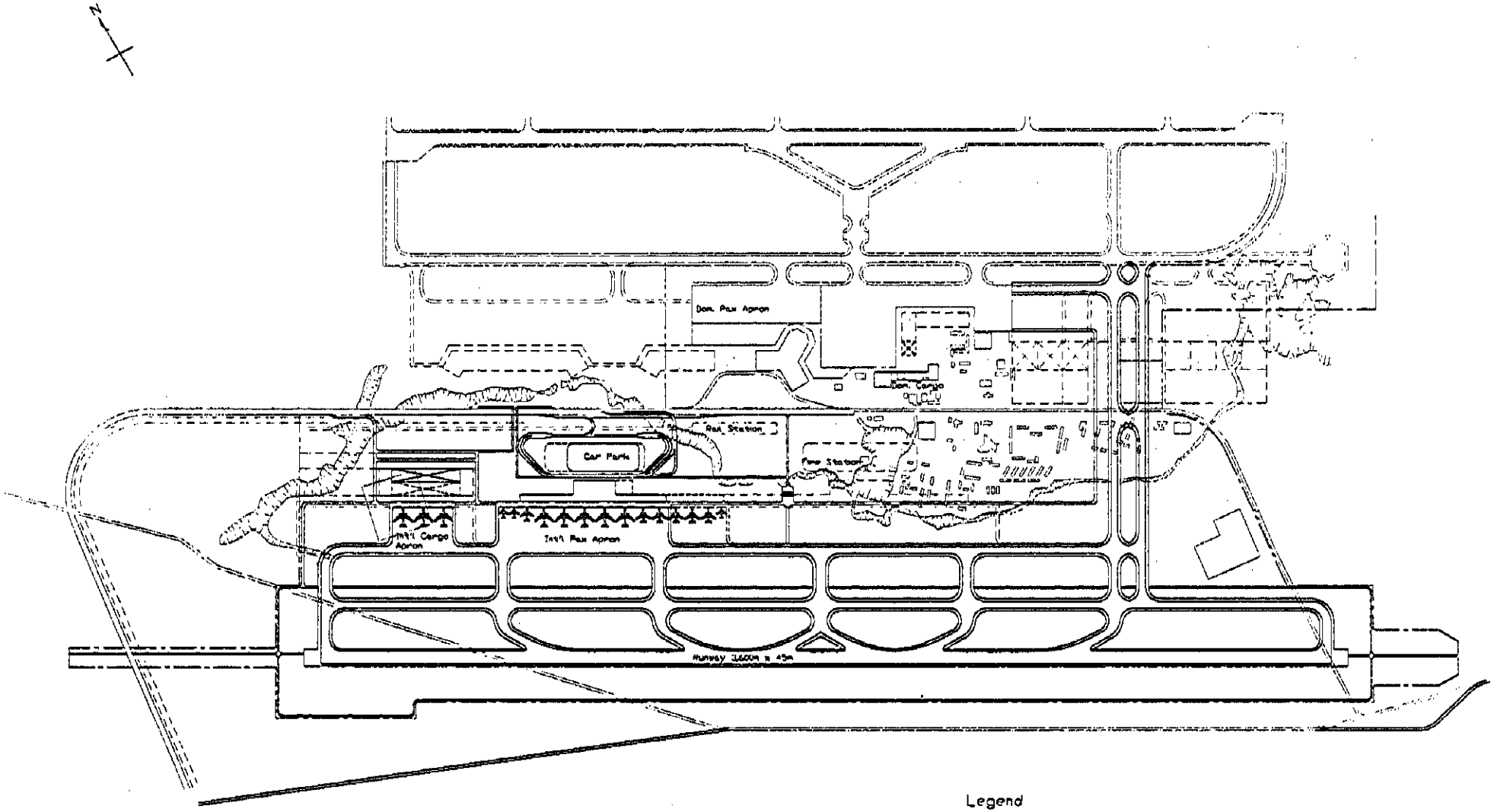



Figure 9.2.8 Facility Layout of Alternative-2(b)

Note: CAAV's development plans for the existing airport area are indicated as future developments for reference purposes.

### 9.2.7 Outline of Construction Works

Tables 9.2.3 and 9.2.4 outline the major construction works required for the Medium and Long Term Developments respectively. Airport utilities need to be developed in concert with the expansion of the building and civil facilities.

Development of air navigation systems has been planned as follows:

a) The existing aged ILS, VOR/DME and NDBs will be replaced before the Medium Term Development.

b) A SALS and PAPI for the existing Runway 29, an Aerodrome Beacon, RVR and ceilometer for the existing runway will be installed before the Medium Term Development.

c) ATC consoles and equipment for the new control tower and ASR, SSR and PAR will also be installed before the Medium Term Development.

d) When the second runway is constructed, a Category II ILS and appropriate lighting systems will be installed.

e) Installation of ATIS, ARTS and Daylight Radar Display has been planned for Long Term.

f) ASDE and an additional ATC console for Clearance Delivery will be installed in future beyond the Long Term Development period.

Table 9.2.3 Outline of Construction Works for Medium Term Development

| Item | Alt-1(a) | Alt-1(b) | Alt-2(a) | Alt-2(b) |
|---|---|---|---|---|
| Runway | New runway 3,600m x 45m | | | |
| Taxiway | 7,400 m | 7,700 m | 8,400 m | 10,000 m |
| Apron | 103,000 $m^2$ | | | |
| International Passenger Building | New building 45,800 $m^2$ | | | |
| Domestic Passenger Building | Renovation of T1 | | | |
| International Cargo Building | New building 12,300 $m^2$ | | | |
| Domestic Cargo Building | - | | | |
| International Car Park | New car park 25,600$m^2$ | | | |
| Domestic Car Park | Expansion by 9,200 $m^2$ | | | |
| Roads | 19.4 km | 18.5 km | 13.2 km | 16.6 km |
| Taxiway Bridge | 1 no. | | - | |
| Earthworks & Drainage | 300 ha | 310 ha | 290 ha | 330 ha |
| Diversion of National Road No.2 | 2.0 km | | | |
| Diversion of Noi Bai Canal | 3.0 km | 2.0 km | 2.0 km | 1.8 km |
| Diversion of Irrigation Channels | 1.7 km | | | |
| Diversion of Power Transmission Lines | 3.6 km | | | |
| Diversion of Telephone Lines | 2.1 km | | | |
| Other Relocation | Fuel Storage N-2, Immigration and Customs Complexes, Staff Housing | Receiving Station, Fuel Storage N-2 | Fuel Storage N-2, Immigration and Customs Complexes, Staff Housing | Receiving Station, Fuel Storage N-2 |
| Land Acquisition & Compensation | 420 ha | | 290 ha | 360 ha |

Note: Quantities are approximate only.

Table 9.2.4 Outline of Construction Works for Long Term Development

| Item | Alt-1(a) | Alt-1(b) | Alt-2(a) | Alt-2(b) |
|---|---|---|---|---|
| Runway | - | | | |
| Taxiway | 600 m | | | - |
| Apron | 38,000 $m^2$ | | | 28,000 $m^2$ |
| International Passenger Building | Second building 16,700 $m^2$ | | | |
| Domestic Passenger Building | - | | | |
| International Cargo Building | Expansion by 9,200 $m^2$ | | | |
| Domestic Cargo Building | Second building 3,600 $m^2$ | | | |
| International Car Park | Second car park 9,400$m^2$ | | | |
| Domestic Car Park | Expansion by 8,700 $m^2$ | | | |
| Roads | 1.7 km | 1.4 km | 1.9 km | 1.3 km |
| Taxiway Bridge | - | | | |
| Earthworks & Drainage | 40 ha | 40 ha | 40 ha | 20 ha |
| Diversion of National Road No.2 | - | | | |
| Diversion of Noi Bai Canal | - | 0.8 km | - | 0.8 km |
| Diversion of Irrigation Channels | - | | | |
| Diversion of Power Transmission Lines | - | | | |
| Diversion of Telephone Lines | - | | | |
| Other Relocation | - | | | |
| Land Acquisition & Compensation | - | | 40 ha | - |

Note: Quantities are approximate only.

## 9.3 PLANNING OF AIRSPACE USE

### 9.3.1 Air Traffic Services at Noi Bai International Airport

Aerodrome Control, Approach Control and Ground Controlled Approach (GCA) are currently provided at the NBIA. These Air Traffic Services (ATS) shall be maintained, and their efficiency must be improved to meet increasing air traffic demand in Noi Bai area. In order to increase efficiency, modern Air Traffic Control (ATC) systems, such as Airport Surveillance Radar (ASR), Secondary Surveillance Radar (SSR), Precision Approach Radar (PAR), Automatic Terminal Information Services (ATIS), Airport Surface Detecting Equipment (ASDE) and Daylight Radar Display, will be required as listed in the previous Section 5.5.

Provision of ASR and Monitor Controls are indispensable for independent parallel ILS approach. A monitor controller is required for each ILS approach so as to instruct the aircraft to return to the correct localizer course immediately if an aircraft deviates towards the No Transgression Zone (NTZ) boundary.

Approach Control functions are shared between the Aerodrome and Approach controllers as described in the previous Section 3.7.5. To rationalize control functions, the following procedures are recommended, based on practices widely used elsewhere.

**1) Departures**

a) When aircraft request a ATC clearance to Noi Bai Tower, this is relayed to Hanoi Control..

b) Noi Bai Tower relays the ATC clearance issued by Hanoi Control to the aircraft and makes necessary coordination with Noi Bai Approach.

c) Noi Bai Tower issues take-off clearance to the aircraft confirming the separation with other aircraft.

d) Just after the airborne, Noi Bai Tower instruct the aircraft to contact with Noi Bai Approach.

e) Noi Bai Approach makes radio and radar contact with the aircraft and assume control.

2) Arrivals

a) Noi Bai Approach determine the arrival sequence of aircraft, and spacing of aircraft is provided by radar vectors for establishing proper approach intervals.

b) The approach clearance is issued by Noi Bai Approach and control of the aircraft will be transferred to Noi Bai Tower.

c) Then landing clearance is issued by Noi Bai Tower.

d) Whenever an aircraft makes missed approach, Noi Bai Tower notifies it to Noi Bai Approach.

### 9.3.2 Control Zone of Noi Bai International Airport

The Control Zone (CTR) of the NBIA is the airspace within a 30 km radius of the Aerodrome Reference Point (ARP) and up to a height of 7,000 ft from ground level, except for a southern area wherein Air traffic Control services are provided by Gia Lam tower as described in the previous Section 3.7.4. In conjunction with the aforementioned changes in responsibilities of the Approach and Aerodrome controllers, the Noi Bai CTR should be reduced to a 9 km (5 NM) radius.

### 9.3.3 Instrument Flight Procedures

The following instrument flight procedures have been established for the existing runway as described in Section 3.7.6.

a) VOR/DME Instrument Approach RWY 29;
b) VOR/DME Instrument Approach RWY 11;
c) NDB/DME Instrument Approach RWY 11;
d) NDB/ILS Instrument Approach RWY 11; and
e) VOR/ILS Instrument Approach RWY 11
f) Standard Instrument Departure RWY 11/29 NB W1/W2; MC B465/R474

These instrument flight procedures will be applied for RWY 11L/29R.

Given the existing conditions around NBIA, it is possible to establish instrument flight procedures, including a ILS Cat-II approach, for the new southern runway 11R/29L.

### 9.3.4 Obstacle Limitation Surfaces

Obstacle limitation surfaces of the existing airport were shown in the previous Section 6.2.3. There are no obstacles other than the mountains approximately 6 km north of the airport projecting from the conical surface as described in Section 6.2.3.

Obstacle limitation surfaces for the Alternatives which have the 3,600 m long second runway are shown in Figure 9.3.1. There is no hilly terrain which will constitute obstacle other than the above-mentioned mountains. Height restrictions against man-made structures should be applied to the following villages under the approach surfaces.

Runway 11R: Thach Loi, Ben Coc

Runway 29L: Thang Loi, Phu Xa Dong, Thai Phu, Phu Lo, Bac Già, Doai

### 9.3.5 Principles of Runway Utilization

At present, both civil and military aircraft use a single runway at NBIA. In the case of Alternatives with the second runway, two runways are planned to be used in accordance with the following principles:

a) Military aircraft should use the existing runway (RWY 11L/29R) only.

b) Aircraft for international civil air transport would mainly use the new runway (RWY 11R/29L), since an international passenger terminal is located in the Southern area.

c) Aircraft for domestic civil air transport would mainly use the existing runway (RWY 11L/29R), since the domestic passenger terminal remains in the Northern area.

d) If segregation of large and small aircraft is required to minimize vortex turbulence, the new RWY 11R/29L would be used by large aircraft since it is longer than the existing RWY 11L/29R.

e) RWY 11L and 11R would be used primarily since these have precision approach capability.

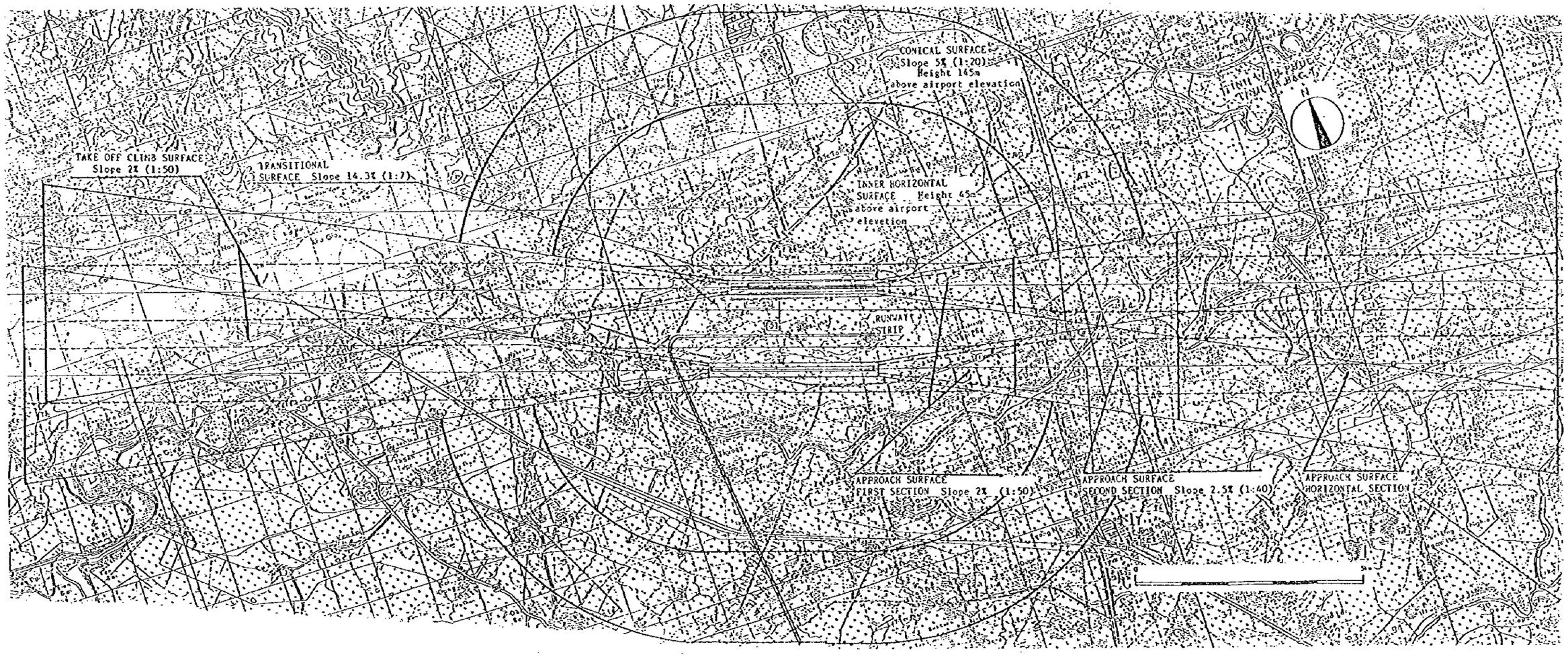



Figure 9.3.1 Obstacle Limitation Surfaces for Alternative Development Plans

## 9.4 PRELIMINARY COST ESTIMATES

### 9.4.1 Basic Conditions of Estimate

A preliminary cost estimate for each alternative development plan has been prepared based on the following considerations.

a) Construction costs were estimated based on the 1995 prices for works of international standard quality.

b) Exchange rates were fixed at US$ 1.00 = VND 11,000 = ¥ 100

c) Price escalation was not included.

d) Cost for engineering services was estimated to be about 10% of the construction cost

e) Contingencies were estimated to be about 10% of the total cost

### 9.4.2 Result of Estimates

Table 9.4.1 summarizes the preliminary cost estimates for each alternative development plan. Further breakdowns of the cost of each alternative are shown in Tables 9.4.2 through 9.4.5.

Table 9.4.1 Summary of Cost Estimates (US$ million)

| | Medium Term | Long Term | Total |
|---|---|---|---|
| Alternative-1(a) | 473 | 109 | 582 |
| Alternative-1(b) | 479 | 109 | 588 |
| Alternative-2(a) | 449 | 113 | 562 |
| Alternative-2(b) | 481 | 101 | 582 |

Table 9.4.2 Cost Breakdown of Alternative-1(a)

(Unit: US$)

| Item | Medium Term | Long Term | Total |
|---|---|---|---|
| Construction Cost | 360,290,000 | 90,200,000 | 450,490,000 |
| Diversion & Relocation | 7,360,000 | 0 | 7,360,000 |
| Diversion of Noi Bai Canal | 650,000 | 0 | 650,000 |
| Diversion of Irrigation Channel | 890,000 | 0 | 890,000 |
| Diversion of Power Transmission Line | 200,000 | 0 | 200,000 |
| Diversion of Telephone Line | 120,000 | 0 | 120,000 |
| Diversion of National Road No. 2 | 2,000,000 | 0 | 2,000,000 |
| Relocation of RX Station | 0 | 0 | 0 |
| Relocation of Fuel Storage "N-2" | 3,500,000 | 0 | 3,500,000 |
| Airport Civil Works | 185,480,000 | 17,480,000 | 202,960,000 |
| Earthworks & Drainage | 45,100,000 | 4,400,000 | 49,500,000 |
| Runway, Taxiway and Apron | 89,410,000 | 8,270,000 | 97,680,000 |
| Roads & Car Park | 21,370,000 | 2,940,000 | 24,310,000 |
| Taxiway Bridge | 8,200,000 | 0 | 8,200,000 |
| Miscellaneous Works | 21,400,000 | 1,870,000 | 23,270,000 |
| Building Works | 95,690,000 | 39,220,000 | 134,910,000 |
| New Passenger Terminal Building | 77,860,000 | 28,390,000 | 106,250,000 |
| Renovation of Passenger Terminal Building | 1,600,000 | 0 | 1,600,000 |
| New Cargo Terminal Building | 8,610,000 | 8,960,000 | 17,570,000 |
| Other Buildings | 7,620,000 | 1,870,000 | 9,490,000 |
| Special Equipment | 11,890,000 | 2,100,000 | 13,990,000 |
| Airport Utilities | 22,200,000 | 4,900,000 | 27,100,000 |
| Fuel Supply System | 17,600,000 | 20,000,000 | 37,600,000 |
| Fire Fighting Vehicles | 2,100,000 | 0 | 2,100,000 |
| Airport Maintenance Equipment | 400,000 | 0 | 400,000 |
| Air Navigation System | 17,700,000 | 6,500,000 | 24,200,000 |
| Land Acquisition & Compensation | 34,020,000 | 0 | 34,020,000 |
| Consultancy Services | 36,030,000 | 9,020,000 | 45,050,000 |
| Contingency | 42,660,000 | 9,780,000 | 52,440,000 |
| Total Cost | 473,000,000 | 109,000,000 | 582,000,000 |

Table 9.4.3 Cost Breakdown of Alternative-1(b)

(Unit: US$)

| Item | Medium Term | Long Term | Total |
|---|---|---|---|
| Construction Cost | 365,080,000 | 90,060,000 | 455,140,000 |
| Diversion & Relocation | 9,840,000 | 170,000 | 10,010,000 |
| Diversion of Noi Bai Canal | 430,000 | 170,000 | 600,000 |
| Diversion of Irrigation Channel | 890,000 | 0 | 890,000 |
| Diversion of Power Transmission Line | 200,000 | 0 | 200,000 |
| Diversion of Telephone Line | 120,000 | 0 | 120,000 |
| Diversion of National Road No. 2 | 2,000,000 | 0 | 2,000,000 |
| Relocation of RX Station | 2,700,000 | 0 | 2,700,000 |
| Relocation of Fuel Storage "N-2" | 3,500,000 | 0 | 3,500,000 |
| Airport Civil Works | 187,660,000 | 17,480,000 | 205,140,000 |
| Earthworks & Drainage | 46,200,000 | 4,400,000 | 50,600,000 |
| Runway, Taxiway and Apron | 90,920,000 | 8,270,000 | 99,190,000 |
| Roads & Car Park | 20,490,000 | 2,640,000 | 23,130,000 |
| Taxiway Bridge | 8,200,000 | 0 | 8,200,000 |
| Miscellaneous Works | 21,850,000 | 1,860,000 | 23,710,000 |
| Building Works | 95,690,000 | 39,220,000 | 134,910,000 |
| New Passenger Terminal Building | 77,860,000 | 28,390,000 | 106,250,000 |
| Renovation of Passenger Terminal Building | 1,600,000 | 0 | 1,600,000 |
| New Cargo Terminal Building | 8,610,000 | 8,960,000 | 17,570,000 |
| Other Buildings | 7,620,000 | 1,870,000 | 9,490,000 |
| Special Equipment | 11,890,000 | 2,100,000 | 13,990,000 |
| Airport Utilities | 22,200,000 | 4,900,000 | 27,100,000 |
| Fuel Supply System | 17,600,000 | 20,000,000 | 37,600,000 |
| Fire Fighting Vehicles | 2,100,000 | 0 | 2,100,000 |
| Airport Maintenance Equipment | 400,000 | 0 | 400,000 |
| Air Navigation System | 17,700,000 | 6,500,000 | 24,200,000 |
| Land Acquisition & Compensation | 34,020,000 | 0 | 34,020,000 |
| Consultancy Services | 36,510,000 | 9,010,000 | 45,520,000 |
| Contingency | 43,390,000 | 9,930,000 | 53,320,000 |
| Total Cost | 479,000,000 | 109,000,000 | 588,000,000 |

Table 9.4.4 Cost Breakdown of Alternative-2(a)

(Unit: US$)

| Item | Medium Term | Long Term | Total |
|---|---|---|---|
| Construction Cost | 349,880,000 | 90,440,000 | 440,320,000 |
| Diversion & Relocation | 7,140,000 | 0 | 7,140,000 |
| Diversion of Noi Bai Canal | 430,000 | 0 | 430,000 |
| Diversion of Irrigation Channel | 890,000 | 0 | 890,000 |
| Diversion of Power Transmission Line | 200,000 | 0 | 200,000 |
| Diversion of Telephone Line | 120,000 | 0 | 120,000 |
| Diversion of National Road No. 2 | 2,000,000 | 0 | 2,000,000 |
| Relocation of RX Station | 0 | 0 | 0 |
| Relocation of Fuel Storage "N-2" | 3,500,000 | 0 | 3,500,000 |
| Airport Civil Works | 175,160,000 | 17,720,000 | 192,880,000 |
| Earthworks & Drainage | 44,000,000 | 4,400,000 | 48,400,000 |
| Runway, Taxiway and Apron | 95,210,000 | 8,270,000 | 103,480,000 |
| Roads & Car Park | 15,290,000 | 3,130,000 | 18,420,000 |
| Taxiway Bridge | 0 | 0 | 0 |
| Miscellaneous Works | 20,660,000 | 1,920,000 | 22,580,000 |
| Building Works | 95,690,000 | 39,220,000 | 134,910,000 |
| New Passenger Terminal Building | 77,860,000 | 28,390,000 | 106,250,000 |
| Renovation of Passenger Terminal Building | 1,600,000 | 0 | 1,600,000 |
| New Cargo Terminal Building | 8,610,000 | 8,960,000 | 17,570,000 |
| Other Buildings | 7,620,000 | 1,870,000 | 9,490,000 |
| Special Equipment | 11,890,000 | 2,100,000 | 13,990,000 |
| Airport Utilities | 22,200,000 | 4,900,000 | 27,100,000 |
| Fuel Supply System | 17,600,000 | 20,000,000 | 37,600,000 |
| Fire Fighting Vehicles | 2,100,000 | 0 | 2,100,000 |
| Airport Maintenance Equipment | 400,000 | 0 | 400,000 |
| Air Navigation System | 17,700,000 | 6,500,000 | 24,200,000 |
| Land Acquisition & Compensation | 23,490,000 | 3,240,000 | 26,730,000 |
| Consultancy Services | 34,980,000 | 9,040,000 | 44,020,000 |
| Contingency | 40,650,000 | 10,280,000 | 50,930,000 |
| Total Cost | 449,000,000 | 113,000,000 | 562,000,000 |

Table 9.4.5 Cost Breakdown of Alternative-2(b)

(Unit: US$)

| Item | Medium Term | Long Term | Total |
|---|---|---|---|
| Construction Cost | 370,830,000 | 83,510,000 | 454,340,000 |
| Diversion & Relocation | 9,800,000 | 170,000 | 9,970,000 |
| Diversion of Noi Bai Canal | 390,000 | 170,000 | 560,000 |
| Diversion of Irrigation Channel | 890,000 | 0 | 890,000 |
| Diversion of Power Transmission Line | 200,000 | 0 | 200,000 |
| Diversion of Telephone Line | 120,000 | 0 | 120,000 |
| Diversion of National Road No. 2 | 2,000,000 | 0 | 2,000,000 |
| Relocation of RX Station | 2,700,000 | 0 | 2,700,000 |
| Relocation of Fuel Storage "N-2" | 3,500,000 | 0 | 3,500,000 |
| Airport Civil Works | 193,450,000 | 10,620,000 | 204,070,000 |
| Earthworks & Drainage | 48,400,000 | 2,200,000 | 50,600,000 |
| Runway, Taxiway and Apron | 103,880,000 | 4,890,000 | 108,770,000 |
| Roads & Car Park | 18,620,000 | 2,540,000 | 21,160,000 |
| Taxiway Bridge | 0 | 0 | 0 |
| Miscellaneous Works | 22,550,000 | 990,000 | 23,540,000 |
| Building Works | 95,690,000 | 39,220,000 | 134,910,000 |
| New Passenger Terminal Building | 77,860,000 | 28,390,000 | 106,250,000 |
| Renovation of Passenger Terminal Building | 1,600,000 | 0 | 1,600,000 |
| New Cargo Terminal Building | 8,610,000 | 8,960,000 | 17,570,000 |
| Other Buildings | 7,620,000 | 1,870,000 | 9,490,000 |
| Special Equipment | 11,890,000 | 2,100,000 | 13,990,000 |
| Airport Utilities | 22,200,000 | 4,900,000 | 27,100,000 |
| Fuel Supply System | 17,600,000 | 20,000,000 | 37,600,000 |
| Fire Fighting Vehicles | 2,100,000 | 0 | 2,100,000 |
| Airport Maintenance Equipment | 400,000 | 0 | 400,000 |
| Air Navigation System | 17,700,000 | 6,500,000 | 24,200,000 |
| Land Acquisition & Compensation | 29,160,000 | 0 | 29,160,000 |
| Consultancy Services | 37,080,000 | 8,350,000 | 45,430,000 |
| Contingency | 43,930,000 | 9,140,000 | 53,070,000 |
| Total Cost | 481,000,000 | 101,000,000 | 582,000,000 |

## 9.5 INITIAL ENVIRONMENTAL EXAMINATION

### 9.5.1 General

Environmental considerations are intended to forecast and evaluate the nature and scale of possible adverse impacts caused by development projects, and to prepare environmental protection plans and appropriate countermeasures, should significant adverse impacts are expected.

If appropriate environmental considerations are not made the nearby population's social and economic well-being may be endangered. As a result, the project itself may be suspended or even terminated. It is, therefore, important to promote sustainable development by harmonizing development projects with environmental conservation measures.

An Initial Environmental Examination (IEE) is the first step of an environmental consideration. To conduct the IEE, it is essential to fully understand the project and the surrounding site at the outset. Chapters 1 through 7 and preceding sections of this chapter describe the contents and features of the project, such as its background, objectives, location and scale of the development. Chapter 8 outlines the existing conditions of the site.

### 9.5.2 Impacts to be Examined in IEE

The IEE normally requires an examination of the following 23 environmental impacts that may result from project implementation, not only in the project area but also in any area that may be directly or indirectly affected during construction and the subsequent operation of the facilities.

Social Environment

a) Impact by Resettlement
b) Impact on Economic Activities
c) Impact on Traffic and Public Facilities
d) Impact by Split of Communities
e) Impact on Cultural Property
f) Impact on Water Rights and Rights of Common
g) Impact on Public Health Condition
h) Impact on Waste
i) Impact by Hazards

Natural Environment

a) Impact on Topography and Geology
b) Impact by Soil Erosion
c) Impact on Groundwater
d) Impact on Hydrological Situation
e) Impact on Coastal Zone
f) Impact on Flora and Fauna
g) Impact on Meteorology
h) Impact on Landscape

Pollution

a) Impact by Air Pollution
b) Impact by Water Pollution
c) Impact by Soil Contamination
d) Impact by Noise and Vibration
e) Impact by Land Subsidence
f) Impact by Offensive Odor

In the case of the New Development Plan of Hanoi International Airport, seven of these 23 environmental issues need not be examined for the following reasons:

a) Public Health Condition: No large increases in vermin which deteriorate public health and sanitary conditions, can be expected.
b) Groundwater: No activities that cause exhaustion of groundwater due to over drafting and pollution by leachate are foreseen.
c) Coastal Zone: The project site is not located around the coastal zone.
d) Meteorology: No large scale land reclamation and building construction is planned that might change temperature, precipitation and wind around the site.
e) Soil Contamination: No construction works are planned that might cause soil contamination by dust and asphalt emulsion.
f) Ground Subsidence: No activities are foreseen that would cause deformation of land or land subsidence due to the lowering of groundwater tables.
g) Offensive Odor: No construction works and facilities operations are foreseen that would cause offensive odor.

Therefore, the remaining 16 environmental impacts have been examined in the IEE. Section 9.5.3 describes the results of IEE of New Development Plan of Hanoi International Airport.

### 9.5.3 Results of IEE

#### 1) Social Environment

##### (1) Impact by Resettlement

Land acquisition for the airport development will require a large scale resettlement of local people especially in the southern area of the access road. These people will face loss of their familiar living environment. Social and cultural inadaptability to the new settlement site is a potential problem. Conflict between the original residents and those resettled may occur. These problems could result in social and economic burdens, and deterioration of living standards after resettlement due to inadequate compensation. The scale of impact depends on the number resettled. Since all Alternatives will require land acquisition of 340 to 420 ha, the impact of resettlement will be considerable. A more detailed examination of the population, economic conditions and conditions of the new resettlement site is, therefore, required in the Environmental Impact Assessment (EIA).

The following measures for resettlement will be required as part of the implementation of the project.

a) public hearings and meetings between authorities concerned and residents;
b) open exchanges of information;
c) selection of the resettlement site taking account the wishes of the residents;
d) improving of living and economic conditions at the resettlement site;
e) adequate and impartial compensation systems; and
f) job training and guidance.

The impacts by resettlement under Alternatives 2(a) and 2(b) would be somewhat less than that under Alternatives 1(a) and 1(b) because of the less land will need to be acquired.

(2) Impact on Economic Activities

The loss of arable land and fishing areas will erode the bases of livelihoods. Change of land use, traffic systems, commodity distribution routes and volume in and around the site will cause changes in economic structures. The impact by large scale project like this will also stimulate the regional economy and create job opportunities; therefore, it is considered the impact will be positive impact rather than negative. The impact on economic activities is, therefore, need not be examined further in the EIA.

As a preliminary assessment, the impact on economic activity of all Alternatives is of a similar magnitude, since the scale and site of the project are almost the same in each case.

(3) Impact on Traffic and Public Facilities

The increase of traffic volumes on access roads and spatial land occupancy by the airport facilities will have impacts on public facilities such as schools and hospitals, and traffic conditions (e.g. increase of traffic congestion and accidents). A part of National Road No. 2 needs to be relocated when the second runway is constructed. The preliminary realignment and crossing of the existing airport access road, which has been conceived in this Study, does not seem to create any adverse environmental impacts. Further considerations for the traffic system and public facilities will be made in the design stage; therefore, impact on traffic and public facilities need not be examined further in the EIA.

The impacts on traffic and public facilities of all Alternatives is considered to be of a similar magnitude, since the scale and site of the project are almost the same in each case.

(4) Impact by Split of Communities

In general, an introduction of spatial land occupancy such as by an airport may interrupt the existing traffic routes, split communities and create detached territories and isolated areas. This could inconvenience the daily activities of residents, and diminish economic activities. In such a case, sufficient compensation, such as creation of new community centers and arrangement of new traffic systems, will be required as countermeasures.

In the case of NBIA development project, however, the proposed site and its surroundings are mainly the farmland and relatively sparsely inhabited. Thus, the impact or splitting

communities does not seem to be a significant problem. The impact by splitting communities, therefore, need not be examined further in the EIA.

From a preliminary assessment, the impact by splitting communities under all Alternatives are considered to be of a similar magnitude, since the scale and site of the project are almost the same in each case.

(5) Impact on Cultural Property

Damage to and the loss of value of cultural assets, such as temples, churches and archaeological remains, may occur due to reclamation and the vibration from construction works, increase in pedestrian traffic, and the vibration and air pollution from aircraft and vehicle operations.

Although there is no officially registered cultural property to be preserved in and around the site, a more detailed survey is considered necessary to determine the existence of any cultural properties. Based on the detailed survey, the impact on cultural property will be examined further in the EIA.

As a preliminary assessment, the impacts on cultural property under all Alternatives are considered to have similar magnitude, since the scale and site of the project are almost the same in each case.

(6) Impact on Water Rights and Rights of Common

Fishing rights in a river and water use rights will be obstructed by land acquisition and an increase in traffic. This obstruction will affect activities, such as fishing, domestic water use and irrigation. Water rights and the rights of common are often recognized by custom even if not by law. The magnitude of impact depends on the scale of the change of the waterway. Since all of the Alternatives need diversion of Noi Bai Canal (a 2,000 to 3,000 m section), a more detailed survey and examination are necessary in the EIA.

As a preliminary assessment, the impact on water rights and rights of common under Alternatives 1(b) and 2(a) would be a little less than those of Alternatives 1(a) and 2(b) because of the scale of diversion of the Noi Bai Canal.

(7) Impact on Waste

Problems of waste will be caused by debris, construction and demolition, and general waste from airport facilities and aircraft. Aquatic life and birds may be affected by water pollution caused by the inflow of waste into the rivers, lakes, ponds and canals. In cases of illegal disposal, hygienic conditions and aesthetic values of the area will deteriorate, and an outbreak of pathogenic insects and animals would worsen the sanitary conditions of the area; therefore, a more detailed survey and examination are required in the EIA.

As a preliminary assessment, impacts on waste under all of the Alternatives are considered to be of a similar magnitude because the scale and site of the project are almost the same in each case.

(8) Impact by Hazards

The risk of accidents will increase due to the increased operations of aircraft and the construction of storage facilities for hazardous materials such as aircraft fuel. Loss of and damage to the lives, livelihood, production, and houses of residents may occur due to aircraft accidents or by the explosion or leakage of hazardous material. The safe operation of aircraft is a prime concern in airport design and appropriate measures will also be made in design of hazardous material storage. Thus, the impact of hazards should be minimal for all Alternatives.

The impact of hazards, therefore, need not be examined further in the EIA.

2) Natural Environment

(1) Impact on Topography and Geology

Excavation and reclamation will cause the changes in the structure of topography and geology. Cave-ins and upheaval may be caused by upsetting soil balance due to large scale alterations. A preliminary assessment of the impact on topography and geology indicates no serious problems for all of Alternatives. These issues will be addressed further in the design stage based on the topographical and geological surveys, and considered appropriately during civil

engineering designs; therefore, the impact on Topography and Geology need not be further examined in the EIA.

(2) Impact by Soil Erosion

Soil erosion and flooding may occur due to the exposure of topsoil during the construction stage and the creation of a large paved area that increases rainwater runoff over a short period. These issues will also be addressed in the design stage, and appropriate surface protection and drainage systems will minimize any adverse effects; therefore, the impact by soil erosion and flood will not be serious problems for all Alternatives, and need not be examined further in the EIA.

(3) Impact on Hydrological Situation

Groundwater and surface water regimes will be affected by the paving of large areas that prevent infiltration of rain water and by earthworks which affect the rivers, lakes, ponds and canals. These changes in water regimes in turn may adversely affect the ecosystem; therefore, a more detailed examination based on the environmental survey is required in the EIA.

As a preliminary assessment, however, the impacts on the hydrological situation under all Alternatives will be of a similar magnitude, because the scale and site of the project are almost the same in all cases.

(4) Impact on Flora and Fauna

Vegetation on the sites will be removed, and it may bring about the loss of animal habitats. of Breeding disturbances and extinctions of species, due to change of habitat conditions, may result from: the spatial occupation and alteration of topography and vegetation; by the inflow of waste and drainage resulting from facility operations; and from exhaust gas and noise due to the construction of facilities and increased number of operations of aircraft and vehicles. Migratory routes and habitat areas could be disturbed by the airport facilities and operation of aircraft and vehicles. Fortunately, however, there are no natural forests or vulnerable ecosystems at the site because the existing land is mainly for farming. The impact on flora and fauna will, therefore, not be significant, but a more detailed survey is recommended in the EIA to confirm the present assessment.

The impact on flora and fauna under all Alternatives are considered to be very little and the magnitudes are similar because the scale and site of the project are almost the same in all cases.

(5) Impact on Landscape

The existing aesthetic harmony around the site may be disturbed by the advent of new and different facilities from a large scale project. Changes to the present landscape, which may have cultural values or close relationship with the lifestyle of the local people, may adversely affect tourism and the daily life of residents.

These issues are to be addressed throughout the planning and design stages, and appropriate protection measures shall be taken. In the case of NBIA project, however, the impact on landscape will not be a significant issue for all Alternatives, and thus need not be examined further in the EIA.

The impacts on the landscape under all Alternatives are considered to be of a similar magnitude because the scale and site of the project are almost the same in all cases.

**3) Pollution**

(1) Impact by Air Pollution

Air pollution will be increased due to exhaust gas and dust during the construction stage, as well as during the airport operation stage. Air pollution from toxic gas may be caused by oil and other spills. These may negatively impact the health of people, plants and animals. A more detailed examination is, therefore, necessary in the EIA.

The adverse impacts of air pollution under all Alternatives are considered to be of a similar magnitude because the scale and site of the project are almost the same in all cases.

(2) Impact by Water Pollution

The pollution of rivers, lakes, ponds, canals and groundwater may increase due to the generation of turbid water during the construction stage (change of inflows, and disturbances of sand and silt caused by reclamation), and the discharge of waste water from airport

operations, runoff of spilt material washed from aprons, etc. Health hazards to residents through the food chain may occur, if drainage contains toxic substances. Water use of residents and industries utilizing the water zone may be affected. In order to prevent these adverse impacts, careful planning and design will be required, both for construction and operation phases, including the installation of proper collection and treatment systems; therefore, a more detailed examination will be required in the EIA.

Impacts of water pollution under all Alternatives are considered to be of a similar magnitude because the scale and site of the project are almost the same I all cases.

(3) Impact by Noise and Vibration

In general, noise and vibration will be increased by the operation of construction equipment and detonations during the construction stage, and operation of aircraft and vehicles during the operation stage. This may adversely affect the daily life of residents (e.g. take-offs and landings of aircraft at night would disturb sleep) and facilities such as hospitals and schools which require tranquillity. Interference of livestock breeding and the dispersion of wildlife could also be a problem; therefore, a more detailed examination will be required in the EIA.

The adverse impact of aircraft noise under all Alternatives are considered to be of a similar magnitude because the scale and site of the project are almost the same in all cases.

### 9.5.4 Issues to be Examined in Environmental Impact Assessment

The examination of Alternatives has made clear that the several environmental issues shown in Table 9.5.1 would require more detailed examination in the Environmental Impact Assessment (EIA).

## Table 9.5.1 Environmental Issues to be Examined in EIA

| Environmental | | Major Facilities/Activities: Airports / Access roads | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Activities which may cause impacts | Overall Evaluation | Before Operation | | After Operation | | | |
| | | | Reclamation and Spatial Occupancy | Operation of Construction Equipment and Vehicles | Spatial Occupancy | Operation of Vehicles | Operation of Airplanes | Operation of Facilities |
| Social Environment | 1 Resettlement | O | O | | | | | |
| | 2 Economic Activities | | | | | | | |
| | 3 Traffic and Public Facilities | | | | | | | |
| | 4 Split of Communities | | | | | | | |
| | 5 Cultural Property | O | O | | | | O | |
| | 6 Water Rights·Rights of Common | O | | | O | | O | |
| | 7 Public Health Condition | | | | | | | |
| | 8 Waste | O | O | | | | | O |
| | 9 Hazards ( Risk ) | | | | | | | |
| Natural Environment | 10 Topography and Geology | | | | | | | |
| | 11 Soil Erosion | | | | | | | |
| | 12 Groundwater | | | | | | | |
| | 13 Hydrological Situation | O | O | | O | | | O |
| | 14 Coastal Zone | | | | | | | |
| | 15 Fauna and Flora | O | O | O | O | O | O | O |
| | 16 Meteorology | | | | | | | |
| | 17 Landscape | | | | | | | |
| Pollution | 18 Air Pollution | O | | O | | O | O | |
| | 19 Water Pollution | O | O | | | | | O |
| | 20 Soil Contamination | | | | | | | |
| | 21 Noise and Vibration | O | | O | | O | O | |
| | 22 Land Subsidence | | | | | | | |
| | 23 Offensive Odor | | | | | | | |

Note.O : The environmental issues to which special attention has to be paid, because they might cause serious adverse impacts that may affect the project formulation, depending on the magnitude of the impacts and the possible countermeasures.

No mark : The environmental items which require no impact assessment since the anticipated impacts are not significant.

## 9.6 SELECTION OF OPTIMUM DEVELOPMENT PLAN

### 9.6.1 Evaluation Criteria

In order to make comprehensive evaluation of the alternatives, the following evaluation criteria were established.

a) Aircraft Operation:
- No obstacle above the obstacle limitation surfaces
- No limitation in establishing instrument flight procedures
- Short aircraft taxiing distance

b) Convenience of Passengers:
- Short walking distance for originating and terminating passengers
- Short walking distance for transferring passengers

c) Convenience of Airlines:
- Short distance for transporting originating and terminating baggage
- Short distance for transporting transfer baggage
- Short distance for transporting cargo between passenger loading apron and cargo terminal

d) Convenience of Airport Authority:
- Proximity of major functions and facilities
- Good visibility of all airport operation from the control tower
- Short response time for rescue and fire fighting services

e) Flexibility to Cope with Unexpected Changes in Demand and Technology:
- Maximum possible flexibility for changing the size of facilities

f) Future Expandability:
- Large potential for expansion in the future

g) Impact on Environment:
- Least land acquisition
- Least number of households to be relocated
- Least relocation and/or diversion of existing public facilities
- Least people affected by aircraft noise pollution

h) Construction Considerations:
- Ease of Construction
- Least construction cost
- Least land acquisition

- Least relocation and/or diversion of existing airport facilities
- Least relocation and/or diversion of existing public facilities.

### 9.6.2 Comparative Evaluation of Development Alternatives

Table 9.6.1 summarises evaluation results of four alternative development plans.

### 9.6.3 Conclusion

As a result of the comparative evaluation, Alternative-2(a) was considered to be the best option for the southern area development. The major reasons for selecting Alternative-2(a) were;

a) It will provide the maximum flexibility for future development beyond the year 2015, since physical expansion to the west will not be impeded by a connecting taxiway.
b) With no connecting taxiway on the west side, lowering of Access Road will not be required,
c) ease of operation and maintenance for the airport authority because major activities and facilities will not be scattered over a wide area.

Table 9.6.1 Comparison of Alternative Development Plans

| Item | | Alternative-1(a) | | Alternative-1(b) | | Alternative-2(a) | | Alternative-2(b) |
|---|---|---|---|---|---|---|---|---|
| 1. Aircraft Operation<br>1.1 Obstacles | F | Two mountain peaks, about 6km north of the Airport, infringe the north conical surface. These would not adversely affect the safety of aircraft operations. | F | - ditto - | F | - ditto - | F | - ditto - |
| 1.2 Establishment of Flight Procedure | G | No problem in establishment of flight procedures including ILS Cat-II approach. | G | - ditto - | G | - ditto - | G | - ditto - |
| 1.3 Taxiing Distance | F | Reasonable taxiing distance in the normal operations since the terminals are located in the central area.<br><br>Even in the case of closing one runway, good circulation route for taxiing aircraft can be maintained.<br><br>In the case of closing a section of parallel taxiway, a runway may be used for taxiing. | F | - ditto -<br><br>- ditto -<br><br>- ditto - | F | - ditto -<br><br>In the case of closing one runway, additional taxiing of about 1 to 4km is required depend on the parking position.<br><br>Closing a section of parallel taxiway cause no problem because there are dual taxiways. | F | - ditto -<br><br>In the case of closing one runway, additional taxiing of about 3 to 5km is required depend on the parking position.<br><br>- ditto - |
| 2. Convenience of Passengers<br>2.1 Walking Distance for Originating/Terminating Passengers | G | Maximum about 300m depending on the design of the terminal building. | G | - ditto - | G | - ditto - | G | - ditto - |
| 2.2 Walking Distance for Transferring Passengers | F | Maximum about 500m and 700m within the international terminal in the Medium and Long Term respectively.<br><br>Transfer between international and domestic requires a travel of about 1.0km. Terminal circulation bus service is required. | F | - ditto -<br><br>Transfer between international and domestic requires a travel of about 1.5km. Terminal circulation bus service is required. | F | - ditto -<br><br>The same as Alternative-1(a). | F | - ditto -<br><br>The same as Alternative-1(b). |
| 3. Convenience of Airlines<br>3.1 Handling of Originating/Terminating Baggage | G | No specific problem in handling originating and terminating baggage. | G | - ditto - | G | - ditto - | G | - ditto - |
| 3.2 Handling of Transfer Baggage | F | Maximum 600m and 800m between international flights in Medium and Long Term respectively.<br><br>Maximum 600m between domestic flights.<br><br>Transfer between international and domestic requires transport of about 1.0km at landside. | F | - ditto -<br><br>- ditto -<br><br>The same as Alternative-1(a), but the maximum transport of about 1.5km. | F | - ditto -<br><br>- ditto -<br><br>The same as Alternative-1(a). | F | - ditto -<br><br>- ditto -<br><br>The same as Alternative-1(b). |
| 3.3 Handling of Cargo | F | Maximum transportation of international berry cargo is about 1 and 1.2km in Medium and Long Term respectively. | F | Maximum transportation of international berry cargo is about 0.9 and 1.1km in Medium and Long Term respectively. | F | The same as Alternative-1(a). | F | The same as Alternative-1(b). |
| 3.4 Flexibility in Use of Aircraft | P | It is costly to use an aircraft arrived as a domestic flight for an international flight (or vice versa), because it require long taxiing (or towing) of aircraft or transporting passengers by ramp buses at airside. | P | - ditto - | P | - ditto - | P | - ditto - |
| 4. Convenience of Airport Authority<br>4.1 Proximity of Major Functions | F | Major functions are located within 1.5km x 0.7km area in Medium Term. It will be extended to 2km x 0.7 km in Long Term . | P | Major functions are located within 2.5km x 0.7km area. | F | The same as Alternative-1(a). | P | The same as Alternative-1(b). |
| 4.2 Visibility from Control Tower | F | Furthest end of runway is 11R at about 2.1km from the new control tower. Good visibility can be achieved. | F | - ditto - | F | - ditto - | F | - ditto - |
| 4.3 Response Time of Fire Fighting Services | F | Response time can be maintained within 2 to 3 minutes by provision of a satellite fire station. | F | - ditto - | F | - ditto - | F | - ditto - |

Note: G : Good, F : Fair, P : Poor

Table 9.6.1 Comparison of Alternative Development Plans (Continued)

| Item | Alternative-1(a) | Alternative-1(b) | Alternative-2(a) | Alternative-2(b) |
|---|---|---|---|---|
| 5. Flexibility to Cope with Unexpected Demand Change | F No problem in minor change in the size of project. Major change in traffic demand, however, may affect the viability of development of the southern area in Medium Term. | F - ditto - | F - ditto - | F - ditto - |
| 6. Expandability | F Reasonable spaces for future expansion can be reserved, but there is some restriction by the connecting taxiways at both sides. | F - ditto - | G Reasonable spaces for future expansion can be reserved. No physical restriction by a connecting taxiway on the western side. | G - ditto - |
| 7. Environmental Impact<br>7.1 Land Acquisition | P Medium Term 420 ha<br>Long Term 0 ha<br>Total 420 ha | P - ditto - | G Medium Term 290 ha<br>Long Term 40 ha<br>Total 310 ha | F Medium Term 360 ha<br>Long Term 0 ha<br>Total 360 ha |
| 7.2 Relocation of Households | F About 1,080 households. | F - ditto - | F About 1,040 households. | F About 1,080 households. |
| 7.3 Relocation of Public Facilities | F Lowering Access Road<br>Diversion of National Road No 2<br>Diversion of Noi Bai Canal<br>Diversion of Irrigation Channel<br>Diversion of Power & Telephone Lines | F Lowering Access Road<br>Diversion of National Road No 2<br>Diversion of Noi Bai Canal<br>Diversion of Irrigation Channel<br>Diversion of Power & Telephone Lines | G Diversion of National Road No.2<br>Diversion of Noi Bai Canal<br>Diversion of Irrigation Channel<br>Diversion of Power & Telephone Lines | G Diversion of National Road No.2<br>Diversion of Noi Bai Canal<br>Diversion of Irrigation Channel<br>Diversion of Power & Telephone Lines |
| 7.4 Aircraft Noise Pollution | F Some pollution at Thang Lai, Phu Xa Dong, Thai Phu and Thach Loi Villages. | F - ditto - | F - ditto - | F - ditto - |
| 8. Construction<br>8.1 Construction Cost | F Medium Term US$ 486 million.<br>Long Term US$ 111 million.<br>Total US$ 597 million. | F Medium Term US$ 492 million.<br>Long Term US$ 111 million.<br>Total US$ 603 million. | F Medium Term US$ 462 million.<br>Long Term US$ 115 million.<br>Total US$ 577 million. | F Medium Term US$ 493 million.<br>Long Term US$ 103 million.<br>Total US$ 596 million. |
| 8.2 Land Acquisition | P Medium Term 420 ha<br>Long Term 0 ha<br>Total 420 ha | P - ditto - | G Medium Term 290 ha<br>Long Term 40 ha<br>Total 310 ha | F Medium Term 360 ha<br>Long Term 0 ha<br>Total 360 ha |
| 8.3 Relocation of Airport Facilities | F Receiving Station<br>Fuel Storage N-2<br>Administration Building<br>Customs & Immigration Complexes<br>Part of Staff Housing | F Receiving Station<br>Fuel Storage N-2<br>Administration Building | F The same as Alternative-1(a) | F The same as Alternative-1(b) |
| 8.4 Relocation of Public Facilities | F Lowering Access Road<br>Diversion of National Road No 2<br>Diversion of Noi Bai Canal | F Lowering Access Road<br>Diversion of National Road No.2<br>Diversion of Noi Bai Canal | G Diversion of National Road No.2<br>Diversion of Noi Bai Canal | G Diversion of National Road No.2<br>Diversion of Noi Bai Canal |
| Overall Score | G:3, F:16, P:3 | G:3, F:15, P:4 | G:8, F:13, P:1 | G:6, F:14, P:2 |
| Comparative Advantages | | | No physical restriction of expansion to the west.<br>Less relocation of public facilities | No physical restriction of expansion to the west.<br>Less relocation of public facilities |
| Comparative Disadvantages | Whole land needs to be acquired in Medium Term. | Whole land needs to be acquired in Medium Term.<br>Airport functions are scattered in the wide area. | | Airport functions are scattered in the wide area. |

Note: G : Good, F : Fair, P : Poor

## 9.7 FINANCIAL ANALYSES OF THE SELECTED DEVELOPMENT PLAN

### 9.7.1 General

The financial analysis in this section examines the financial returns of investments needed to implement the medium- and long-term developments plans at Noi Bai International Airport, which were selected in the previous section. Since the Vietnamese Government has already decided the implementation of the short-term development, i.e., the T1 Project, the analysis treats completion of this project as the "status quo". The objective of the present analysis is to determine whether the longer term development plans are financially feasible.

The evaluation is carried out by comparing revenues and costs in terms of the financial internal rate of returns (FIRR). Detailed analyses, based on income and fund statements and sensitivity tests, will be provided in the feasibility study for the medium-term development plan later in this Study.

### 9.7.2 "With Project" (WP) Case and "Without Project" (WOP) Case

The investments required to implement the medium- and long- term development plans will be additional investments for the expansion of airport capacity; therefore, the returns of the Project (hereinafter defined as a combined plan for the medium- and long-term developments) should be evaluated as incremental revenues derived from the expansion of airport capacity. Revenues and costs should, therefore, be compared between the following two cases:

- **With Project (WP) Case**: The medium- and long-term development plans will be implemented and airport capacity will be expanded to handle increases in air traffic.

- **Without Project (WOP) Case**: No investments will be made after the T1 Project, and airport capacity will remain at the maximum of the T1 Project.

The design capacity of the T1 Project was determined in Section 7.2 to be about 4.5 mppa (million passenger per annum), which would be reached in the year 2003 according to the medium forecast. Although it is difficult to determine the absolute capacity of the terminal building, the levels of service (LOS) standard defined by the IATA suggests that the terminal building can handle 120% of design passenger throughput at acceptable minimum service levels and maximum delays. The T1 terminal, therefore, should be able to handle a maximum of 5.5 mppa, which will accommodate air traffic increases up to the year 2005.

In the WOP case, air traffic at Noi Bai Airport will be restricted to a maximum of 5.5 mppa, while in the WP case it will continue to grow until the maximum capacity of the long-term development plan is reached. This will be about 15 mppa, calculated as 120% of the design capacity (12.5 mppa), which is reached in the year 2018 in the medium forecast.

The incremental air traffic levels which can be accommodated after implementation of the Project is the difference between air traffic in the WP Case and the WOP Case, as shown in Figure 9.7.1.

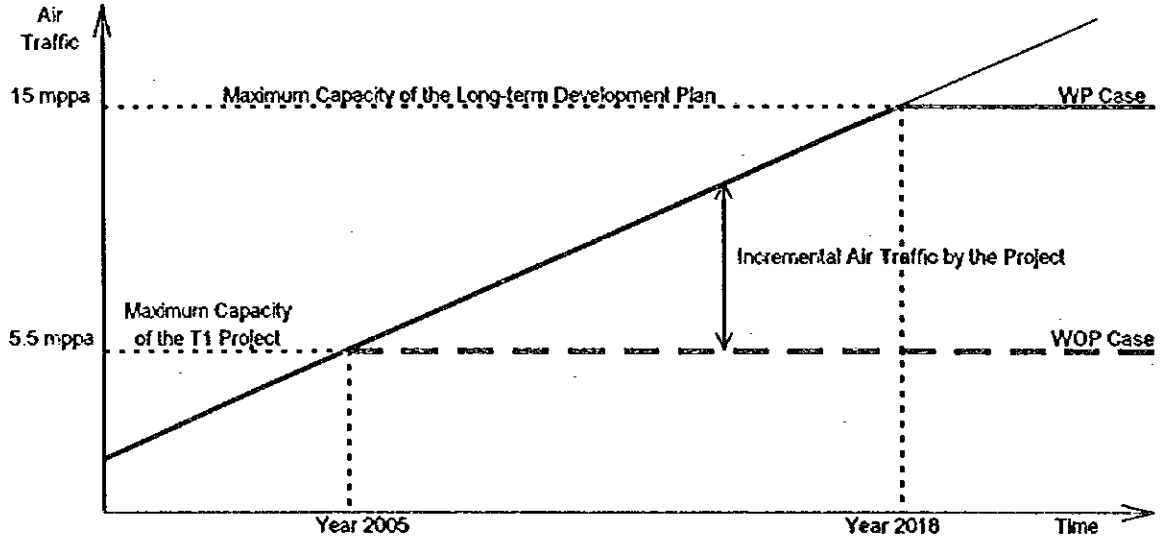



Figure 9.7.1 Air Passenger Traffic in the WP Case and the WOP Case

The number of air passengers, volume of air cargo, aircraft movements in the both cases and the incremental values of expanded airport capacity are shown in Appendices 9.7.1, 9.7.2 and 9.7.3.

### 9.7.3 General Assumptions

The general assumptions of the analysis are;

**1) Project Evaluation Period**

The project life is evaluated until 20 years from the start of operations of the medium-term development plan. Since the facilities of the medium-term development plan will complete in the year 2005 and they will be operated from 2006, the project is evaluated until the year 2025.

**2) Project Costs and Revenues**

The costs and revenues are estimated at 1995 market prices in U.S. dollars. No price inflation is factored in, assumed that general increases in costs would be met with increases in airport charges and improvements in productivity.

### 3) Foreign Exchange Rate

The exchange rate has fixed at US$1.0 = VND11,000 for the entire project evaluation period. This assumption simultaneously assumes that nominal exchange rate will be adjusted by reflecting the relative differences in inflation rates in the United States and Vietnam.[1]

### 4) Residual Value

Residual values are calculated over a 30 year depreciation period for civil works and buildings. No residual values are considered for equipment since their depreciation periods are less than 15 years.

### 5) Project Entity (Owner)

The entity (owner) of the Project in this Study is a hypothetical organization which invests in and operates facilities planned in the medium- and long-term developments. It almost duplicates the Northern Airport Region (NAR) at Noi Bai Airport, but also includes fuel supply operations and the management of car parks, which respectively come under the Vietnam Air Petrol Company (VINAPCO) and Northern Airport Services Company (NASCO) at present.

## 9.7.4 Costs of the Project

### 1) Construction Costs

The construction costs estimated in Section 9.4 are distributed over time periods taking into consideration the anticipated project implementation schedule. The methodology and the annual investment requirements are detailed in Appendix 9.7.4.

### 2) Operation and Maintenance Costs

The operation and maintenance costs consist of a) maintenance costs, b) personnel costs, overhead and other labor costs and c) utilities costs. They are respectively estimated as follows:

#### a) Maintenance Costs

Implementation of the Project will require additional funding to maintain expanded and upgraded facilities. This is estimated by multiplying the construction cost by

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[1] This is an important assumption. The Projects receives most of its income in U.S. dollar, while the major part of operation and maintenance costs will be paid in Vietnamese Dong. A relative strengthening of Vietnamese Dong, which seems to be occurring at present, will worsen the feasibility of the Project.

percentage rates, which differs from facility to facility. Details of the methodology are described in Appendix 9.7.5.

b) Personnel Costs, Overhead and Other Labor Costs

The number of staff required to manage, operate and maintain the airport will increase as the airport becomes larger. It is estimated based on the growth of air traffic less the rate of productivity improvement of the airport staff. It is assumed that the real personnel related cost (salaries, bonuses, pensions and insurance) per staff will increase at the same rate as the growth rate of GDP per capita in Vietnam while labor productivity will improve at the same rate.

The overhead and other labor cost are estimated using percentage rates obtained from the financial statements of the NAR. A detailed description of the estimated incremental personnel costs, overhead and other labor costs are shown in Appendix 9.7.6.

c) Utilities Costs

Utilities costs for electricity and fuel are estimated for both the WP Case and the WOP Case as shown in Appendix 9.7.7.

d) Operation and Maintenance Costs per Passenger

The operation and maintenance costs, i.e., the total maintenance, personnel, overhead, other labor, and utilities costs per passenger in the WP Case differs year by year, but it averages around US$2.5-3.0 per passenger. The corresponding figures at Bangkok and Hong Kong International Airports were US$ 3.2 per passenger and US$ 5.3 per passenger respectively in 1993. The lower cost per passenger at Noi Bai Airport is mainly due to lower personnel costs.

### 9.7.5 Revenues of the Project

The following operating revenues are considered for the analysis.

1) Landing charges
2) Parking charges
3) Passenger service charges
4) Terminal equipment charges
5) Concession fees
6) Car parking charges
7) Passenger and cargo terminal rents
8) Fuel surcharges
9) Advertisement revenues

Among these revenue items, 1), 2), 3), 4), 7) and 9) are currently collected by the NAR, while 6) and 8) are collected by NASCO and VINAPCO respectively. The concession fees, received for the transfer of commercial rights in the airports are expected to be introduced in line with current practices at many other airports in the world. The air navigation charge for overflying aircraft is not included in the project revenues since there is little relationship between the volume of overflying aircraft and airport capacity.

The principle applied for determining the rates for airport charges is by international comparison -- on they should be more or less the similar levels to those of neighboring countries and any increases in rates would be justified only when significant improvements in service levels are realized through the Project.

### 1) Landing Charges and Parking Charges

The current rates for landing charges for international flights at Noi Bai Airport are compared with other major airport in Southeast Asia in Table 9.7.1.

Table 9.7.1 International Landing Charges in Vietnam and Other Countries in Southeast Asia

| Country | B747 (395 tons) | DC 10 (252 tons) |
|---|---|---|
| Vietnam | US$2,458 | US$1,242 |
| Thailand | US$1,770 | US$1,130 |
| Hong Kong | US$3,040 | US$2,260 |
| Singapore | US$2,720 | US$1,680 |
| Indonesia | US$2,290 | US$1,420 |

Source: ICAO Manual on Airport and Air Route Navigation Facility Charges

The air navigation facilities charges, which are collected for air traffic services and use of air navigation facilities by the Air Navigation Department of Vietnam, is also collected for each arriving aircraft. Current rates for all countries in the comparison appear in Table 9.7.2.

Table 9.7.2 International Air Navigation Facilities Charges in Vietnam and Other Countries in Southeast Asia

| Country | B747 (395 tons) | DC 10 (252 tons) |
|---|---|---|
| Vietnam | US$1,150 | US$1,150 |
| Thailand | US$1,080 | US$1,030 |
| Hong Kong[2] | - | - |
| Singapore[3] | - | - |
| Indonesia[4] | US$660 | US$460 |

Source: ICAO Manual on Airport and Air Route Navigation Facility Charges

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2 Air navigation facilities charges are collected only from aircraft overflying through Hong Kong's airspace.

3 Air navigation facilities charges are collected only from aircraft overflying through Singapore airspace.

4 Air navigation Facilities charge from international landing aircraft with 1,000km distance flown through Indonesia airspace.

Combined airport charges per landing appear in Table 9.7.3.

Table 9.7.3 Cost per International Aircraft Landing in Vietnam and Other Countries in Southeast Asia

| Country | B747 (395 tons) | DC 10 (252 tons) |
|---|---|---|
| Vietnam | US$3,608 | US$2,392 |
| Thailand | US$2,850 | US$2,160 |
| Hong Kong | US$3,040 | US$2,260 |
| Singapore | US$2,720 | US$1,680 |
| Indonesia | US$2,950 | US$1,880 |

Source: Tables 9.7.1 and 9.7.2

The total charge for arriving flights in Vietnam is highest among other countries listed above. Although the runway at Noi Bai Airport will be lengthened and the quality of air traffic services and air navigation facilities will be improved by the Project, those improvements would be just as significaht as those facilities at other world class airports in Southeast Asia.

Therefore, no rises in landing charges are considered in the present analysis, and incremental landing charges are calculated based on the current rates. The calculation of landing and parking charges is shown in Appendix 9.7.8.

**2) Passenger Service Charges, Terminal Equipment Charges, Concession Fees and Car Parking Charges**

The current international passenger charge at Noi Bai Airport is US$7 per departing passenger. This rate is among the lowest in other countries in Southeast Asia as shown in Table 9.7.4.

Table 9.7.4 International Passenger Service Charge at Noi Bai and Other Major Airports in Southeast Asia

| Airport | International Passenger Service Charge |
|---|---|
| Hanoi | US$7.0 |
| Bangkok | US$8.1 |
| Hong Kong | US$6.5 |
| Singapore (except for Malaysia) | US$10.7 |
| Jakarta | US$9.4 |
| Manila | US$11.5 |
| Kuala Lumpur (except for Singapore) | US$8.1 |

Source: ABC Air Time Tables, June 1995

The low rate at Noi Bai Airport reflects the poor service levels in the present terminal building. Since the service levels will be significantly improved by implementing the Project, an increase in the passenger service charge will be justified. In the present Study, it is set at US$12 per international departing passenger, the feasibility level of the T1 Project. The domestic passenger service charge is assumed to rise from US$1.4 (VND15,000) to $2.7 (VND30,000).

international departing passenger, the feasibility level of the TI Project. The domestic passenger service charge is assumed to rise from US$1.4 (VND15,000) to $2.7 (VND30,000).

The terminal equipment charge is collected from airline companies for the use of passenger boarding bridges, check-in counters, weight scales and baggage conveyors. This charge is not collected as an independent charge at present, but the package payments agreed between Vietnam Airlines and the NAR seems to include it. The assumed rate is US$0.8 per international passenger and $0.2 per domestic passenger.

Concession fees, although not yet introduced at Noi Bai Airport, are commonly charged at many airports in the world. These fees are considered as valuable sources of revenue by many airport authorities, for example terminal buildings are sometimes renovated only to increase concession revenues. These fees are normally levied up to 5-7% of the gross sales of the concessionaires at the airport, depending on the type of businesses such as: duty free shop, restaurants and bars, souvenir shops, book shops, banks, hotel reservations, car rentals, public telephones, aviation fuel supply, etc.

A successful example is Hong Kong International Airport, where concession revenues are twice the revenues from passenger service charges.[5] At Bangkok International Airport, concession revenues (not including fuel and oil) in 1993 amounted to US$3.5 per international passenger, i.e., comparable to passenger service charge of US$4 per passenger (US$8 per departing passenger).

Since the new terminal building to be completed through the Project will allow sufficient space for airport retail outlets, this will be a source of new income. Given the relatively small size of buildings, however, compared with that at Bangkok Airport, it would be reasonable to estimate US$2.0 per international passenger. The expected revenues per domestic passenger is set at US$0.2 because no duty-free sales apply and the average income of these passengers would be lower.

The car parking charge has assumed to increase from US$0.45 (VND5,000) to US$0.9 (VND10,000).

The calculations of incremental passenger service charges, terminal equipment charges, concession fees and car parking charges are shown in Appendix 9.7.9.

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5 Accurately speaking, no passenger service charge is collected at Hong Kong International Airport. Instead, departure tax is collected, and incorporated into the general revenue of the Hong Kong Government.

### 3) Terminal Building Rents and Advertise Revenues

The revenues from passenger terminal rents, cargo terminal rents[6] and advertisements are also important potential incremental incomes through the Project. The unit rates for space rent and advertising are assumed to increase by about 20% from the present rates. The calculations of those incomes are shown in Appendix 9.7.10.

### 4) Fuel Surcharge Revenues

The hypothesized airport operator has assumed to sell aviation fuel to airline companies and recover the capital invested in the fuel storage and supply system.[7] A fuel surcharge (margin) of US$0.015 per liter is used for this analysis. The estimated incremental revenues from the supply of aviation fuel at Noi Bai Airport appears in Appendix 9.7.11.

### 5) Total Operating Revenues per Passenger

The total operating revenues per passenger are expected to increase from US$3.3 at present to US$9-9.5 per passenger in the WP Case (US$14.5-15 for an international passenger and US$5-5.5 per domestic passenger). The average unit revenue of international and domestic passengers is slightly lower than that at Bangkok International Airport (US$10.6 per passenger in 1993). Since more than 50% of passengers at Noi Bai Airport are domestic passengers, however, the level of revenues projected in this Study appear to represent an allowable maximum.[8] (The percentage of domestic passengers at Bangkok Airport is about 25%.) The operating revenue per international passenger of US$15-15.5 is close to that of Hong Kong Airport (US$16.5 per passenger in 1993), which is one of the most profitable airports in Southeast Asia. It is, therefore, necessary to avoid higher rates of charges than those used in this Study so that airport charges will not represent too high a cost burden on businesses in Vietnam.

## 9.7.6 Financial Evaluation

The comparison of costs and revenues incrementally incurred by implementing the Project are indicated in Table 9.7.5. The financial rate of return (FIRR) is calculated as 4.9%.

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[6] It is assumed that cargo terminal building is built and rented by the Project entity in this Study. However, cargo throughput charge is a possible alternative to cargo terminal rent in the case where cargo terminal building is built and operated by airline companies.

[7] This assumption is made since the project cost include the fuel storage and supply systems. It is possible for the NAR to rent those facilities to VINAPCO. In practice, other alternatives such that the NAR will construct only fuel hydrant system and rent it to VINAPCO (or collect user charge from airline companies), or the NAR lets the VINAPCO to construct the whole facilities and collect concession fees, etc. are possible.

[8] The percentage of domestic passengers at Bangkok Airport is about 25%.

Table 9.7.5 Comparison of Costs and Revenues - Alternative-2(a)

Unit: US$ '000 at 1995 Prices

| Year | Costs | | | | | Revenues | | | | | | | | | | | Operating Profits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Construction Cost | Maintenance Cost | Personnel, Overhead & Other | Utilities Cost | Total Costs | Landing Charges | Parking Charge | Passenger Service Charge | Terminal Equipment Charge | Concession Fee | Car Parking Charge | Passenger Terminal Rent | Cargo Terminal Rent | Advertisement | Fuel Surcharge | Total Revenues | |
| | (1) | (2) | (3) | (4) | (5)=(1)+..+(4) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16)=(6)+..+(15) | (17)=(16)-(5) |
| 1995 | | | | | | | | | | | | | | | | | |
| 1996 | | | 0 | | | | | | | | | | | | | | |
| 1997 | 1,292 | | 0 | | 1,292 | | | | | | | | | | | | -1,292 |
| 1998 | 12,260 | | 0 | | 12,260 | | | | | | | | | | | | -12,260 |
| 1999 | 21,879 | | 0 | | 21,879 | | | | | | | | | | | | -21,879 |
| 2000 | 5,277 | | | | 5,277 | | | | | | | | | | | | -5,277 |
| 2001 | 16,411 | | 0 | | 16,411 | | | | | | | | | | | | -16,411 |
| 2002 | 77,165 | | 0 | | 77,165 | | | | | | | | | | | | -77,165 |
| 2003 | 114,376 | | 0 | | 114,376 | | | | | | | | | | | | -114,376 |
| 2004 | 136,462 | | 0 | | 136,462 | | | | | | | | | | | | -136,462 |
| 2005 | 63,678 | | 0 | | 63,678 | | | | | | | | | | | | -63,678 |
| 2006 | 1,454 | 5,013 | 169 | 446 | 7,082 | 1,135 | 80 | 1,583 | 223 | 480 | 185 | 899 | 1,215 | 110 | 976 | 6,890 | -192 |
| 2007 | 2,842 | 5,013 | 358 | 446 | 8,660 | 2,409 | 168 | 3,324 | 478 | 1,008 | 387 | 899 | 1,215 | 110 | 1,953 | 11,950 | 3,291 |
| 2008 | 18,325 | 5,013 | 572 | 446 | 24,355 | 3,863 | 268 | 5,239 | 753 | 1,591 | 608 | 899 | 1,215 | 110 | 2,930 | 17,475 | -6,881 |
| 2009 | 44,223 | 5,013 | 810 | 446 | 50,492 | 5,506 | 380 | 7,343 | 1,055 | 2,231 | 849 | 899 | 1,215 | 110 | 3,906 | 23,494 | -26,998 |
| 2010 | 46,533 | 5,013 | 1,147 | 446 | 53,139 | 7,360 | 505 | 9,649 | 1,386 | 2,934 | 1,113 | 899 | 1,215 | 110 | 4,889 | 30,061 | -23,078 |
| 2011 | | 6,661 | 1,435 | 966 | 9,062 | 9,046 | 619 | 11,703 | 1,681 | 3,564 | 1,345 | 1,841 | 2,831 | 226 | 5,354 | 38,209 | 29,147 |
| 2012 | | 6,661 | 1,749 | 966 | 9,377 | 10,910 | 743 | 13,916 | 1,999 | 4,243 | 1,594 | 1,841 | 2,831 | 226 | 5,819 | 44,121 | 34,744 |
| 2013 | | 6,661 | 2,097 | 966 | 9,724 | 12,973 | 879 | 16,311 | 2,342 | 4,979 | 1,862 | 1,841 | 2,831 | 226 | 6,284 | 50,528 | 40,804 |
| 2014 | | 6,661 | 2,475 | 966 | 10,102 | 15,237 | 1,028 | 18,897 | 2,713 | 5,775 | 2,151 | 1,841 | 2,831 | 226 | 6,749 | 57,447 | 47,345 |
| 2015 | | 6,661 | 2,886 | 966 | 10,513 | 17,722 | 1,190 | 21,688 | 3,114 | 6,634 | 2,460 | 1,841 | 2,831 | 226 | 7,227 | 64,933 | 54,420 |
| 2016 | | 6,661 | 3,325 | 966 | 10,952 | 20,161 | 1,347 | 24,326 | 3,492 | 7,440 | 2,761 | 1,841 | 2,831 | 226 | 8,410 | 72,835 | 61,883 |
| 2017 | | 6,661 | 3,798 | 966 | 11,426 | 22,807 | 1,517 | 27,148 | 3,898 | 8,303 | 3,082 | 1,841 | 2,831 | 226 | 9,592 | 81,244 | 69,818 |
| 2018 | | 6,661 | 4,315 | 966 | 11,943 | 25,710 | 1,701 | 30,171 | 4,332 | 9,228 | 3,425 | 1,841 | 2,831 | 226 | 10,775 | 90,239 | 78,296 |
| 2019 | | 6,661 | 4,531 | 966 | 12,158 | 25,710 | 1,701 | 30,171 | 4,332 | 9,228 | 3,425 | 1,841 | 2,831 | 226 | 10,775 | 90,239 | 78,080 |
| 2020 | | 6,661 | 4,761 | 966 | 12,388 | 25,710 | 1,701 | 30,171 | 4,332 | 9,228 | 3,425 | 1,841 | 2,831 | 226 | 10,775 | 90,239 | 77,851 |
| 2021 | | 6,661 | 4,997 | 966 | 12,625 | 25,710 | 1,701 | 30,171 | 4,332 | 9,228 | 3,425 | 1,841 | 2,831 | 226 | 10,775 | 90,239 | 77,614 |
| 2022 | | 6,661 | 5,248 | 966 | 12,875 | 25,710 | 1,701 | 30,171 | 4,332 | 9,228 | 3,425 | 1,841 | 2,831 | 226 | 10,775 | 90,239 | 77,364 |
| 2023 | | 6,661 | 5,512 | 966 | 13,140 | 25,710 | 1,701 | 30,171 | 4,332 | 9,228 | 3,425 | 1,841 | 2,831 | 226 | 10,775 | 90,239 | 77,099 |
| 2024 | | 6,661 | 5,791 | 966 | 13,418 | 25,710 | 1,701 | 30,171 | 4,332 | 9,228 | 3,425 | 1,841 | 2,831 | 226 | 10,775 | 90,239 | 76,821 |
| 2025 | -118,744 | 6,661 | 6,083 | 966 | -105,034 | 25,710 | 1,701 | 30,171 | 4,332 | 9,228 | 3,425 | 1,841 | 2,831 | 226 | 10,775 | 90,239 | 195,273 |

| | |
|---|---|
| FIRR | 4.9% |
| NPV (at 2% discount rate) | 233,686 |
| NPV (at 8% discount rate) | -86,605 |

Unlike the economic analysis, there is no absolute standard witch the FIRR of the projects should be evaluated with for the financial analysis. The financial feasibility of the projects simply depends upon the rates of interest at which they are financed. For example, if the capital for this Project has to be raised from the international market, it may be unfeasible since long-term commercial loans normally carry interest rates of 7-8% per annum. The result would be the same if the Project is financed with the "Capital Formation Loan" of the Industrial and Commerce Bank of Vietnam, for which the interest rate is 8.4%. However, the Project would be feasible if a low-interest loan, such as a soft loan from overseas development aid (ODA), could be obtained.

The alternative solutions for improving the FIRR of the Project would be to increase revenues or decrease costs or a combination of both. As mentioned in the previous section, the projected revenues used in the analysis are reasonably maximized by the exploitation of possible sources in the light of international practices, further increases in airport charges are not recommended. Since the FIRR of 4.2% is not very close toe commercial financing rates, drastic cost cutting measures may be required.

## 9.8 ECONOMIC ANALYSIS OF THE SELECTED DEVELOPMENT PLAN

### 9.8.1 General

The objective of the economic analysis is to determine project viability in terms of its impact on the national economy. It indicates how efficiently national resources are allocated by means of the project and how superior (or inferior) the project is in comparison with other competing projects.

The analytical framework of the economic analysis contrasts sharply with that of the financial analysis. The latter is an analysis in terms of one investment entity, e.g., the airport authority; therefore, it has no relation with the project's impact on national economy. In addition, the economic analysis uses economic prices instead of market prices. Economic cost is equivalent to the real productivity of the inputs, and thus excludes non-productive monetary transfers such as taxes and subsidies, while the economic benefit is measured in improvement in productivity and/or social welfare.

### 9.8.2 Methodology

As with the financial analysis, the costs and benefits of the Project are compared in the forms of incremental costs and benefits given as differences between the WP Case and the WOP Case. The economic internal rate of returns (EIRR) is used to evaluate the feasibility of the Project in terms of net benefits to the national economy.

### 9.7.3 General Assumptions

The general assumptions of the analysis are established as follows:

**1) Project Evaluation Period**

The Project is evaluated until 20 years from the start of operations of the medium-term development plan as in the case of the financial analysis.

**2) Project Costs and Benefits**

All the costs and benefits are evaluated at 1995 constant prices in U.S. dollars. No price escalation is factored in, and it is assumed that general increases in costs would be matched by increases in benefits.

**3) Foreign Exchange Rate**

It is debatable whether the current exchange rate of $US1.0 = VND 11,000 reflects the relative purchasing power of those currencies. Although the Government has established a foreign exchange market in Hanoi and Ho Chi Minh, Vietnamese Dong has been very stable against U.S. dollar regardless of a higher inflation rate (about 15% per annum in Vietnam).[9] On the other hand, it is also true that demand for Vietnamese Dong is high due to the scale of investment flows into Vietnam. In addition, it seems that there is little black market in foreign exchange transactions. In this Study, it is assumed that the current exchange rate is not significantly far from a market equilibrium, with a simultaneous assumption that the exchange value of Vietnamese Dong would be adjusted to reflect the differences in rates of price escalation in other countries in future.

**4) Residual Value**

The residual value is calculated with 30 years depreciation period for civil works and buildings as in the case of the financial analysis.

### 9.8.4 Economic Costs of the Project

**1) Construction Costs**

Estimate of construction costs in this Study suppose international competitive tenders; therefore, it could be assumed that the estimated construction costs reflect real consumption of

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[9] This view is shared by UNDP. It is asserted that the export sector of Vietnam lost a significant degree of competitiveness over the past year due to appreciation of real effective exchange rate. ("Some Challenges Facing the Vietnamese Economy, UNDP Vietnam, April 1995, Hanoi)

national resources. Furthermore, price distortions attributable to import duties on the materials for public infrastructure project is small in Vietnam.

One obvious distortion is the turnover tax, which the Vietnamese Government imposes on all the transactions in the manufacturing, construction, transport, commercial and other service sectors. The applicable turnover tax rate for the project is set at 3%, so 97% of the cost estimate at market prices is regarded as the economic cost.

The estimated annual investment requirements at economic prices are shown in Appendix 9.8.1.

2) **Operation and Maintenance Costs**

a) Maintenance Costs

The incremental maintenance cost at economic prices is estimated as 97% of the nominal cost as shown in Appendix 9.8.2.

b) Personal Costs, Overhead and Other Labor Costs

The estimated personnel related cost is converted into economic cost by applying a 90% rate to exclude income tax, which is a transfer payment in the national economy. The conversion factor of 97% is applied to the nominal overhead and other labor costs, by deducting the turnover tax equivalent of 3%. The results are shown in Appendix 9.8.3.

c) Utilities Costs

The incremental utilities costs in economic prices are also converted to the economic cost by applying a 97% rate as shown in Appendix 9.8.4.

### 9.8.5 Economic Benefits of the Project

The following economic benefits are considered for the analysis.

1) Time saving benefits to business passengers on international routes
2) Time saving benefits to business passengers on domestic routes
3) Benefits from increased tourist passengers on international routes
4) Benefits from increased tourist passengers on domestic routes
5) Benefits from increased cargo

Other benefits such as improvements in air safety, promotion of foreign investment, etc. are important contributions to the Vietnamese economy, but not included because of estimation difficulties.

1) **Time Saving Benefits to Business Passengers on International Routes**

In the WOP Case, air passengers exceeding the airport capacity would have to either give up their travel or divert to other transport modes. It may be assumed that business passengers who would use international flights from/to Noi Bai Airport in the WP Case would not give up their travel, but use Tan Son Nhat Airport in Ho Chi Minh in the WOP Case. It is also assumed that they would use domestic air transport between Ho Chi Minh and Vinh, and rail transport between Vinh and Hanoi to complete their business travel. Those detours would inevitably result in longer times and additional domestic transport costs for the national economy. The associated costs (time cost and additional domestic transport cost between Hanoi and Ho Chi Minh via Vinh) would be avoided in the WP case, and thus constitute economic benefits to those passengers, and eventually to the national economy.

A distinction was made between Vietnamese passengers and foreign passengers since the time values are significantly different and the benefits to the latter may only partly contribute to the Vietnamese economy. The whole process of benefit calculation is explained in Appendices 9.8.5 and 9.8.6 for Vietnamese and foreign business passengers respectively.

2) **Time Saving Benefits to Business Passengers on Domestic Routes**

Similar assumptions are made for business passengers on domestic routes. In the WOP Case, those who travel from/to Ho Chi Minh, Danang, Hue and Nha Trang would use air transport between their origin/destination and Vinh, and rail transport between Vinh and Hanoi.

If the Project is implemented, those passengers will save time at the expense of higher cost of direct air travel. The net savings in travel cost will reduce the cost of doing business in Vietnam, help to improve competitiveness, and thus represent economic benefits from the Project.

The method of estimation for those benefits are explained in Appendices 9.8.7 and 9.8.8 for Vietnamese and foreign business passengers respectively.

3) **Benefits from Increased Tourist Passengers on International Routes**

In the case of tourist passengers, it is assumed that they would decide not to travel if the airport capacity was not expanded. The benefit from the Project may be measured as a consumer surplus to those who would give up their travel. The benefit per passenger can be measured as 50% of the air travel cost, assuming a straight line demand curve with the price axis intercept being twice the travel cost. This benefit is only accounted for Vietnamese passengers, however, since the surplus for foreign passengers does nothing for the welfare level

of Vietnam. Instead, it can be supposed that a part of the tourism revenues from foreign passengers would be lost if they do not visit Vietnam because of the airport capacity limitations.

The procedures for estimating the surplus to Vietnamese tourist passengers on international routes and the increased tourism revenues for Vietnam from foreign visitors are explained in Appendices 9.8.9 and 9.8.10 respectively.

**4) Benefits From Increased Tourist Passenger on Domestic Routes**

This benefit can be measured as an increased consumer surplus for Vietnamese passengers and increased tourism revenue to Vietnam from foreign passengers respectively, as in the cases of Vietnamese and foreign passengers on international routes.

The unit benefit per passenger is 50% of the domestic air travel cost for Vietnamese and a part of tourism expenses for foreigners. The estimation methodologies, and the results of calculations are shown in Appendices 9.8.11 and 9.8.12.

**5) Benefits From Increased Cargo**

The characteristics of air cargo are quite different from those which are transported by other modes such as railways and roads. They are generally a high value to weight ratio, with a short life and/or vulnerable to damage. It is, therefore, not conceivable that air cargo over the airport capacity would be carried by other modes of transport in the WOP Case. The benefit in such a situation may be measured in a similar manner to consumer's surplus to Vietnamese tourist passengers. The unit benefit per ton of increased air cargo is quantified as 50% of the cargo airfare.

In the case of international cargo, a further 50% will only be attributed to the Vietnamese economy since international trade benefits the Vietnamese economy, as well as economies of trading partners.

The whole process for estimating benefits from increased cargo is described in Appendices 9.8.13 and 9.8.14.

### 9.8.6 Economic Evaluation

The economic costs and benefits of the Project are compared in Table 9.8.1, and the economic internal rate of returns (EIRR) is estimated at 21.3%.

## Table 9.8.1 Comparison of Economic Costs and Benefits - Alternative-2(a)

Unit: '000 US$ at 1995 Prices

| Year | Costs | | | | | Benefits | | | | | | | | | | | Net Benefits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Construction Cost | Increased Maintenance Cost | Increased Personnel, Overhead and Other Cost | Increased Utility Cost | Total Costs | Time Savings by VNamese Business Passengers (International) | Time Savings by Foreign Business Passengers (International) | Time Savings by VNamese Business Passengers (Domestic) | Time Savings by Foreign Business Passengers (Domestic) | Increased Surplus to Vietnamese Tourist Pax (International) | Increased Receipts from Foreign Tourist Pax (International) | Increased Surplus to Vietnamese Tourist Pax (Domestic) | Increased Receipts from Foreign Tourist Pax (Domestic) | Benefits from Increased International Cargo | Benefits from Increased Domestic Cargo | Total Benefits | |
| | (1) | (2) | (3) | (4) | (5)=(1)+..+(4) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) | (15) | (16)=(6)+..+(15) | (17)=(16)-(5) |
| 1995 | | | 0 | | 0 | | | | | | | | | | | | |
| 1996 | | | | | | | | | | | | | | | | | -1,292 |
| 1997 | 1,292 | | | | 1,292 | | | | | | | | | | | | -12,202 |
| 1998 | 12,202 | | | | 12,202 | | | | | | | | | | | | -21,533 |
| 1999 | 21,533 | | 0 | | 21,533 | | | | | | | | | | | | -5,197 |
| 2000 | 5,197 | | | | 5,197 | | | | | | | | | | | | -15,957 |
| 2001 | 15,957 | | | | 15,957 | | | | | | | | | | | | -74,850 |
| 2002 | 74,850 | | | | 74,850 | | | | | | | | | | | | -110,945 |
| 2003 | 110,945 | | 0 | | 110,945 | | | | | | | | | | | | -132,368 |
| 2004 | 132,368 | | 0 | | 132,368 | | | | | | | | | | | | -61,768 |
| 2005 | 61,768 | | 0 | | 61,768 | | | | | | | | | | | | 16,389 |
| 2006 | 1,442 | 4,863 | 157 | 433 | 6,895 | 3,819 | 1,334 | 2,815 | 506 | 5,246 | 1,444 | 2,298 | 185 | 4,545 | 1,092 | 23,284 | 40,961 |
| 2007 | 2,768 | 4,863 | 333 | 433 | 8,396 | 8,091 | 2,723 | 6,054 | 979 | 11,165 | 3,090 | 4,843 | 376 | 9,729 | 2,307 | 49,357 | 54,917 |
| 2008 | 17,796 | 4,863 | 531 | 433 | 23,623 | 13,032 | 4,181 | 9,748 | 1,422 | 17,757 | 4,970 | 7,661 | 587 | 15,551 | 3,629 | 78,540 | 62,644 |
| 2009 | 42,918 | 4,863 | 753 | 433 | 48,966 | 18,644 | 5,719 | 13,943 | 1,830 | 25,425 | 7,096 | 10,850 | 803 | 22,226 | 5,075 | 111,610 | 96,979 |
| 2010 | 45,158 | 4,863 | 1,066 | 433 | 51,520 | 24,926 | 7,326 | 18,636 | 2,189 | 33,899 | 9,501 | 14,336 | 1,029 | 29,967 | 6,690 | 148,500 | 174,522 |
| 2011 | | 6,462 | 1,334 | 937 | 8,733 | 30,986 | 8,855 | 23,312 | 2,529 | 41,702 | 11,765 | 17,476 | 1,214 | 37,281 | 8,135 | 183,255 | 212,643 |
| 2012 | | 6,462 | 1,627 | 937 | 9,025 | 37,812 | 10,508 | 28,558 | 2,859 | 50,311 | 14,244 | 20,896 | 1,401 | 45,376 | 9,704 | 221,668 | 254,984 |
| 2013 | | 6,462 | 1,949 | 937 | 9,348 | 45,321 | 12,266 | 34,441 | 3,185 | 59,997 | 16,969 | 24,646 | 1,589 | 54,536 | 11,380 | 264,332 | 301,826 |
| 2014 | | 6,462 | 2,301 | 937 | 9,700 | 53,871 | 14,148 | 41,203 | 3,479 | 70,489 | 20,000 | 28,685 | 1,779 | 64,691 | 13,180 | 311,526 | 353,557 |
| 2015 | | 6,462 | 2,683 | 937 | 10,082 | 63,274 | 16,177 | 48,716 | 3,775 | 82,058 | 23,325 | 33,079 | 1,963 | 76,124 | 15,148 | 363,639 | 400,047 |
| 2016 | | 6,462 | 3,091 | 937 | 10,490 | 71,686 | 18,194 | 55,847 | 4,255 | 92,013 | 26,150 | 37,140 | 2,206 | 85,852 | 17,194 | 410,537 | 450,325 |
| 2017 | | 6,462 | 3,532 | 937 | 10,930 | 80,731 | 20,339 | 63,606 | 4,757 | 102,774 | 29,175 | 41,483 | 2,463 | 96,504 | 19,424 | 461,255 | 504,680 |
| 2018 | | 6,462 | 4,012 | 937 | 11,411 | 90,548 | 22,671 | 72,174 | 5,295 | 114,209 | 32,425 | 46,099 | 2,738 | 108,079 | 21,854 | 516,091 | 507,013 |
| 2019 | | 6,462 | 4,213 | 937 | 11,611 | 91,472 | 22,723 | 73,720 | 5,307 | 114,209 | 32,425 | 46,099 | 2,738 | 108,079 | 21,854 | 518,624 | 509,434 |
| 2020 | | 6,462 | 4,426 | 937 | 11,825 | 92,435 | 22,774 | 75,327 | 5,319 | 114,209 | 32,425 | 46,099 | 2,738 | 108,079 | 21,854 | 521,259 | 512,522 |
| 2021 | | 6,462 | 4,646 | 937 | 12,045 | 93,578 | 22,900 | 77,314 | 5,371 | 114,209 | 32,425 | 46,099 | 2,738 | 108,079 | 21,854 | 524,566 | 515,754 |
| 2022 | | 6,462 | 4,879 | 937 | 12,278 | 94,778 | 23,026 | 79,401 | 5,424 | 114,209 | 32,425 | 46,099 | 2,738 | 108,079 | 21,854 | 528,032 | 519,140 |
| 2023 | | 6,462 | 5,125 | 937 | 12,524 | 96,039 | 23,154 | 81,591 | 5,477 | 114,209 | 32,425 | 46,099 | 2,738 | 108,079 | 21,854 | 531,664 | 522,688 |
| 2024 | | 6,462 | 5,384 | 937 | 12,783 | 97,362 | 23,284 | 83,892 | 5,530 | 114,209 | 32,425 | 46,099 | 2,738 | 108,079 | 21,854 | 535,470 | 522,688 |
| 2025 | -115,182 | 6,462 | 5,656 | 937 | -102,128 | 98,751 | 23,414 | 86,307 | 5,585 | 114,209 | 32,425 | 46,099 | 2,738 | 108,079 | 21,854 | 539,459 | 641,587 |
| | | | | | | | | | | | | | | | | EIRR | 21.3% |
| | | | | | | | | | | | | | | | | NPV (at 12% discount rate) | 295,148 |

The EIRRs of the projects should be compared with the opportunity cost of capital, which indicates the marginal productivity of capital or the mininum level of returns which may be expected if the capital is used for alternative projects. The opportunity cost of capital has a clear definition in economic terms; however, it is rather theoretical and its estimation is difficult in practice.

In this analysis, 12%, which is a general standard used to evaluate infrastructure projects in developing countries by the World Bank, is used. Although this standard is quite general and may not be applicable to a specific project in a specific country, the EIRR of 21.3% is high enough by any criteria to justify its implementation in terms of net benefits to the national economy. Realistically, however, it would be difficult to imagine a situation whereby airport capacity of the capital city would become saturated, with people having to use other modes of transport.

## 9.9 APPRAISAL OF SELECTED DEVELOPMENT PLAN

Alternative-2(a), which has been selected as the best development plan in Section 9.6, is considered viable (if low-interest loan such as the soft loan of ODA is utilized) from the financial and economic viewpoints as described in the preceding sections. Some of the key statistics are as follows:

| | | |
|---|---|---|
| Construction Cost: | Medium Term Development: | US$ 449 million |
| | Long Term Development: | US$ 113 million |
| | Total : | US$ 562 million |
| Financial Internal Rate of Return: | | 4.9 % |
| Economic Internal Rate of Return: | | 21.3 % |

With regard to the environmental issues, the following needed to be examined further as pointed out in Section 9.5 Initial Environmental Examination.

a) Impact by resettlement
b) Impact on cultural property
c) Impact on water rights and rights of common
d) Impact on waste
e) Impact on hydrological situation
f) Impact on flora and fauna
g) Impact by air pollution
h) Impact by water pollution
i) Impact by noise and vibration

In addition to the above items for further assessment, the following considerations were prerequisites of the planning and design of the Medium Term Development Project from the environmental point of views.

a) Construction of alternate routes and adequate connection with other roads and installation of safety facilities.
b) Creation of new community centre and arrangement of new traffic system and sufficient compensation.
c) Installation of adequate systems to maintain safety of aircraft operation as well as to minimise the possibilities of disaster at storage facilities of hazardous materials.

d) Appropriate civil engineering design and method of construction to avoid cave-ins, upheaval and soil erosion.

e) Appropriate planning and design of facilities to preserve and/or improve the present landscape.

These environmental issues shall carefully be taken into account in the designs of Medium Term Development.