6.9.3 Fire Station Building

The fire station building is located on the northern side of the runway, next to the control tower building. It is a one-story reinforced concrete structure. The building was built in 1989 and has a total floor area of 235 sq.m. The building accommodates a garage for fire engines, an office, rest room, dining room and a storage for fire station staff. The building condition is generally good as determined by a visual inspection. The floor plan of the fire station building is shown in Appendix-6.9.3.

6.10 Access Road, Curbside Road and Car Parking

6.10.1 Access Road

The access road has a 10.0m wide cement concrete slab pavement with 2.0m wide paved shoulders on each side. It is a two-lane for two-way traffic. The capacity of the road is adequate for the future traffic demand up to 2010. After 2010, two lanes per direction will be required.

6.10.2 Curbside Road

The curbside road has a 9.0m wide cement concrete slab pavement with a 1.5m wide paved sidewalk. It is a two-lane road for one-way traffic. At the peak hour, the length of the curb frontage of the building is too short, especially for arrival passengers.

6.10.3 Car Parking

The existing car parking area has 154 lots. The number of the lots is sufficient for handling the present car parking demand. However, the taxi stand area, which is located in front of PAL fuel farm, is insufficient for meeting the present demand.

In addition, the location of the existing taxi stand is opposite from the normal location in terms of traffic circulation. Arrival passengers, therefore, encounter the inconvenience of walking a long distance to the taxi stand.

At the existing car parking, there are many and wide/long cracks in the cement concrete pavement slabs.

6.11 Drainage System

A layout plan of the existing airport drainage system is illustrated in Figures 6.11.1 and 2.

The runway is located on the ridge. Four culverts laid across and beneath the runway carry the storm water on the north side of the airfield to the south. These culverts do not connect with other downstream drainage facilities. The storm water carried through these culverts is discharged onto the natural ground.

At the terminal area, the drainage system is provided properly. So far there has been no problem reported on the existing drainage system.

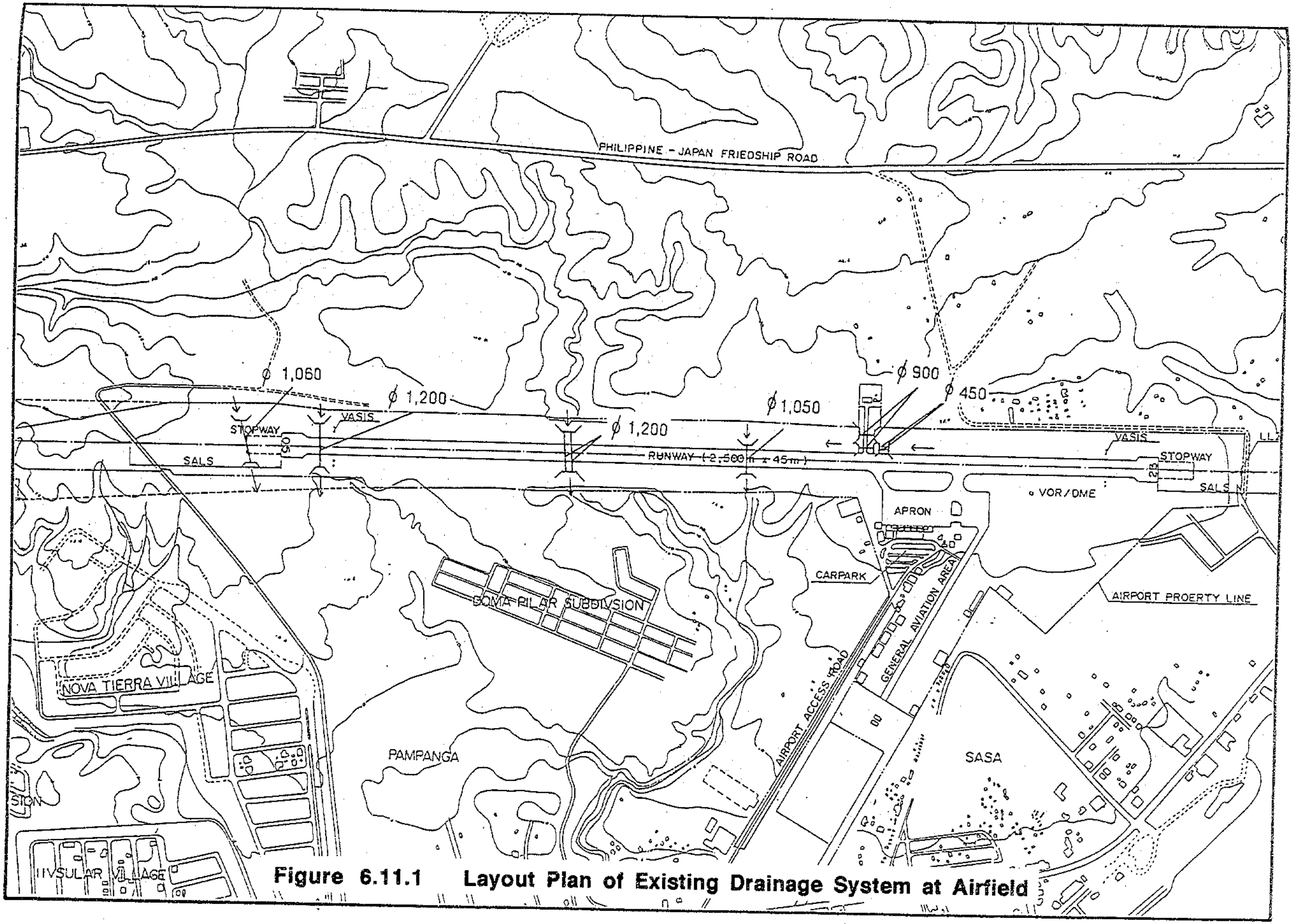

Figure 6.11.1 Layout Plan of Existing Drainage System at Airfield

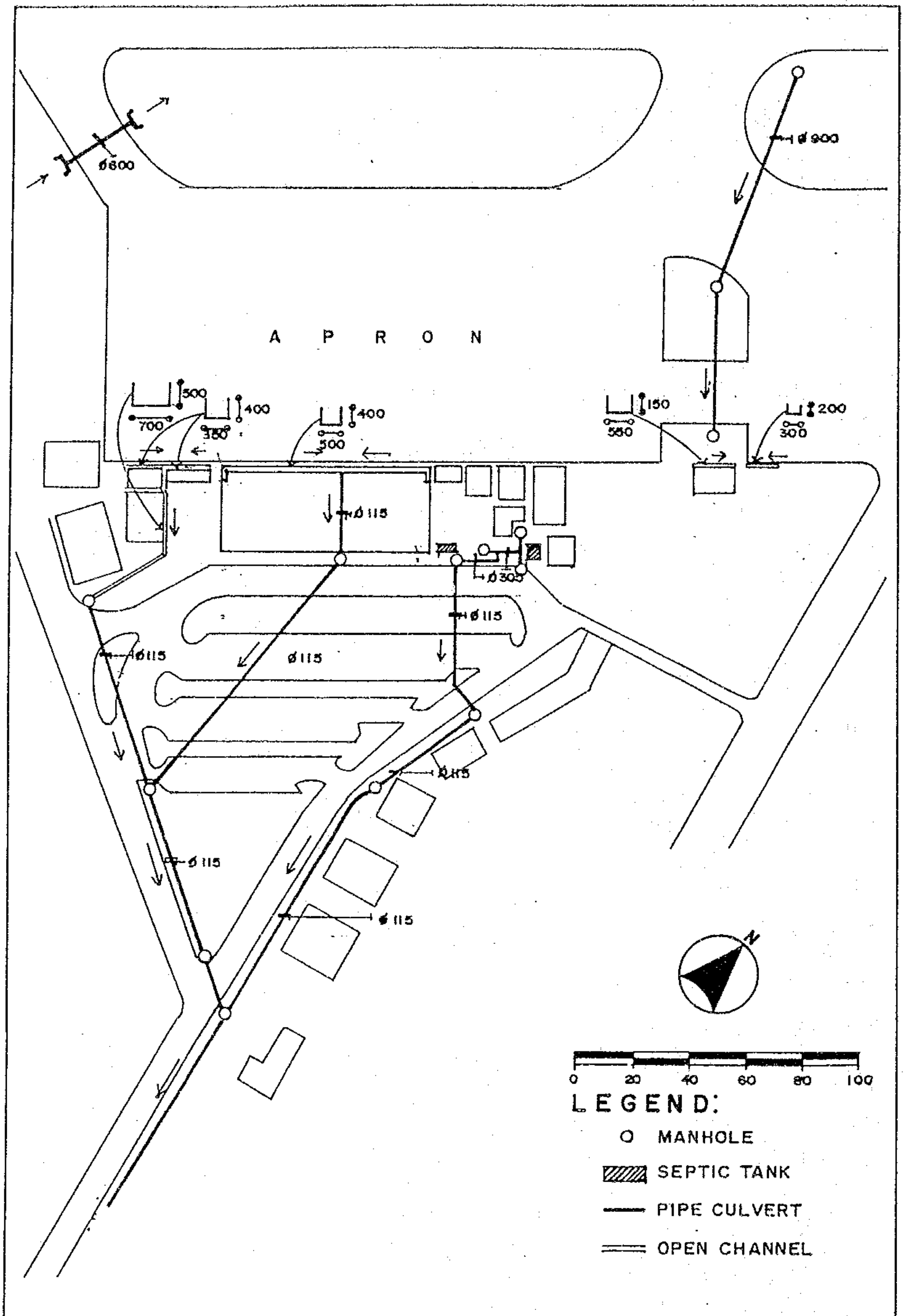

Figure 6.11.2 Layout Plan of Existing Drainage System at Terminal Area

6.12 Air Navigation System

The conceptual diagram of the existing air navigation system is shown in Figure 6.12.1.

6.12.1 Radio Navigational Aids Facilities

ILS/LLZ, VOR/DME and NDB are now operating as the radio navigation facilities of the airport as follows:

(1) ILS/LLZ

The equipment was installed in 1983 for RWY 05 landings. The location of the LLZ antenna is 100m from the RWY 23 threshold. There are no problems with the equipment. However, the LLZ is not utilized for precision approach due to the incompletion of the ILS.

The renewal of the ILS system for both RWY 05 and RWY 23 is committed by the Government of the United States, including ILS/LLZ, GP, IM, MM. The installation work is expected to be completed this year but has not been started yet.

(2) VOR/DME

The equipment was installed in May, 1990 by the conventional type after being transfered from Manila International Airport.

The existing system is operating without any problems. However, there are some operational restrictions due to the existence of obstructions as shown in AIP.

Also, there is a plan to replace the conventional type with a doppler type under the nationwide air navigation facilities modernization project.

(3) NDB

The equipment was installed in 1973 at a point 700m on the northern side of RWY 23.

The existing system is only operated by the main equipment because the stand-by equipment is out of order due to the lack of spare parts.

Since equipment component is of a vacuum type tube, its life span is expected to be saturated in the near future. Consideration will be required soon for the renewal of the equipment.

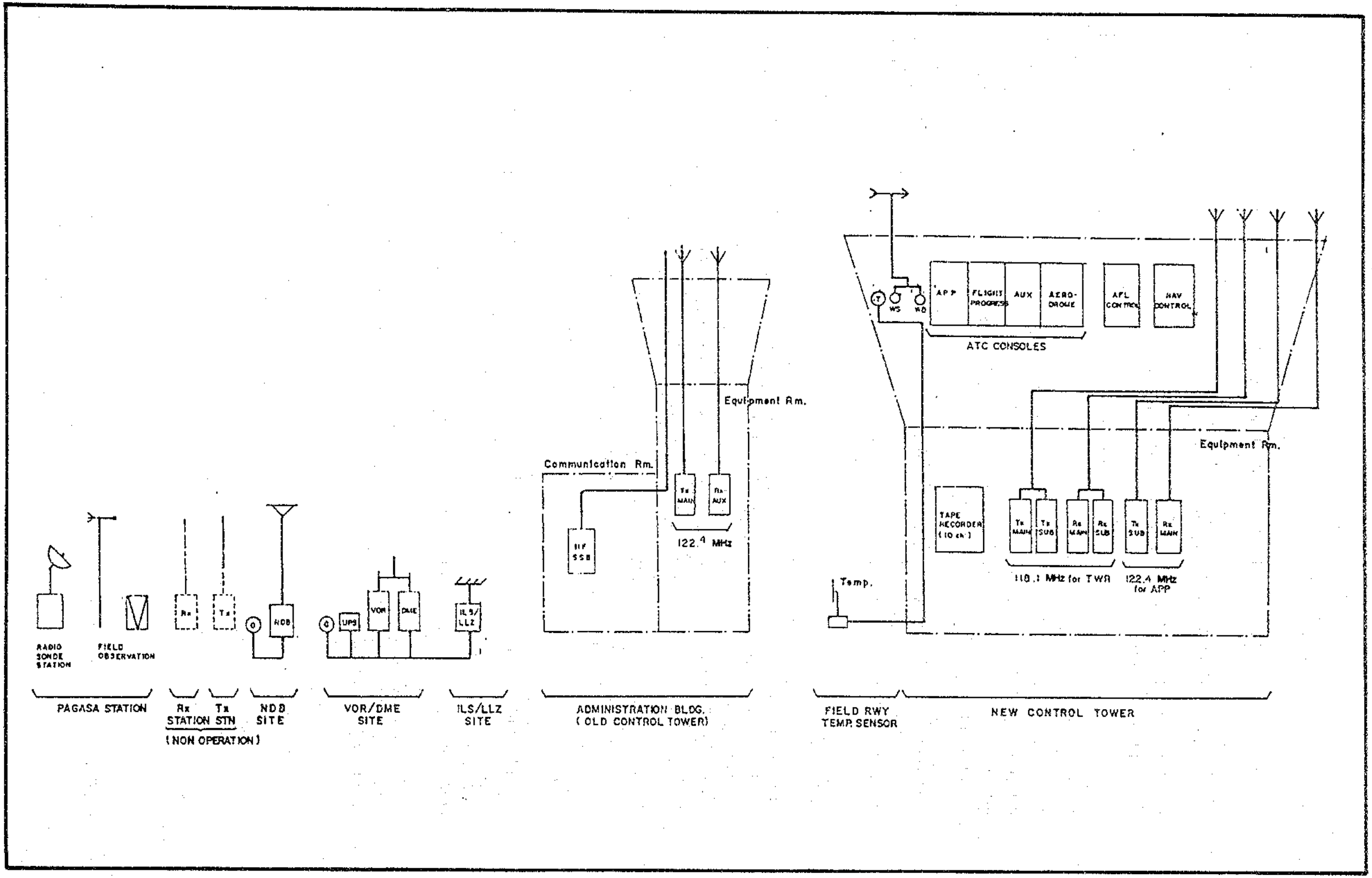

Figure 6.12.1 Conceptual Diagram of Existing Air Navigation System

6.12.2 Air Traffic Control System

Air traffic control services at the airport is provided for approach control and aerodrome control subject to take-off and landing aircraft. The allocated frequencies for this services are 118.1 MHz for TWR, and 122.4 MHz for APP. The control consoles of the system were installed in 1984 by a project financed by OECF.

6.12.3 Aeronautical Telecommunication System

The aeronautical telecommunications for air traffic control is a dual system. Main and sub transmitters and receiver of 118.1MHz for TWR and a main receiver and sub transmitter of 122.4MHz of APP are installed at the control tower, and a main transmitter and sub receiver of 122.4MHz are installed at the old tower of the administration building so as to avoid mutual interference.

Flight services of point-to-point communications with Mactan by HF-SSB 6,802.5 MHz are done at the communication room of the Flight Service Station (FSS). Aeronautical Fixed Telecommunication Networks (AFTN) service between Tandag, Surigao and Cotabato is also done by HF-SSB in the administration building.

Since 1983 there has been a serious shortage problem of spare tapes for the voice recorder since 1983. Therefore, the preservation period of a voice recorded tape is limited only to 60 days so as to re-utilize the existing tape effectively. Also, there is a shortage of spare parts for the roller and head of the voice recorder.

The communication equipment for point-to-point communications with small airports by HF-SSB is installed at TX and RX stations, but operations were discontinued due to the lack of necessity.

The operation of communication equipment of Air to Ground by HF (6,617 KHz) was also discontinued.

FSS also performs pre-flight briefing services to aircrews. In general, there are no serious problems with the existing system.

6.12.4 Aeronautical Ground Light System

The following aeronautical ground lighting systems are now provided at the airport:

- Simple approach lighting system (SALS) for RWY 05 and RWY 23
- VASIS for RWY 05 and RWY 23
- Runway edge lights
- Runway end lights
- Taxiway edge lights
- Illuminated wind direction indicator (IWDI) for RWY 23
- Aerodrome beacon
- Apron floodlight

It was observed that some runway edge lights were damaged. Runway edge lights at a section that is 600m from the runway threshold (one third of the runway length) are not yellow and do not comply with ICAO requirements.

The SALS of RWY 05 and RWY 23 are the barrette type and single source systems respectively in compliance with ICAO recommendations. However, the center lights of barrette at RWY 05 were broken and not functioning.

Lighting fixtures for runway, taxiway and IWDI and control equipment, such as panels and CCR, are Japanese products provided as reparation goods in 1968.

The fixing bolts of runway and taxiway lights are broken and due to the lack of spare parts, steel wire is being used tentatively for fixing the housing.

Also, the corrosion on the supporting pole of IWDI was observed. The airport authority is now installing a typical PAPI on both runways, and the flight check on PAPI for RWY 23 was carried out in May 1992. However, there is no definite schedule for its operation. Installation work for RWY 05 is now undergoing. The aerodrome beacon located at the top of old control tower is now out of order.

6.12.5 Weather Observation System

Weather observation services at the airport are being carried out by the Philippine Atmosphere Geophysical and Astronomical Services Administration (PAGASA) of the Department of Science and Technology.

A field observation site is located at the eastern part of the old runway in the general aviation area.

The following items are observed every hour and are conveyed to the Flight Service Station (FSS) for airport operations.

- Wind direction and velocity, temperature, and QNH by sensors
- Visibility and sky condition by visual observation.

At 8:00 A.M. daily, the upper air condition to a height of about 24,000m is now being observed by "the wind finding radar" by balloon. The data is analyzed to wind direction and speed by a computerized system.

The observed data was being sent to FSS by intercom and PAGASA's main office in Manila by commercial telephone lines because the exclusive communication line with headquarters by means of HF-SSB and telex were out of order at the time when the site visit was made in May 1992.

The site observation found the following problems:

- Lack of operational and maintenance technicians
- Out-of-order communication line

6.13 Rescue and Fire Fighting Services

6.13.1 Category of Services

The current airport is being used by the following aircraft:

B737	:	56 flights per month
A300	:	60 flights per month
F-50	:	30 flights per month

The airport category for rescue and fire fighting services will be determined by the overall length of the longest aircraft and its maximum fuselage normally using the airport, and the movements during the three (3) consecutive busiest months of the year shall also be considered in compliance with ICAO ANNEX 14.

The airport category for the services is determined as Category 6 based on the above-mentioned condition in compliance with ICAO ANNEX 14.

The notification on the crash protection category of the airport by AIP-Philippines is Category 6.

6.13.2 Capacity of Extinguishing Agents

- One foam tank car	:	AFFF	1,585 US gal	(=6,000 l)
- One foam tank car	:	AFFF	600 US gal	(=2,270 l)
Total	:		2,185 US gal	(=8,270 l)
- One rapid intervention vehicle	:	Dry foam 450 lbs Light =H_2O 50 US gal		(= 204 kg) (= 190 l)

The minimum usable amounts of extinguishing agents, 7,900 liters of AFFF (Aqueous Film Forming Foam), is recommended for airport Category 6 in Airport Service Manual of ICAO and amount of dry chemical as complementary agents for same airport category is 225 kg in the above recommendation.

6.13.3 Operational Organization

The services are performed by one of the airport maintenance service units. 33 personnel are provided for 24 hour service on a 3 shift basis. The training programs for personnel are established as follows:

a) Exercise : one time per week
b) Grade up training : Two times per year in Manila

For emergency cases, there is the assistance agreement with the Sampalanang Fire Station that is located about 5 km away from the airport.

6.13.4 Current Problems

The amount of dry chemicals for the complementary agents is about 10 percent less than recommended.

The following problems were found as a result of the site observation:

a) No provision of transceivers on each vehicle
(Current condition is one-way communication because receiver is only provided.)

b) No provision of ambulance car

c) No provision of searchlights for night activites.

d) Shortage of tank car operators.

e) Shortage of fire fighting clothes (only 12 sets are provided at the present)

No problems for the storage of extinguishing agents was reported by the staff.

6.13.5 Evaluation

The current vehicles are becoming old and their life spans will expire within a few years. Some of the vehicles have been in service at the airport since 1983 after being transferred from Manila International Airport.

The following points may be worthwhile noting:

a) The ambulance car shall be provided so as to ensure that rescue services are carried out quickly in times of emergency.

b) Two-way communications with the concerned agency by transmitter will be provided.

6.14 Airport Utilities

6.14.1 Power Supply System

The conceptual program of the existing power supply system is shown in Figure 6.14.1.

According to the current system, each facility received electrical power from the Davao Light and Power Company that is owned and managed by ABOITIZ Cooperation. They also furnished an emergency generator for backup power.

The total installed electrical load capacity of the airport is about 300 KVA. This amount seems to remain the same as the capacity of the facility. One 113 KVA generator transferred from Manila Airport is now being installed (as of May 1992) to accommodate the additional emergency loads at the passenger terminal and administration building. Most of the electrical equipment and panels were installed at the beginning of 1970; therefore, some equipment is not functioning. Most of the current equipment will complete their life span in the near future.

In conclusion, the existing facility and its capacity will be saturated in the near future from a superannuation and capacitation point of view.

This facility must be replaced by a new one based on the results of the study.

6.14.2 Telephone System

The subscribed telephone system of the airport is also under a separate contract with the Philippine Long Distance Telephone Company (PLDT) by each user, such as the airport authority, airline, cargo handling agent and concessionaire. Therefore, there is no telephone system controlled by a telephone exchange.

The airport authority at ATO has seven (7) subscribed telephone lines.

The airline not only has subscribed telephone lines with the city office but also microwave lines to the headquarters in Manila through the PLDT service line.

It was reported that the service reliability of the PLDT telephone lines have trouble even during rainy seasons.

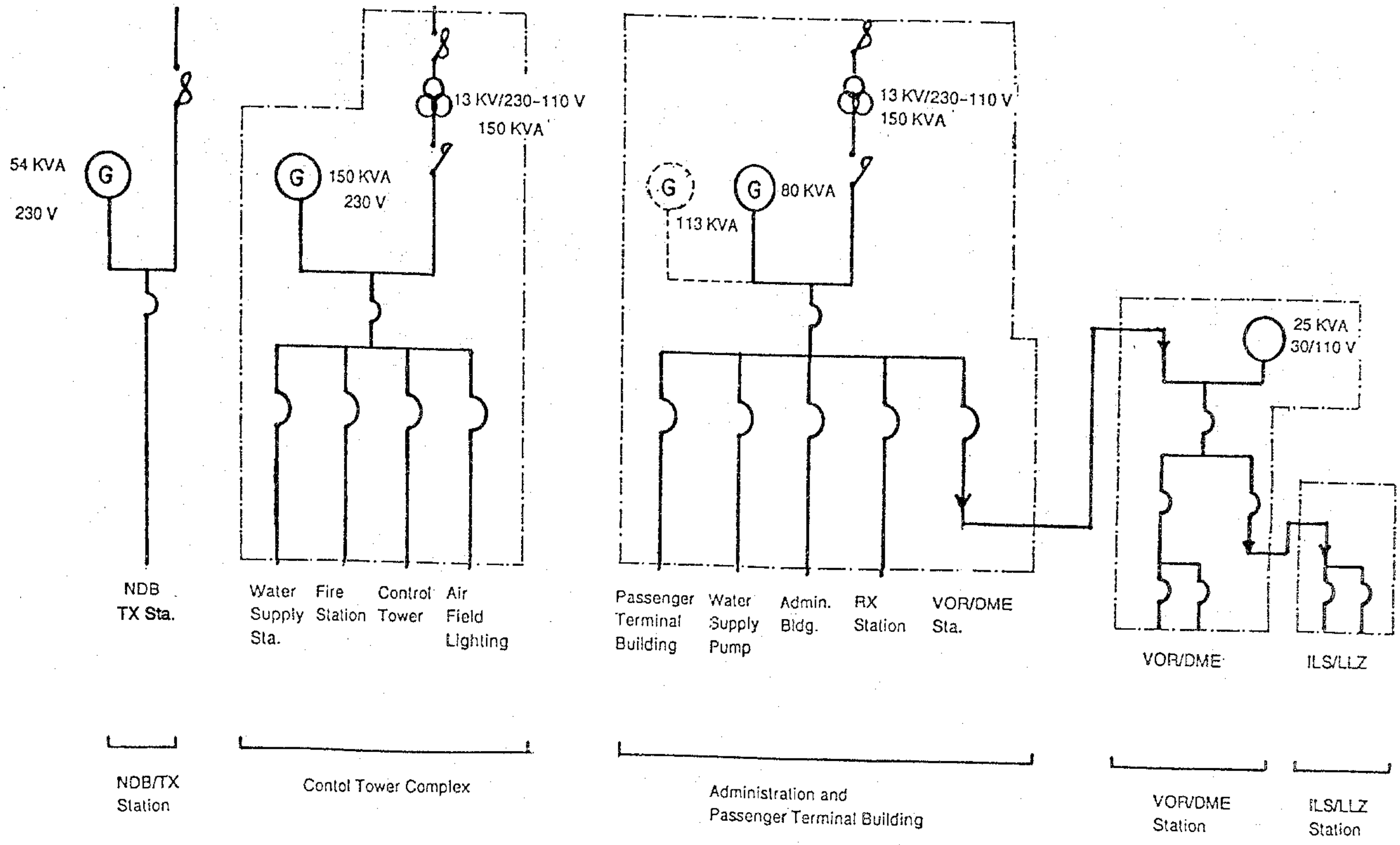

Figure 6.14.1 Conceptual Diagram of Existing Power Supply System

The telephone system using a telephone exchange will be required based on the required capacity of the telephones for airport operations not only by the airport authority but by other users, such as airlines, concessions, etc., in order to facilitate the effective utilization of the limited subscribed telephone lines by PLDT.

No special consideration is required for the existing telephone system.

6.14.3 Water Supply System

The current water supply system is operated independently for the administration and passenger terminal building, and the control tower.

The outline of the system for the administration and passenger terminal building are as follows:

a) Type of well	:	deep well (180 feet depth)
b) Capacity of pump 5,000 gallon/20 min.	:	7.5 HP (230 3Ø)
c) Elevated tank capacity	:	2,000 kl
d) Consumption	:	Approx. 25 liter/hour

The water supply system for the administration building also includes one (1) fire hydrant on the apron.

The water supply system for the control tower is basically the same system as the above.

The existing water supply system has no problems meeting the present demand.

6.14.4 Sewage Disposal

Sewage from the buildings is collected in the septik tank. From the septic tank the sewage is discharged into the nearest drainage system. So far there have been no problems.

6.14.5 Solid Waste Disposal

Solid waste from the airport is basically collected by the city government. Some excess solid waste is burned and dumped in a vacant field near the ECJ Hangar.

To dispose of all solid waste within the airport promptly, an incinerator should be installed.

6.15 Fuel Supply System

The JET-A1 fuel supply for jet aircraft at the airport is performed by the apron fuel hydrant system with 4 hydrant pits.

There are two fuel hydrant pipes at the apron area because of the two different service agents.

The avgas for general aviation aircraft is served by refueler.

The current two service agencies are as follows:

a) Philippine Airlines

- Services for the jet aircraft by apron fuel hydrant system at 4 pits
- Two (2) simultaneous operations are possible because of the available number of servicers
- Current average daily consumption is about 9,000 US gallons
- Total storage capacity is about 47,000 US gallons

b) PETRON

- Services of avgas for general aviation aircraft and military aircraft by refueler
- One (1) hydrant pit is available for Jet-A1 fuel
- Total storage capacity is 8,000 US gallons with 2 tanks

Under current operational conditions, there are no problems with the existing facility.

6.16 Airport Management

The current maintenance and operational condition of airport facilities are considered to be good.

Judging from the operational aspects, the following items are to be improved to upgrade the service level or each system.

a) Management of spare parts

b) Immediate rehabilitation or improvement of the performance of the obsolete equipment, such as the panels at the main substation of the administrative building, and the vehicles for fire fighting.

c) Expansion of the capacity of the saturated equipment, such the generator at the main substation.

d) Establishment of flight inspection procedures for air navigation equipment.

e) Expansion of supporting facilities for operation and maintenance activities, such as the provision or transceivers for vehicles, sweeper, etc.

The development of the airport management with regards to the number of staff members, the establishment of a staff training program and the management of spare parts will be studied based on the results of the study and the basic policy of DOTC.

Regarding this matter, DOTC considered the plan as follows:

a) Centralization of management of spare parts.
b) Unification of utilized types of equipment due to the system and manufacturer.
c) Establishment of flight check procedures after obtaining an additional flight checker.

6.17 Security

The current condition of the system and facility is described under section 3.10 of Chapter 3.

The countermeasures will be taken against the problems mentioned in section 3.10.

The most urgent and important matter is to install a complete boundary and security fence around the airport.

The screening of passengers and their luggage prior to check-in is required. A dual system of inspection equipment for passenger screening is considered necessary so as to cope with the demand and maintain reliability.

Providing equipment for screening cargo is also deemed necessary.

6.18 Influence of Aircraft Noise

To evaluate the influence of aircraft noise exposure, aircraft noise contour drawings have been prepared for the year 1992, 2000 and 2010. The level of aircraft noise is estimated by use of WECPNL (weighted equivalent continuous perceived noise level), which is one of the ICAO standard indices for aircraft noise. For reference, environmental criteria on aircraft noise in Japan is shown in Table 6.18.1. Definition of WECPNL is shown in Appendix-6.18.1.

Table 6.18.1 Environmental Criteria on Aircraft Noise

Type of Land Use	Criteria (WECPNL)
I. Area Exclusive for Residential Use	Less than 70
II. Other Area for Ordinary Living Life	Less than 75

Conditions for estimation of aircraft noise levels are shown in Appendix-6.18.2.

The aircraft noise contours of WECPNL 75 in 1992, 2000 and 2010 are shown in Figure 6.18.1. The number of house units to be exposed to aircraft noise is shown in Table 6.18.2. A breakdown of the above number by hospitals, schools, churches and houses is shown in Table 6.18.1.

Table 6.18.2 Number of House Units Exposed to Aircraft Noise

WECPNL	1992	2000	2010
More than 95	0	0	0
95 - 90	25	15	34
90 - 85	269	213	236
85 - 80	768	670	637
80 - 75	2,124	1,947	1,690
75 - 70	4,050	3,947	4,083

As shown in Table 6.18.2, many houses are already exposed to aircrafft noise of high WECPNL. The aircraft noise exposure area in 2010 is nearly same as in 1992. Because the movement of B737 in the early morning - the B737 has a higher noise level impact than either the DC-10 or A300 - will decrease gradually in the future.

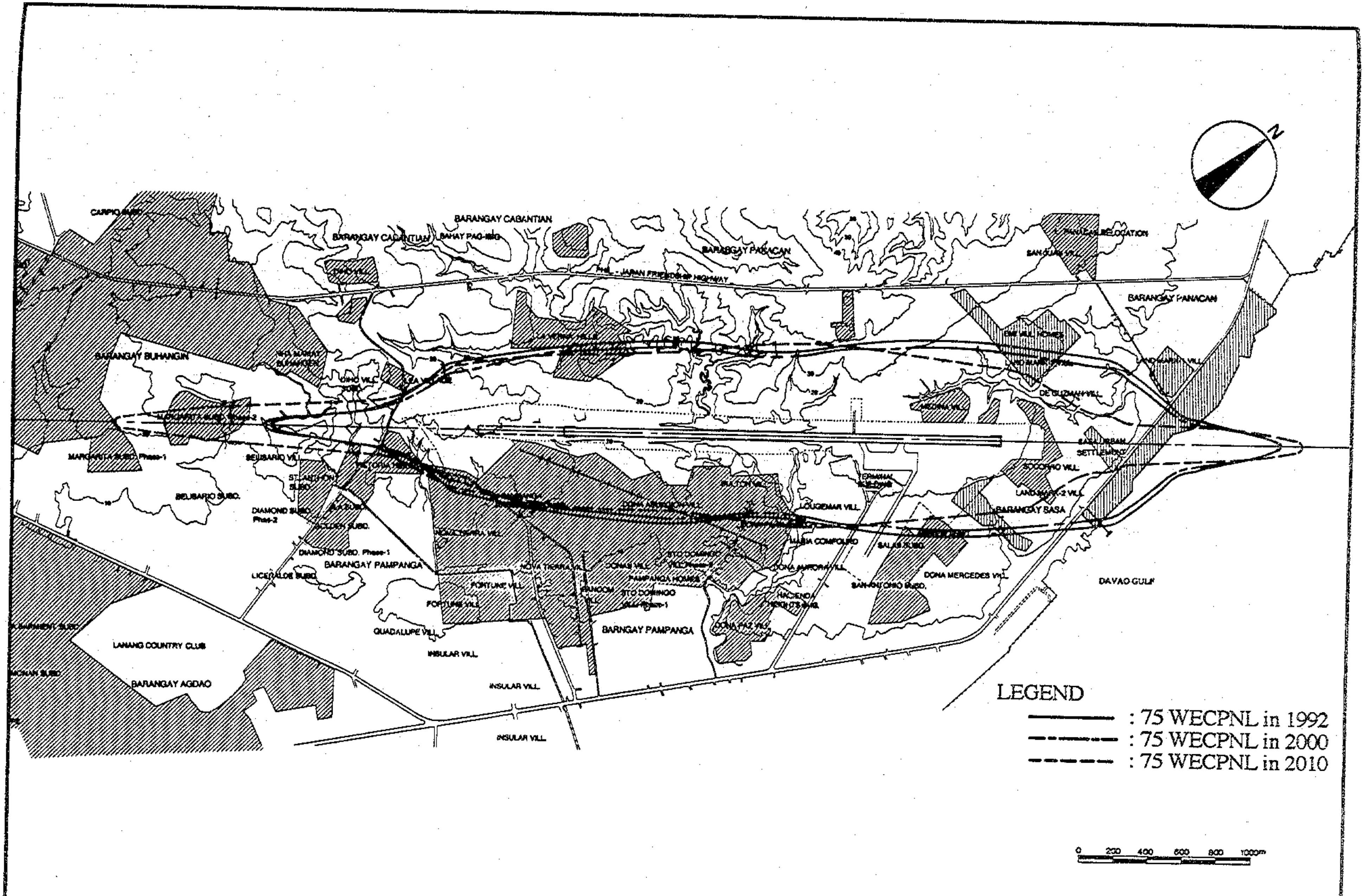

Figure 6.18.1 Aircraft Noise Contours of WECPNL

6.19 Land-Use Surrounding the Airport

In the vicinity of the airport, urbanization is proceeding toward the airport. Until now, no problem has been reported to the ATO and City of Davao in terms of environmental matters, such as aircraft noise pollution. However, the urbanization which is not based on the future land-use plan considering the long-term airport master plan will limit the expansibility of the airport and conflict with future airport development. Accordingly, the urbanization should be controlled in accordance with the future land-use plan and long-term airport master plan.

From such a viewpoint, in November 1992, Davao City council issued the city ordinance approving the amendment of the previous zoning map based on the airport master plan tentatively proposed at that time as mentioned in Section 3.12.2.

CHAPTER 7 AIRPORT MASTER PLAN

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7.1 General

The objectives of the airport master plan are to provide guidelines for future development which will satisfy requirement for the safety/regularity of air navigation and aviation demands. The airport master plan, at the same time, be compatible with the community development.

Based on the future air traffic demand, facility requirement and the evaluation of the existing airport facilities, alternative airport master plans have been prepared and evaluated. This chapter presents the selection of the optimum airport master plan.

7.2 Basic Concept of Airport Master Planning

Basic considerations adopted for the airport master planning of Davao International Airport are briefly discussed in subsections 7.2.1 through 7.2.9.

7.2.1 Phases of Airport Development

Based on Implementing Arrangement agreed upon between JICA and DOTC, the phases of the airport development have been set forth as follows:

Medium-term development plan (Phase-I) : Target year 2000

Long-term development plan (Phase-II) : Target year 2010

7.2.2 Runway Length

Based on the airport facility requirements in Chapter 5, the required runway length is 2,500 m for Phase-I and 3,000 m for Phase-II.

7.2.3 Width of Runway Strip

As mentioned in Chapter 5, the required width of the runway strip is 300 m for Phases-I and -II. (300 m runway strip is necessary for a precision approach runway in accordance with ICAO ANNEX 14.) However, the existing terrain at and adjacent to the existing 200m wide runway strip infringes on the transitional surface. If the existing runway strip is widened to 300 m and the existing terrain is cleared so as not to infringe the transitional surface during the initial phase, it will require about 2 million cu.m earth cut work which would cost about 260 million PHP.

On the other hand, this airport has been operating under substandard conditions in terms of such obstacles infringing on the traditional surface. Therefore, the width of runway strip is proposed to be 200 m in Phase-I and 300 m in Phase-II so that the initial investment could be minimized. Then earth cutting work can be implemented step by step through Phases-I and II until a no obstacle status is achieved by the beginning of Phase-II as shown in Figure 7.2.1.

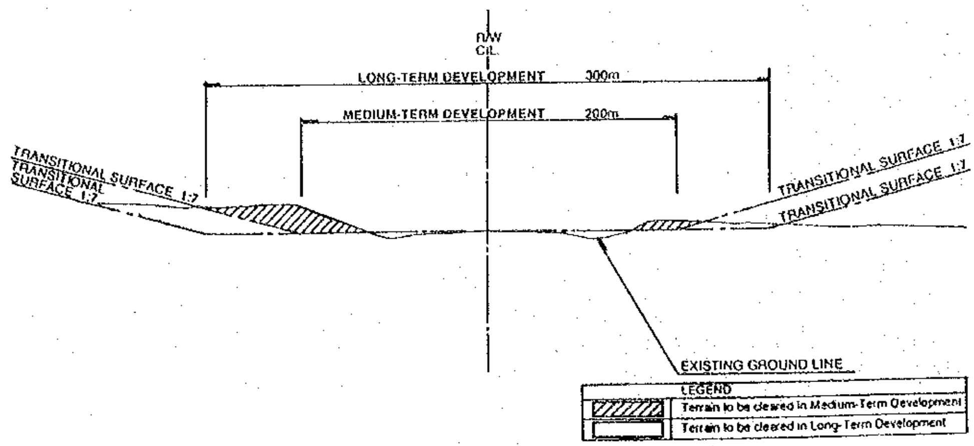


Figure 7.2.1 Phasing Plan for Cutting Terrain Infringing Transitional Surface

By this method, the cutting volume in Phase-I can be reduced to approximately half of the cutting volume necessary to secure the required traditional surface associated with a 300m wide runway strip.

7.2.4 Graded Portion

ICAO recommends that the extent of graded portion for a precision approach runway should be as shown in Figure 7.2.2.

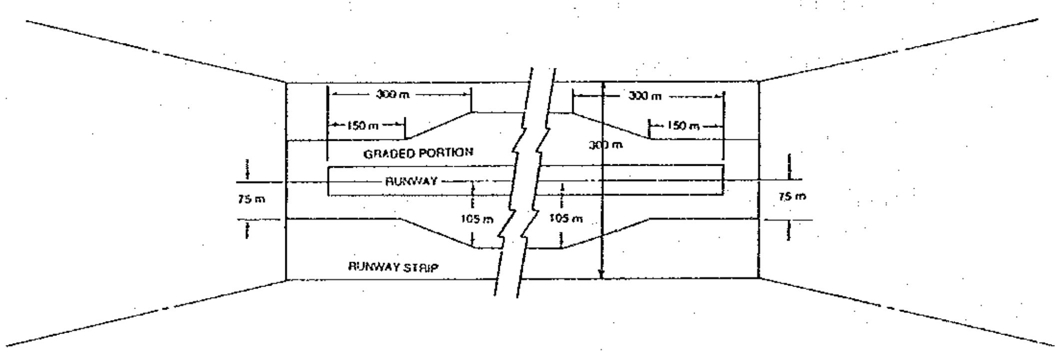


Figure 7.2.2 Graded Portion for Precision Approach Runway

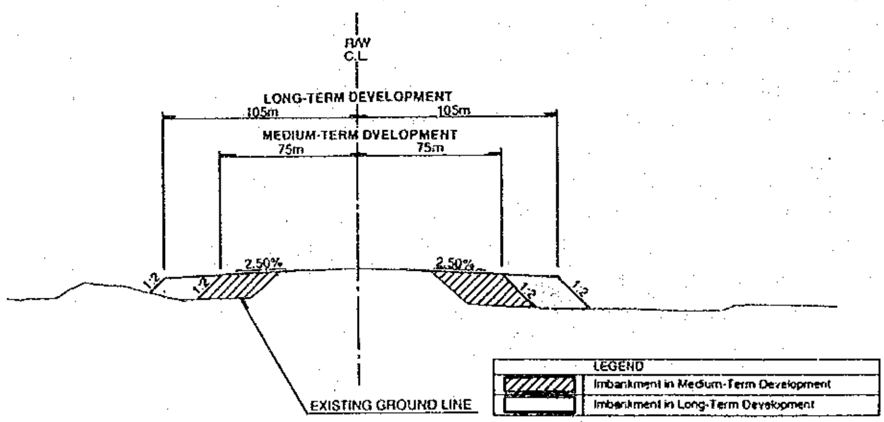


Figure 7.2.3 Phasing Plan for Grading of Runway Strip

If the existing graded portion is widened so as to meet the requirement shown in Figure 7.2.2 at the initial phase, the embankment volume of about 600,000 cu.m costing some 50 million PHP will be required. To minimize the degree of the initial investment for the cutting work of the existing terrain mentioned in Section 7.2.3 above, the graded portion shown in Figure 7.2.4 is proposed for Phase-I which agrees with recommendation by ICAO for instrument runway.

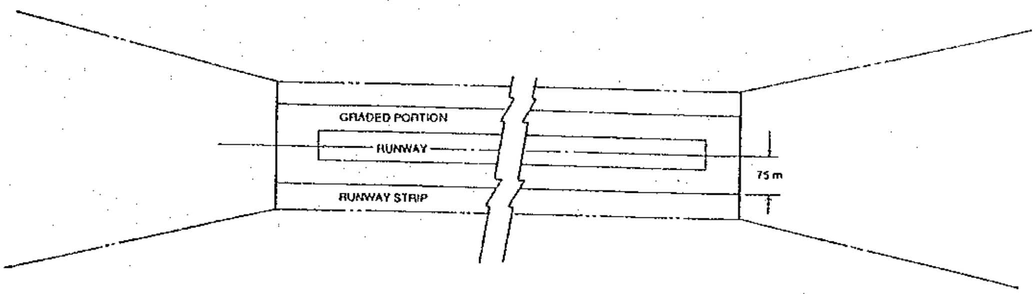


Figure 7.2.4 Graded Portion for Instrument Runway

Proposed phasing of the grading works is as shown in Figure 7.2.3.

7.2.5 Direction of Runway Extension in Phase-II

For the runway extension envisaged in Phase-II, the westerly extension beyond RWY 05 end is determined by taking into account the prevailing terrain and the existing residential area surrounding the airport.

7.2.6 Runway Usage Pattern

The direction of the main approach is one of the factors which determine the layout of air navigation systems, especially instrument landing system (ILS), and approach lighting system (ALS). For the master planning of Davao International Airport, the preferential runway usage pattern, that is the approach from RWY 23 and takeoff from RWY 05, is proposed for the following reasons:

a) The proposed runway usage pattern could reduce the adverse effects of aircraft noise on the existing residential area spread on the west of the airport by utilizing more frequently the flight path on the eastern end of the Runway (RWY 23) which is mostly over the sea;

b) The proposed runway usage pattern is considered possible almost all year long because of the prevailing wind conditions shown in Table 7.2.1;

Table 7.2.1 Wind Coverage for Cross Wind and Tail Wind Operations

Cross Wind	Tail Wind	Wind Coverage
13 kt	10 kt	99.9 %
13 kt	5 kt	96.1 %

c) Because of the prevailing terrain and the residential area, it is preferable to locate the localizer critical area on the western end of the runway where a wide flat area can be secured;

d) The proposed direction of the runway extension in Phase-II is to the west as mentioned in Section 7.2.5. In the case of the main approach from RWY 23, ALS will be installed on the eastern side of the runway. Thus, relocation of the ALS at RWY 23 will not be required although relocation of the simple approach lighting system (SALS) at RWY 05 will be required. By this arrangement it will be possible to minimize the relocation work for the airfield lighting systems caused by the runway extension; and

e) Because of the existing airways structure connecting Manila, Cebu and Cagayan de Oro, most of the scheduled flights are from/to the north of Davao. The proposed pattern is optimum since it allows straight-in and-out aircraft operations.

7.2.7 Layout of Air Navigation Systems

Based on airport facility requirements, air navigation systems for the precision approach runway category-I are to be installed in Phase-I. According to the transition plan from ILS to MLS by ICAO, MLS is supposed to be installed instead of ILS in Phase-I. Nevertheless, the required airport property area is determined to install ILS for the following reasons:

a) ICAO obligatory time limit to install MLS seems to be postponed beyond 2000;

b) ILS to be installed by the USA in the near future will still be within its life span which is more than fifteen years from the installation date; and

c) ILS requires a wider critical area than MLS.

In addition to the localizer and glide slope critical areas, the areas required for ALS, SALS and middle marker (M/M) are also planned.

With regard to the area for VOR/DME, the site selection criteria are less critical than ILS. Therefore, the site will be planned in the course of the preliminary design for the airport master plan to be finally selected. Due consideration will also be given to the implementation schedule of the replacement of existing C-VOR/DME with D-VOR/DME under the ongoing OECF project at the time.

7.2.8 Typical Airport Layout Plan

A typical airport layout plan, excluding terminal areas, is illustrated in Figure 7.2.5 integrating the basic considerations mentioned in subsections 7.2.1 through 7.2.7.

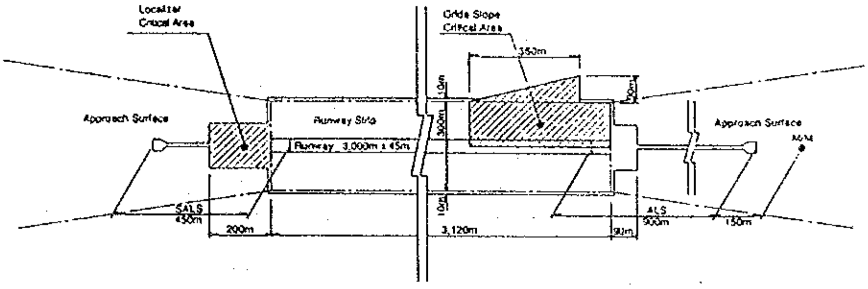


Figure 7.2.5 Typical Airport Layout Plan

7.2.9 Typical Terminal Area Layout Plan

In the planning of a terminal area layout, the separation distance between the runway and the apron edge in front of the passenger terminal building is one of the important factors. The separation distance between the runway center line and the edge of the apron is set at 366m as shown in Figure 7.2.6 in order that the tail wing of an aircraft parked on the apron in a nose-in configuration would not infringe on the transitional surface of a 300m wide runway strip. (In case of B747, angled nose-in parking configuration.)

The typical layout of a terminal area has been planned as shown in Figure 7.2.7 based on the facility requirements estimated in Chapter 5 and considering future expansibility.

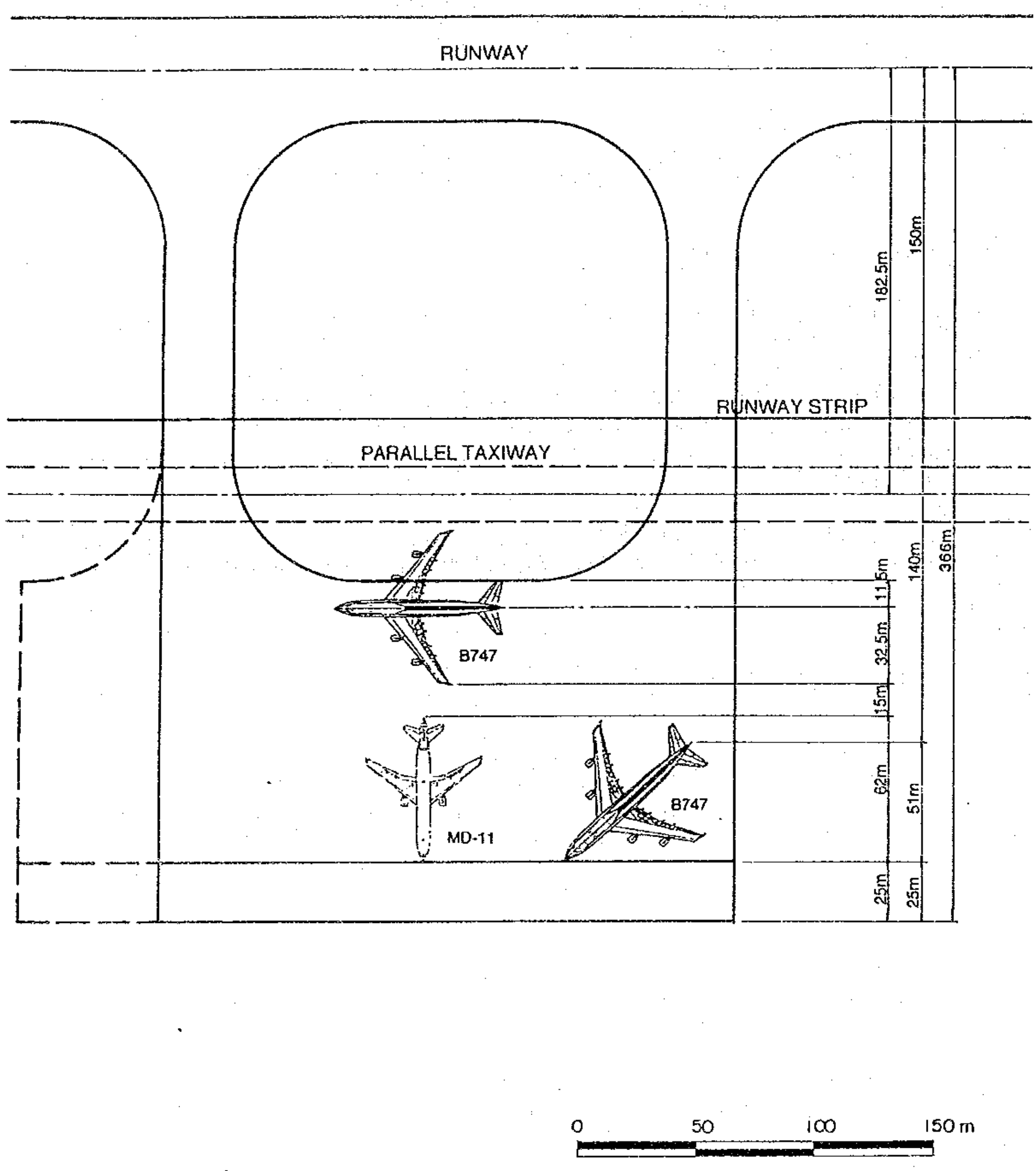


Figure 7.2.6 Separation Distance between Runway and Apron Edge

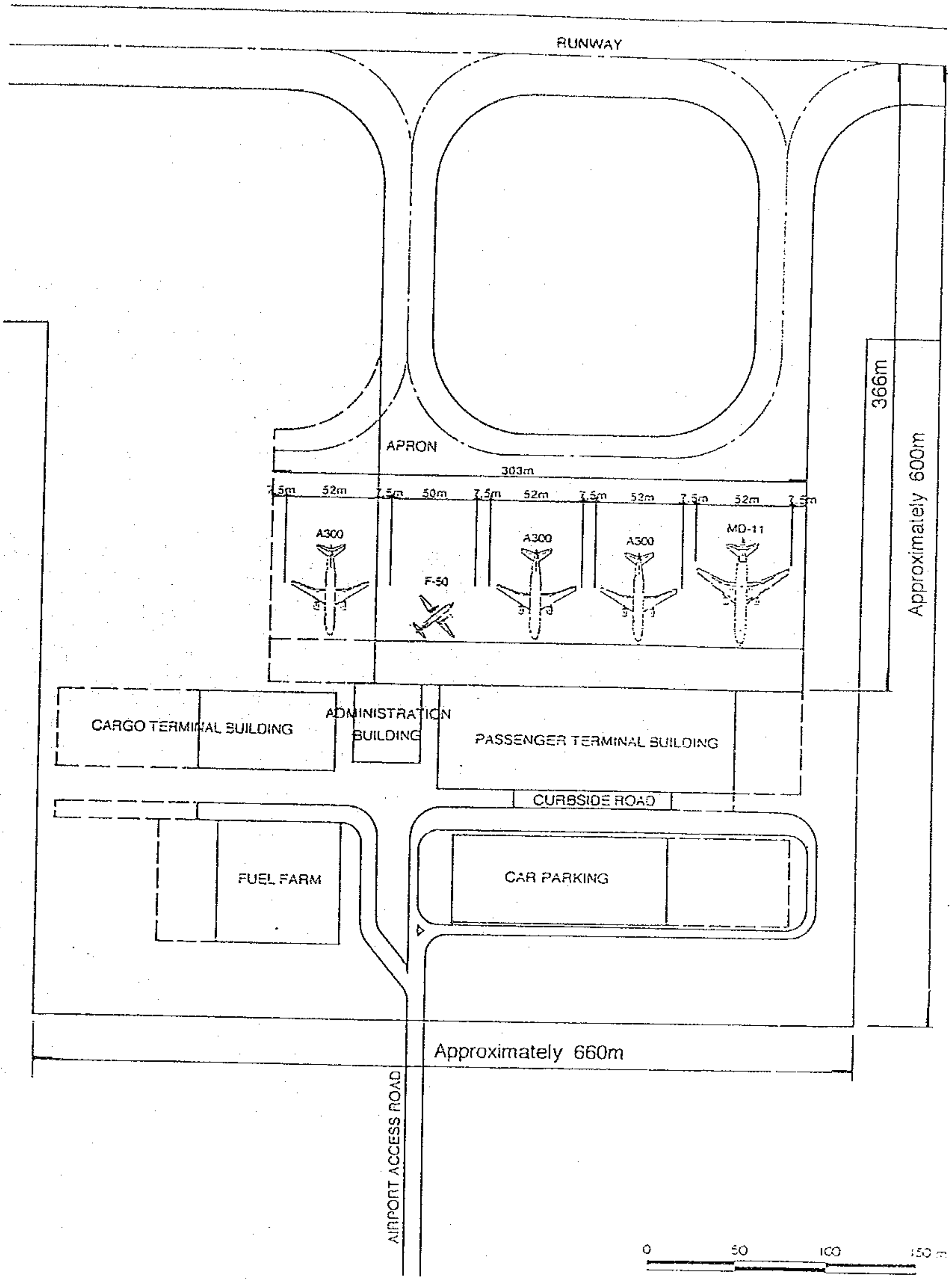


Figure 7.2.7 Typical Terminal Area Layout Plan

7.3 Preparation of Alternative Airport Master Plans

7.3.1 Basic Concept of Runway Development

For the runway development, the following two basic concepts can be considered:

Alternative-A : Use of the existing runway

Alternative-B : Construction of a new runway

For the case of Alternative-B, runway orientation could be in any direction from the viewpoint of the runway wind coverage. However, shifting the runway orientation to a different direction would produce no advantage such as to reducing the effects of aircraft noise, but would only increase airport property requirements. It is also obvious that by locating the new runway on the south side of the existing runway it would further disrupt the existing airport community.

Thus, in the case of Alternative-B, the orientation of the new runway is set the same as the existing one.

Then, the possible location of the new runway is limited to the area between Runway - 1 (300 m from the existing runway center line) and Runway - 2 (180m) as shown in Figure 7.3.1. This location takes into consideration two factors: 1) the runway strip associated with the new runway would not conflict with the existing housing subdivision area, and 2) the required transitional surface of the new runway is secured to clear the tail wing of the aircraft parked on the apron. With regard to the influence of aircraft noise on the surrounding area, there is no remarkable difference among the proposed locations. It is obvious that the location of Runway - 2 requires minimum land acquisition. Therefore, in the case of Alternative - B, the location of the new runway is set at 180 m northward from and parallel to the existing runway center line.

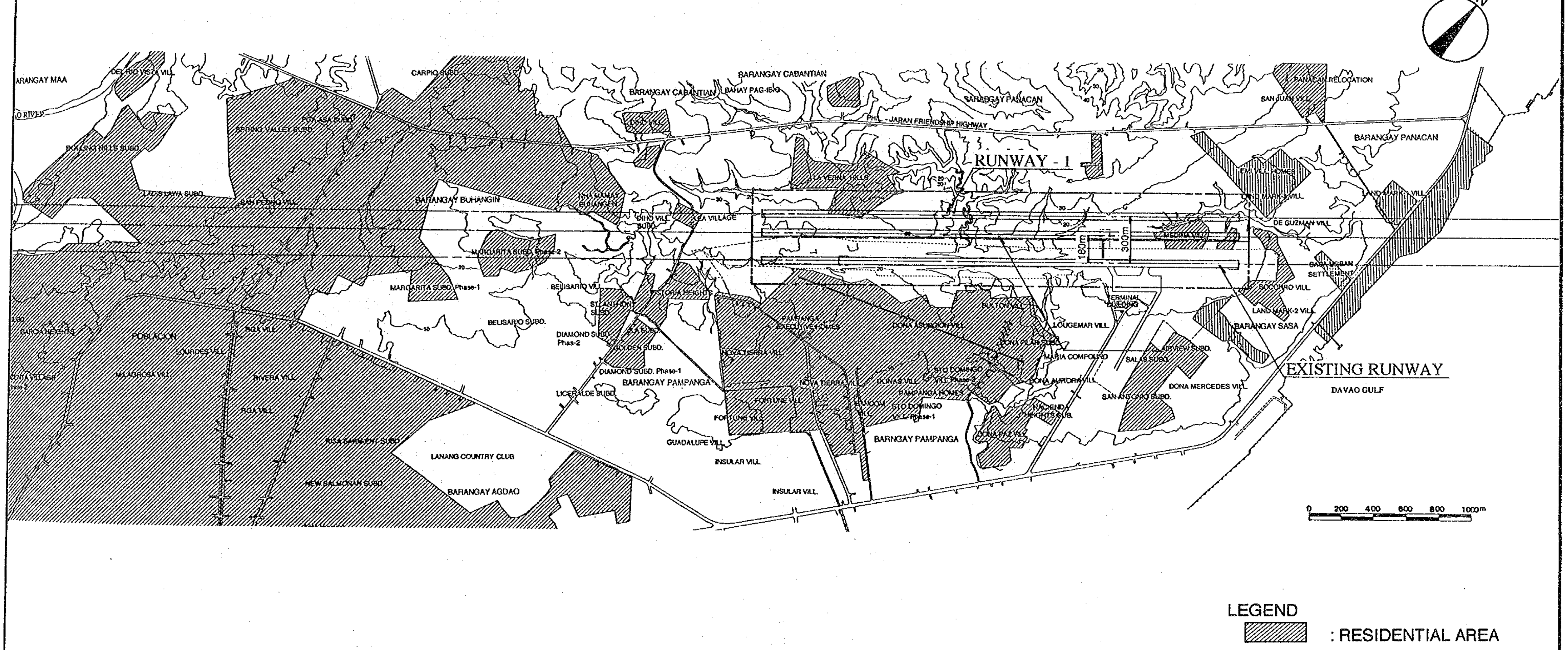


Figure 7.3.1 Alternatives for New Runway

7.3.2 Alternative Sites for Terminal Development

For the terminal development site, the following two basic alternatives can be considered:

Alternative-S : Terminal area development on the south of the runway

Alternative-N : Terminal area development on the north of the runway

In the case of Alternative-S, the proposed site for the terminal area automatically becomes on the west side of the existing terminal areas because other areas on the south side of the runway are already occupied by the residential and airport facilities.

In the case of Alternative-N, three candidate sites are selected for comparison as shown in Figure 7.3.2, considering the existing residential area and the prevailing terrain.

Among those three sites, Site-2 is superior to the others for the following reasons:

b) Site-3 requires the relocation of some 50 houses adjacent to the airport. In the case of Site-3, the taxiing distance of departing aircraft from the apron to RWY 05 threshold is the longest of the three sites. This is not preferable for aircraft operations, especially in the case of the preferential runway usage pattern mentioned in Section 7.2.6. Taxiing distance for landing aircraft on RWY 23 is also the longest of the three alternatives; and

c) In the case of Site-2, no relocation of houses is required. The location of Site-2 is more preferable in terms of the taxiing distance as compared with Site-3. The required earthwork volume is less than that of Site-1 because of the less undulating terrain.

7.3.3 Alternative Airport Master Plans

Four alternative airport master plans are proposed by the combination of alternatives for the runway and terminal area developments as follows:

Alternative-AS : Existing runway with a new terminal area south of the runway

Alternative-AN : Existing runway with a new terminal area north of the runway

Alternative-BS : New runway with a terminal area to be redeveloped at the existing terminal area

Alternative-BN : New runway with a new terminal area north of the runway

Airport layout plans of the four alternatives are shown in Figures 7.3.3 through 7.3.6.

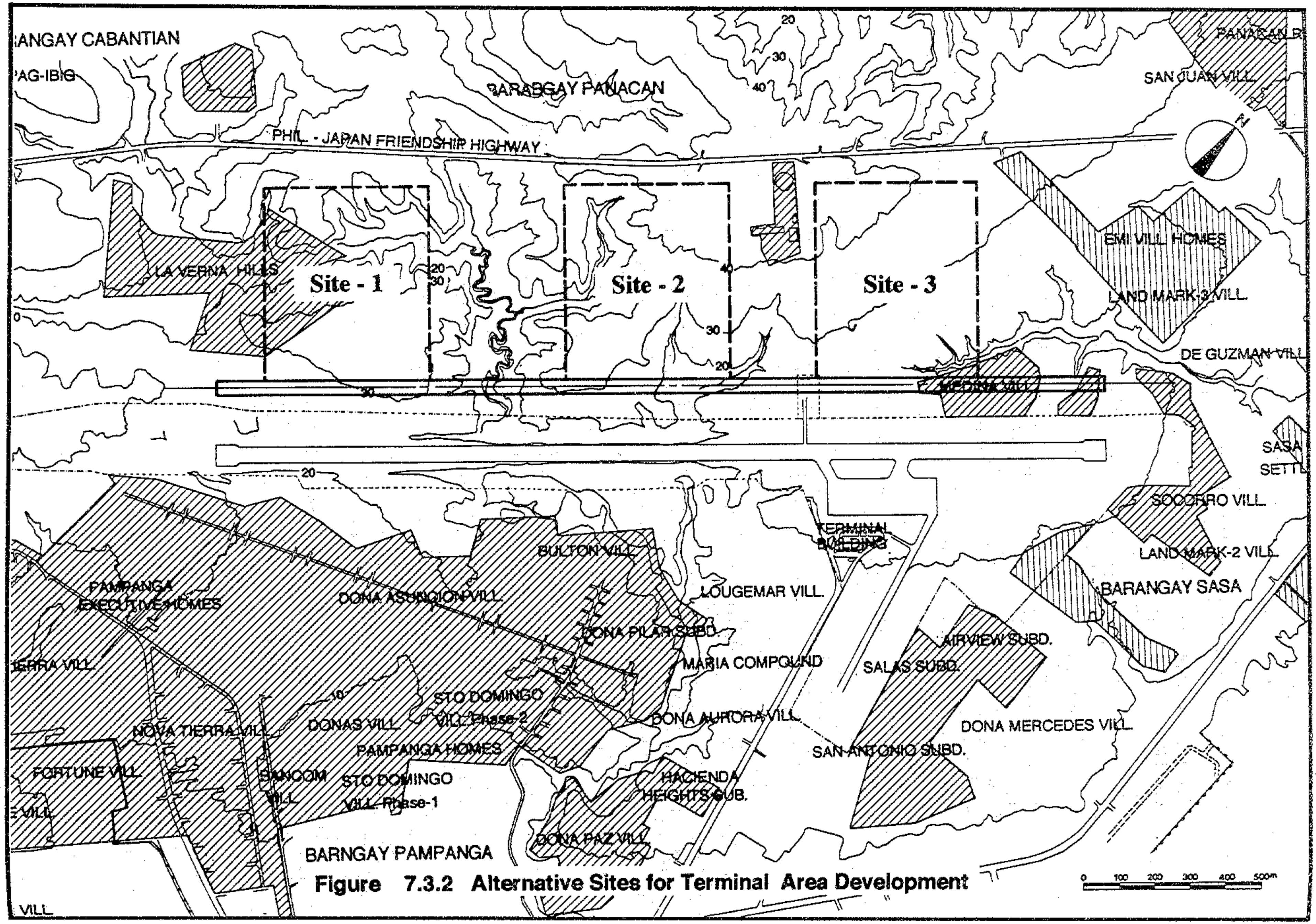


Figure 7.3.2 Alternative Sites for Terminal Area Development

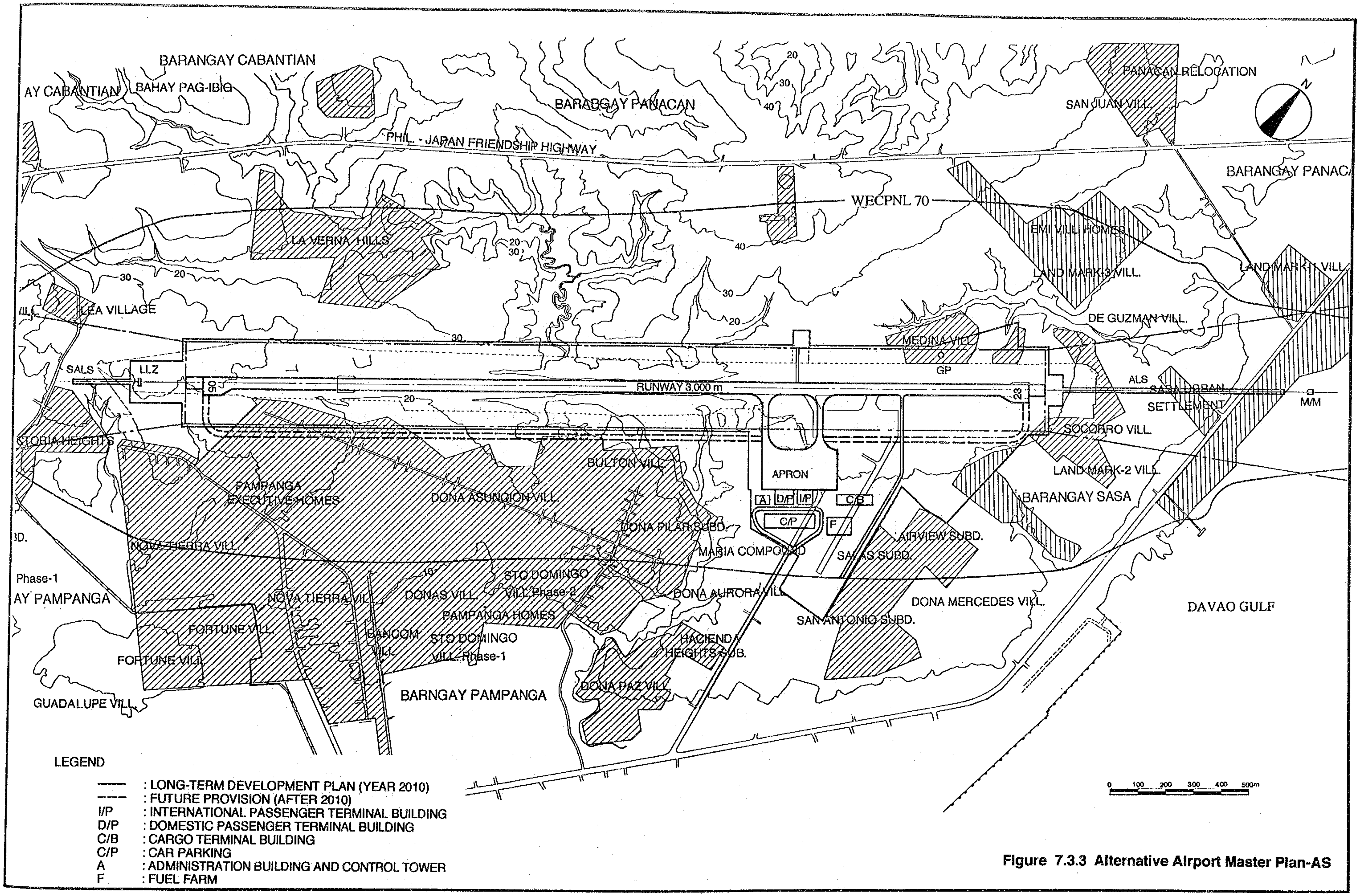


Figure 7.3.3 Alternative Airport Master Plan-AS

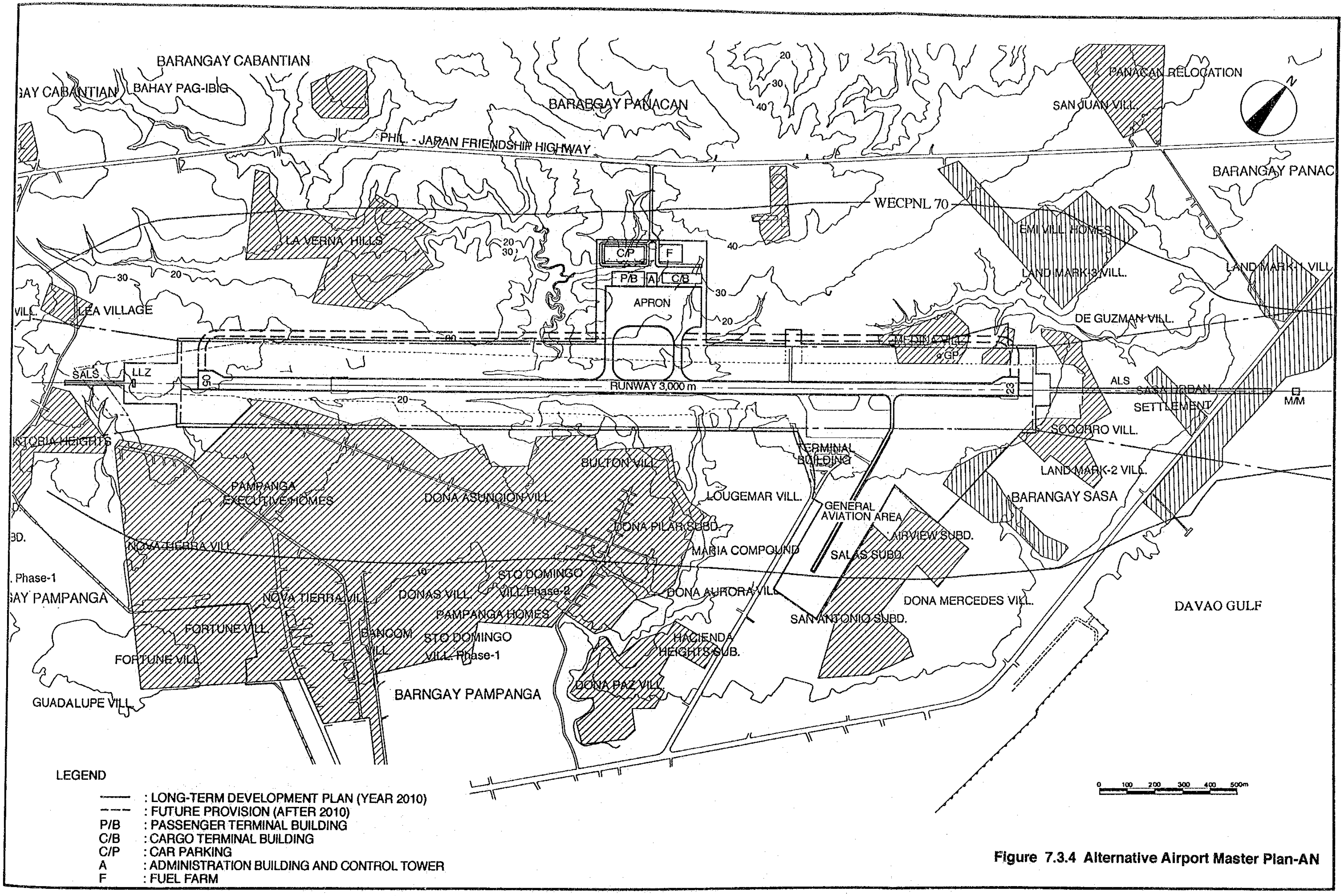


Figure 7.3.4 Alternative Airport Master Plan-AN

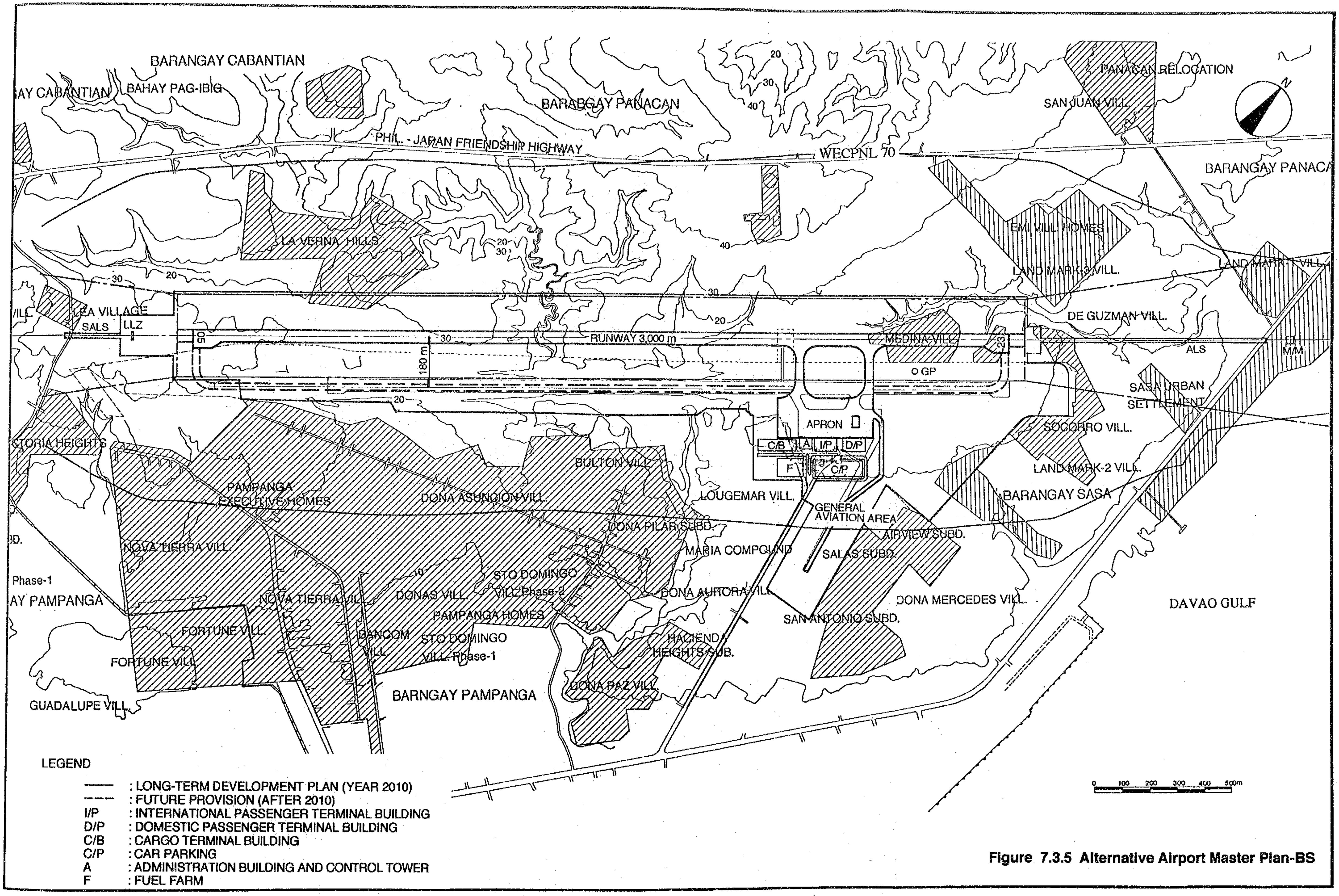
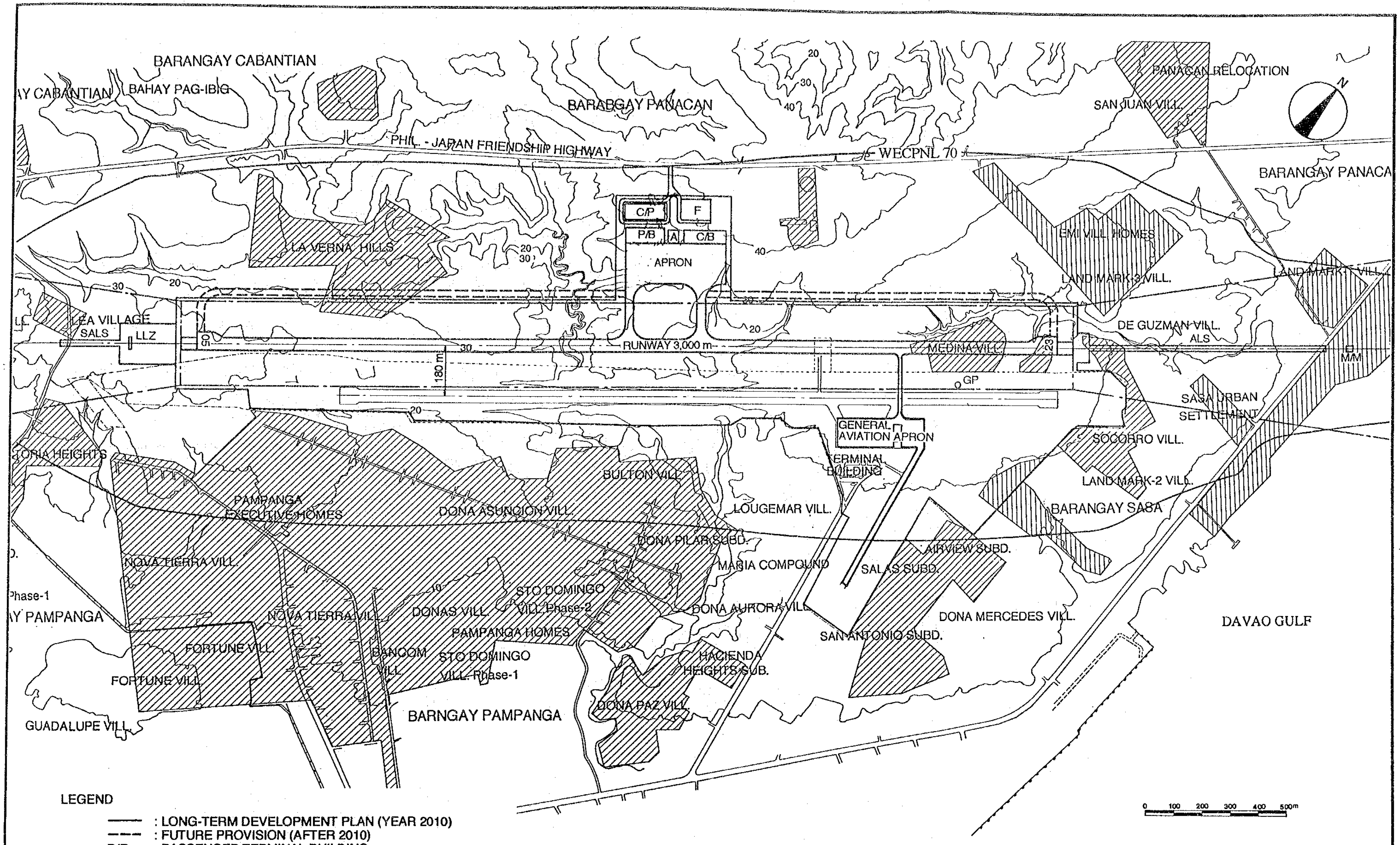


Figure 7.3.5 Alternative Airport Master Plan-BS



LEGEND

—— : LONG-TERM DEVELOPMENT PLAN (YEAR 2010)
- - - : FUTURE PROVISION (AFTER 2010)
P/B : PASSENGER TERMINAL BUILDING
C/B : CARGO TERMINAL BUILDING
C/P : CAR PARKING
A : ADMINISTRATION BUILDING AND CONTROL TOWER
F : FUEL FARM

Figure 7.3.6 Alternative Airport Master Plan-BN

The terminal area layout plan of Alternative-AS is shown in Figure 7.3.7.

In the case of Alternative-AS, incremental implementation of the Phase-I project is possible so that the existing facilities could be used as long and effectively as possible; hence, the initial investment cost could be minimized.

In this case, the scope of the Phase-I development project is divided into the following two packages:

Package-1 : Development of a new domestic passenger terminal, relocation of the existing control tower and the renovation of the existing passenger terminal building into the international passenger terminal building.

Package-2 : Development of a new international passenger terminal, cargo terminal and fuel farm, and cutting work of the terrain infringing on transitional surface associated with the 200m wide runway strip.

For the other alternatives, it is difficult to divide the scope of Phase-I development into two phases.

The terminal area layout plan of Alternative-BS is shown in Figure 7.3.8.

In the case of Alternative-BS, the existing passenger terminal building will continue to be used as the international passenger terminal building in Phases-I and II.

The terminal area layout plans of Alternatives-AN and -BN are basically the same as the typical terminal area layout plan shown in Figure 7.2.7.

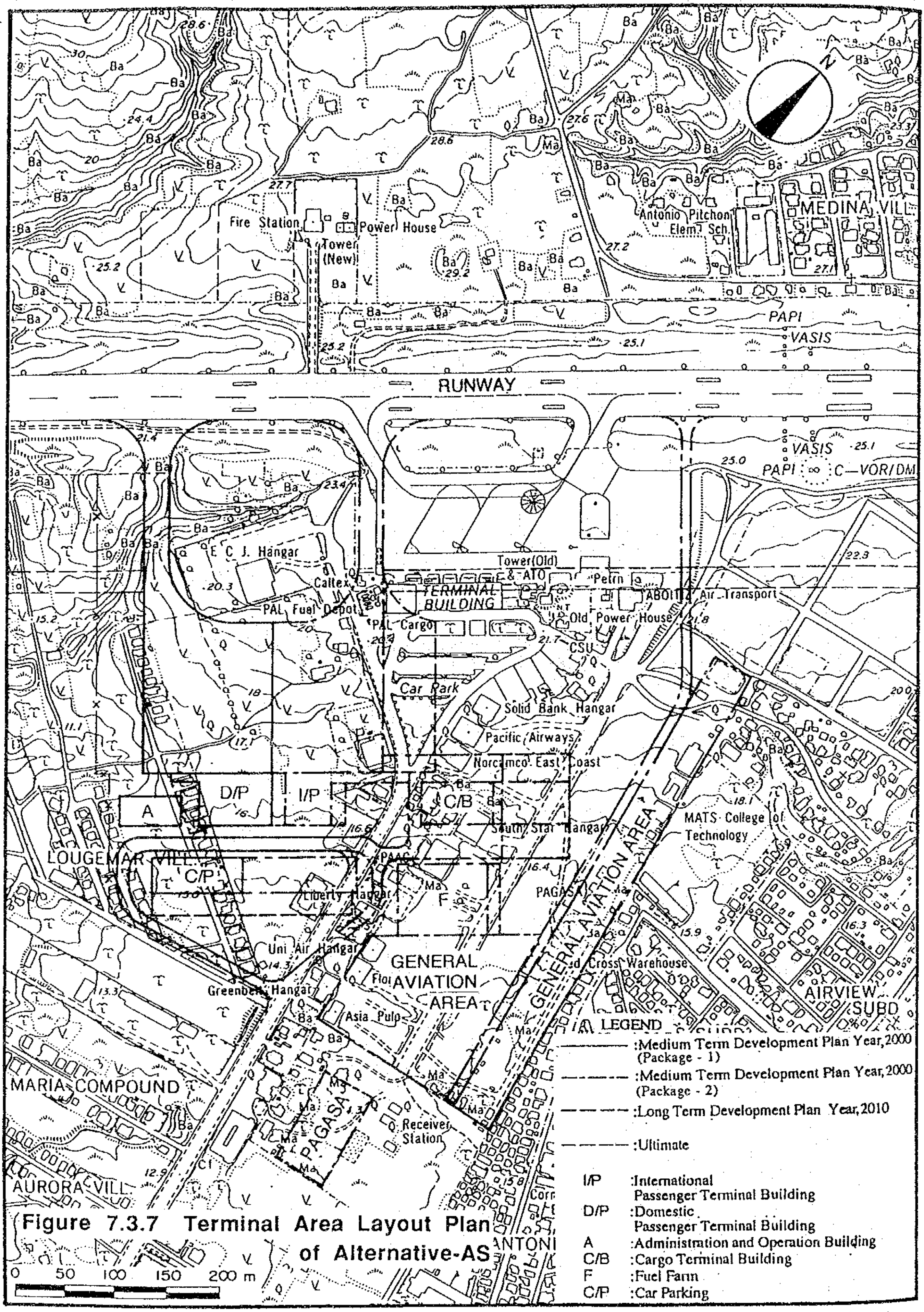


Figure 7.3.7 Terminal Area Layout Plan of Alternative-AS

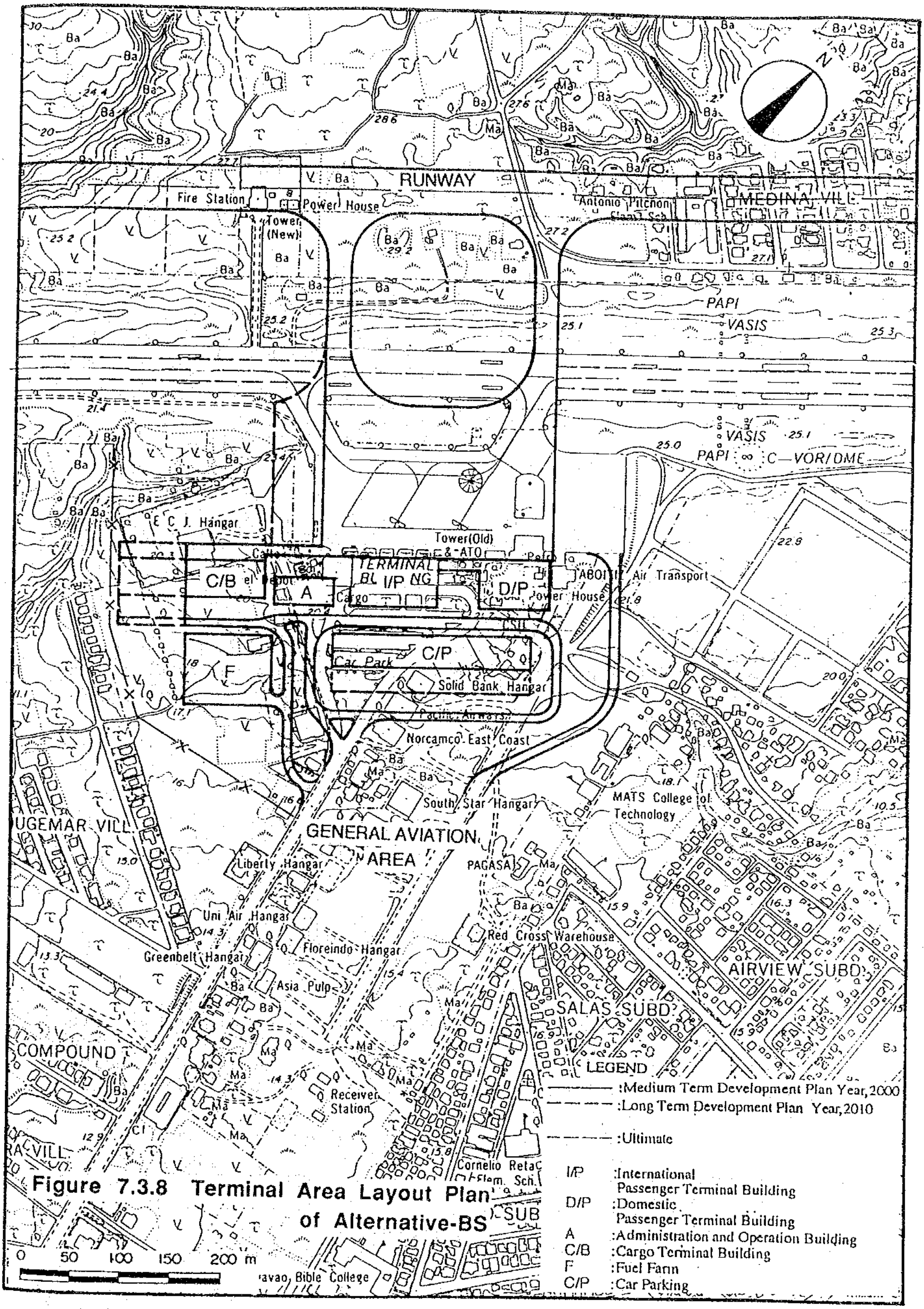


Figure 7.3.8 Terminal Area Layout Plan of Alternative-BS

7.4 Evaluation of Alternative Airport Master Plans

7.4.1 Evaluation of Alternatives by Each Item

The four (4) alternative airport master plans evaluated by various criteria are summarized as follows:

(1) Aircraft Operations

a) Obstacles

For all of the alternatives, the existing obstacles such as control tower, passenger terminal building and terrain can be cleared to ensure the airspace above transitional surfaces associated with the 200m wide runway strip in Phase-I and the 300m wide runway strip in Phase-II . On this point, all the alternatives are equal.

If the scope of the Phase-I development project of Alternative-AS is divided into two packages, the existing passenger terminal building will remain as an obstacle until completion of the Package-2 project. This is considered to be a defect of a temporary nature for Alternative-AS.

b) Aircraft Operations Procedures

The alternatives are equal on this point because there are no problems in terms of aircraft operations procedures.

c) Runway Profile

Improvement of the existing runway profile shown in Figure 7.4.1 to meet ICAO recommendations requires costly overlay work amounting to some 500 million PHP and is considered not practicable. It is a disadvantage of Alternatives-AS and -AN. Alternatives-BS and -BN have no such a disadvantage.

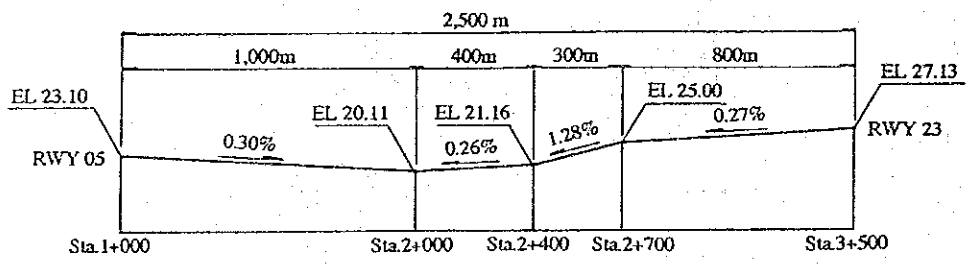


Figure 7.4.1 Existing Runway Profile

d) Taxiing Distance

Most departing aircraft takeoff from RWY 05 both in the ordinary and preferential runway usage pattern. Then, a terminal site close to RWY 05 is preferable to shorten the taxiing distance. With regard to this point, Alternatives-AN and -BN are more preferable than Alternatives-AS and -BS as tabulated in Table 7.4.1.

Table 7.4.1 Taxiing Distance

unit: m

AS	AN	BS	BN
1,980	1,420	2,160	1,420

Note: The above distance is from the proposed apron to RWY 05 threshold for taking off.

(2) Airport Accessibility

In Alternatives-AN and -BN, Philippine - Japan Friendship Road will be used for the access. The distance from Davao City Hall, which is considered to be a center of Davao, to the airport terminal through the Friendship Road is about 7.5 km which is equivalent to the access distance in Alternatives-AS and -BS. Then, the all of the alternatives are at an equal distance from Davao City Hall to the proposed airport terminal area.

Davao Regional Industrial Center (RIC) is planned to be located to the north of the airport as shown in project location map (3). Thus, Alternative-AN and BN have better accessibility to the proposed RIC than Alternatives-AS and BS.

(3) Expansibility for the Remote Future Airport Development

Although the airport master plan has been prepared to meet the demand in 2010, it is preferable to meet the demand beyond 2010 by the small additional investment.

a) Expansibility of Terminal Area

In Alternative-AS, the terminal area is expansible to the east without additional land acquisition. Other alternatives require additional land acquisition. As for the terminal area development within the airport boundary for Phase-II, Alternative-AS is more advantageous than the others. On the other hand, most of the area on the north of the airport consists of coconut/banana farm and open areas, except for the subdivision being constructed near the RWY 05 end. This area has been reserved for airport development by Davao City Municipal Government as shown in Figure 3.12.2. (It is noted that the open area was found to be smaller during the field survey after submission of the Interim Report on Semtember 1992 due to the expansion of the above subdivision into the reserved area.) Therefore, Alternatives-AN and -BN also have good expansibility if additional land can be purchased at additional costs.

b) Construction of Parallel Taxiway

A parallel taxiway will be required after 2010 to increase runway capacity. Alternative-AS would require land acquisition at a densely populated area for the parallel taxiway. Although it would require land acquisition for Alternatives-AN and -BN, it would be easy to provide the parallel taxiway since the sites are not residential areas. In Alternative-BS, the parallel taxiway can be provided at the same location as the existing runway. As for the construction of the parallel taxiway, Alternative-BS is superior to the others.

c) Expansibility of General Aviation Area

In Alternatives-AS and -BS, the general aviation area will be surrounded by the developed terminal area and the residential area. Then, the expansibility of the general aviation area is inferior as compared with Alternatives-AN and-BN. Alternative-BN is more preferable for the general aviation than Alternative-AN because it is possible to utilize the existing apron and passenger terminal building exclusively for general aviation.

(4) Airport Operation

From the aspect of airport management and operation, it is preferable that all terminal facilities be located close enough to each other and still maintain future expansibility of each facility. In Alternatives-AN and -BN, the general aviation area will remain at the existing site separate from the new terminal area and across the runway. Ground traffic across the runway is not desirable from the viewpoint of safe airport operations.

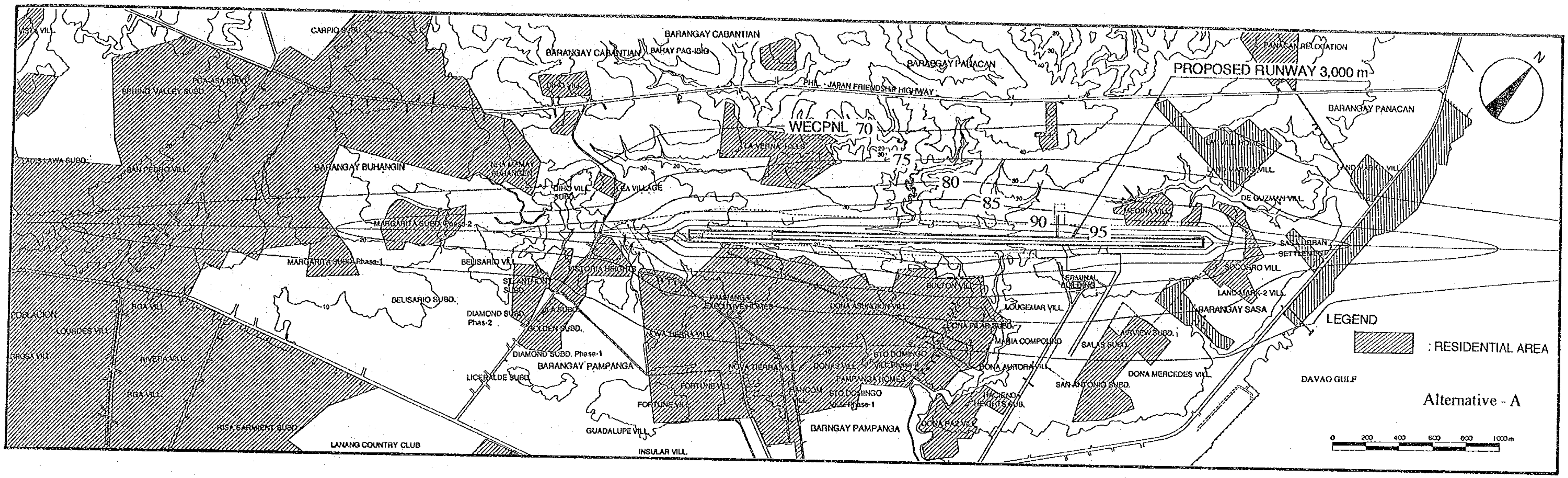
On this point, Alternatives-AS and BS are better than Alternatives-AN and-BN.

(5) Environment

The estimated degree of impact of aircraft noise on the surrounding area in 2010 is shown in Figure 7.4.2 and Table 7.4.2. (Impact of aircraft noise in 1992 is shown in Figure 6.18.1)

Table 7.4.2 Number of Housing Units Exposed to Aircraft Noise

Alternative - AS					
WECPNL	1992	2010	Increase	Decrease	Balance
More than 95	0	0	0	0	0
95 - 90	25	0	10	35	-25
90 - 85	269	125	61	205	-144
85 - 80	808	720	82	170	-88
80 - 75	2,242	1,888	201	555	-354
75 - 70	4,326	4,376	207	157	50
Total	7,670	7,109	561	1,122	-561
Alternative - AN					
WECPNL	1992	2010	Increase	Decrease	Balance
More than 95	0	0	0	0	0
95 - 90	25	0	10	35	-25
90 - 85	269	120	61	210	-149
85 - 80	808	750	82	140	-58
80 - 75	2,242	1,938	201	505	-304
75 - 70	4,326	4,406	207	127	80
Total	7,670	7,214	561	1,017	-456
Alternative - BS					
WECPNL	1992	2010	Increase	Decrease	Balance
More than 95	0	0	0	0	0
95 - 90	25	0	2	27	-25
90 - 85	269	62	19	226	-207
85 - 80	808	258	109	659	-550
80 - 75	2,242	1,736	826	1,332	-506
75 - 70	4,326	4,227	2,955	3,054	-99
Total	7,670	6,283	3,911	5,298	-1,387
Alternative - BN					
WECPNL	1992	2010	Increase	Decrease	Balance
More than 95	0	0	0	0	0
95 - 90	25	0	2	27	-25
90 - 85	269	60	19	228	-209
85 - 80	808	248	109	669	-560
80 - 75	2,242	1,706	826	1,362	-536
75 - 70	4,326	4,227	2,955	3,054	-99
Total	7,670	6,241	3,911	5,340	-1,429



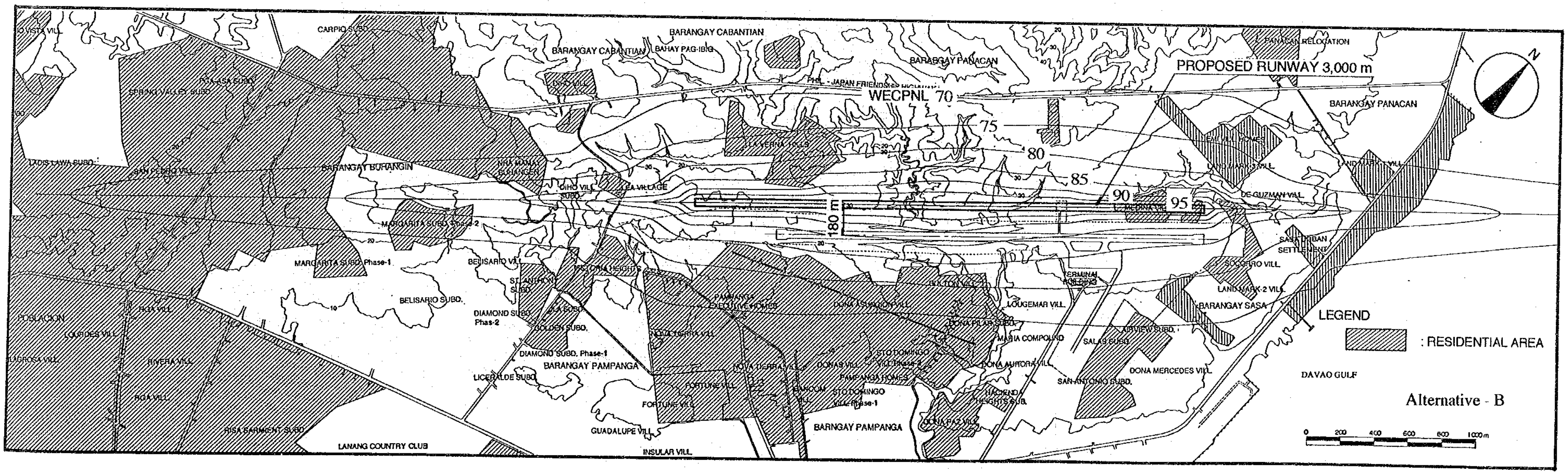


Figure 7.4.2 Influence of Aircraft Noise

With regard to the total number of housing units to be exposed to aircraft noise of WECPNL 70 and above, Alternatives-BS and -BN are superior to Alternatives-AS and -AN because the densely populated area is located south of the airport.

On the other hand, as for the total number of housing units to be newly exposed to aircraft noise, Alternatives-AS and-AN are apparently less than Alternatives-BN and-BS in which a northerly shifted runway naturally involves larger new areas.

The assessment of aircraft noise could differ depending on the viewpoints mentioned above. At the Davao International Airport, the estimated aircraft noise contour in 2010 is nearly the same as at present as shown in Table 6.18.1 and Figure 6.18.1. Presently there have been no complaints about aircraft noise from the neighbors. If the situation remains the same, a change of the location of aircraft noise exposure might be recognized as a more critical problem by the neighbors. In this case, Alternatives-AS and -AN are considered to be advantageous. When some sort of compensation is required for houses exposed to WECPNL 70 and above, the conclusion is reversed.

(6) Social Considerations

Land acquisition area and the removal of houses required for each alternative is shown in Table 7.4.3 and Appendix-7.4.1.

Table 7.4.3 Land Acquisition and Removal of Houses

Alternative	AS	AN	BS	BN
Land Acquisition				
Phase - I	40ha	46ha	66ha	78ha
Phase - II	22ha	21ha	19ha	18ha
Total	62ha	67ha	85ha	96ha
Removal of Existing Houses				
Phase - I	270	220	220	220
Phase - II	140	140	40	40
Total	410	360	260	260

While Alternative-AS requires the least land acquisition, it requires the greatest number of house relocations among the four alternatives. Since the degree of difficulty, cost and time required to relocate the houses is unknown at this stage of the Study, it is impossible to draw any definite conclusion regarding the matter.

(7) Effective Use of Existing Facilities

In the case of two-step implementation of Phase-I in Alternative-AS, the existing passenger terminal building could be used for the international passenger terminal building until the completion of Package-2 project as mentioned in Section 7.2.3.

In Alternatives-BS and -BN, the existing terminal facilities, such as the apron and the building, would not infringe on the transitional surface associated with the new runway. Therefore, the existing passenger terminal building can be used as an international passenger terminal building in Alternative-BS or for general aviation and the VIP lounge in Alternative-BN.

In Alternatives-AS and-AN, the existing runway continues to be used after the overlay work. But the cost required to improve the pavement strength is more expensive than that required for the construction of a new runway as mentioned in subsequent item (9). The runway overlay also requires troublesome night work and yet the existing runway profile cannot be fully improved. Therefore, the use of the existing runway is not considered to be an advantage.

From the aspect of effective use of existing facilities, Alternative-BS is the most preferable among the four alternatives.

(8) Construction

During the construction period, airport operations should be maintained and any interference by the construction work should be minimized. On this point, Alternative-BN is most advantageous among the four alternatives because most of the work can be carried out in the daytime at a virgin site. In Alternative-BS, pavement work and building work would have to proceed step by step with temporary marking and lighting on the apron to permit temporary operations. Alternatives-AS and -AN requires the reinstallation of runway lighting fixtures and markings for the runway overlay.

Taking into considerations the above conditions, preliminary estimates for the construction periods required for the Phase-I project of each alternatives have been prepared as shown in Table 7.4.4.

Table 7.4.4 Construction Period

AS	AN	BS	BN
3 years	2 years	3 years	2.5 years

In Alternative-AS, the period required only for Package-1 is estimated to be about 2 years although the total period for Packages-1 and -2 is estimated to be about 3 years.

From the aspects of the ease of construction work and the construction period, Alternative-BN is superior to the other alternatives.

(9) Project Cost

The preliminary project cost for each alternative are estimated as shown in Table 7.4.5 and Figure 7.4.3. Unit prices of land acquisition, compensation and construction work is shown in Appendix-7.4.2. A breakdown of the cost estimates is shown in Appendix-7.4.3.

Table 7.4.5 Project Cost

Alternative	AS	AN	BS	BN
Land Acquisition and Compensation (Million PHP) Phase - I	271	263	363	423
Phase - II	131	126	101	96
Total	402	389	464	519
Construction Cost (Million PHP) Phase - I	1,464	1,578	1,440	1,592
Phase - II	695	695	550	474
Total	2,156	2,273	1,940	2,066
Project Cost (Million PHP) Phase - I	1,732	1,841	1,803	2,015
Phase - II	826	821	601	570
Total	2,556	2,662	2,404	2,585

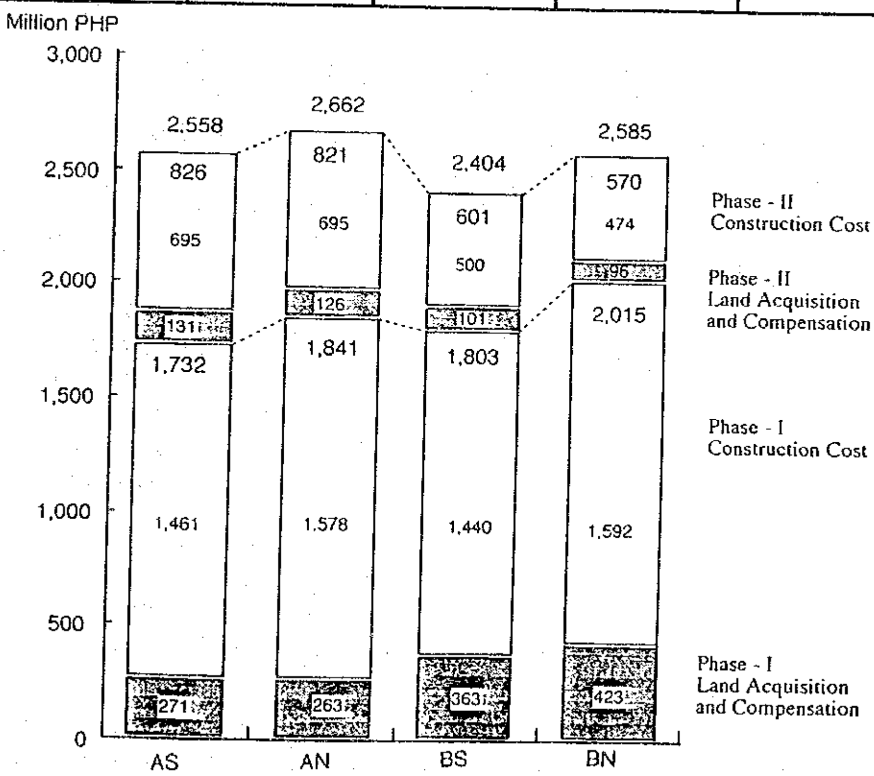


Figure 7.4.3 Comparison of Project Cost

With regard to the cost for the land acquisition and compensation in Phase-I, Alternatives-AS and -AN are more advantageous than Alternatives-BS and -BN.

As for the construction cost in Phase-I, Alternatives-AS and -BS are some 100 to 150 million PHP lower than Alternatives-AN and -BN. This is due to the following reasons:

a) Due to the great cost difference between the asphalt concrete and cement concrete pavement work in the Philippines, the costs for a new concrete runway for Alternatives -BS and -BN is some 20% lower than the cost of asphalt concrete overlay work for Alternatives -AS and -AN as shown below:

   Runway overlay (Asphalt concrete of 22 cm thick)

   112,500 sq.m x 1,760 PHP/sq.m = 198 million PHP

   New runway pavement (Slab of 42 cm thick and base course of 38 cm thick)

   112,500 sq.m x 1,400 PHP/sq.m = 158 million PHP

b) Preliminary costs estimated for earthwork of each alternative are shown in Table 7.4.6.

Table 7.4.6 Comparison of Cost for Earthwork

Alternative	Volume of Cut (cm.m)	Cost (Million PHP)
AS	680,000	88
AN	1,600,000	208
BS	1,500,000	195
BN	1,700,000	221

Note: The unit price of earthwork is assumed to be 130 PHP/cu.m

As seen in Table 7.4.6, except for Alternative-AS, the costs of the other alternatives are fairly similar to each other. Contrary to the first guess, Alternative -AN requires quite a large amount of earth cutting work (some 1.6 million cu.m) in order to lower the elevation of the new terminal apron to the reasonable level to connect with the existing runway via the stub taxiway.

In Alternatives-BS and -BN, the proposed elevation of the new runway can be adjusted to minimize the earthwork volume independently from the elevation of the existing runway.

c) In Alternative-BS, about 130 million PHP for building work can be saved by use of the existing passenger terminal building as compared with a new construction as shown below:

Floor area of the existing passenger terminal building	:	3,250 sq.m
Unit price of building work	:	40,000 PHP/sq.m
Savings in cost	:	130 Million PHP

In case of two step implementation of Phase-I in Alternative-AS, the project cost in Phase-I is divided as shown in Table 7.4.7.

Table 7.4.7 Project Cost for Packages 1 and 2 in Alternative-AS

Unit : Million PHP

	Land Acquisition and Compensation	Construction Cost	Project Cost
Package-1	68	804	872
Package-2	203	657	860
Total	271	1,461	1,732

AS seen in Table 7.4.7, the initial project cost can be reduced to about half of the total project cost for Phase-I.

Therefore, Alternative-AS is the most advantageous among the four alternatives from the viewpoint of minimizing the initial investment.

(10) Other Considerations

In Alternatives-AS and -AN, the existing military area should be set back from the runway so as not to conflict with the 300m wide runway strip to be provided in Phase-II. In Alternative-BS and -BN, it is not necessary to set back the military area.

In Alternatives-AS and -AN, the middle marker and the end part of the approach lighting system (ALS) shoud be located above the sea. In Alternatives-BS and -BN, they can be located on land.

It is said that the USA has committed themselves to install two sets of ILS at the airport. If they are installed before Phase-I, relocation of the ILSs will be required in Alternatives-BS and -BN but not so in Alternatives-AS and -AN.

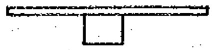
It is difficult to apply an incremental construction method to Alternatives-AN, -BS and -BN except for Alternative-AS. In other words, this means that the reduction of the initial investment can easily be accomplished only by Alternative -AS.

7.4.2 Major Advantages and Disadvantages of Each Alternative

Based on the evaluation mentioned in Section 7.4.1, the major advantages and disadvantages are picked up and summarized in Table 7.4.8.

Table 7.4.8 Major Advantages and Disadvantages of Alternative Airport Master Plans

Legend "A" : Advantageous
"D" : Disadvantageous

Item / Alternative		AS		AN		BS		BN
Illustration		Existing RWY 		 Existing RWY		NEW RWY 		 NEW RWY
1. Aircraft Operations	D	Improvement of runway profile to meet ICAO recommendation is costly and not practicable.	D	Same as Alt.- AS	A	Runway profile meets ICAO recommendation.	A	Same as Alt.- BS
2. Airport Accessibility			A	Easy access from/to RIC			A	Same as Alt.- AN
3. Expansibility for the Remote Future Airport Development			A	Good expansibility			A	Same as Alt.- AN
4. Number of Housing Units Exposed to Aircraft Noise More than WECPNL 70								
1992		7,670		7,670		7,670		7,670
2010		7,110		7,210		6,280		6,240
Increase		560		560		3,910		3,910
Decrease		1,120		1,020		5,300		5,340
Balance		-560		-460		-1,390		-1,430
5. Land Acquisition for Phases I and II	A	62 ha	A	67 ha	D	85 ha	D	96 ha
6. Removal of Exisiting Houses for Phases I and II	D	410	D	360	A	260	A	260
7. Project Cost for Phases I and II								
7.1.Land Aquisitiion and Compensation		400		390		460		520
7.2. Construction Cost	A	2,160	D	2,270	A	1,940	D	2,070
7.3. Total Project Cost		2,560		2,660		2,400		2,590
8. Other Considerations	A	Incremental construction is possible.						

Note, The figures and descriptions in the above table are slightly different from those indicated in "Table 4 Comparison of Alternatives" in Executive Summary. Because Table 4 shows comparison consolidating all the conditions including the new housing development found during the Study.

7.5 Selection of Optimum Alternatives

Although there is some 16% difference in Phase-I project costs between the highest cost of 2,015 million PHP for Alternative-BN and the lowest cost of 1,732 million PHP for Alternative-AS, the difference among the total project costs (Phase-I + Phase-II) of the four alternatives becomes much less, i.e., the highest cost of 2,662 million PHP for Alternative-AN vs. lowest cost of 2,404 million PHP for Alternative-BS, only some 260 million PHP difference. This fact of the minimal difference of the total project costs among the four alternatives, as well as the uncertainty in the assessment of aircraft noise impact, makes it difficult to select the optimum airport master plan out of the four alternatives.

To select on optimum alternative among the four alternatives, the following points are enumerated:

a) Alternative-AN is not recommended because of poor cost effectiveness.

b) Alternative-BN requires about a 200 million PHP higher initial investment cost than Alternatives-AS and BS.

c) With regard to the runway profile, Alternatives-BS and -BN are obviously more advantageous by providing better runway profiles that fully comply with ICAO recommendations and, at the same time, would be able to avoid the troublesome nighttime overlay work required by Alternatives-AS and -AN.

d) With regard to the impact of the aircraft noise, two contradicting judgements can be made for the two Alternatives.

   If it is assumed that public complaints against aircraft noise would arise only from those housing units newly exposed to the aircraft noise but not from those currently within the zone WECPNL 75 and above, it can be concluded that Alternative-AS is more advantageous since the number of houses newly exposed to the noise is less than Alternative-BS. This conclusion, however, becomes reverse if some sort of compensation has to be made to any house located within the zone WECPNL 75 and above since the total number of houses within the said zone under Alternatives-BS is much smaller than that of Alternative-AS (some 2,500 house units vs. some 1,600 house units). Although compensations of 3,000 PHP per sq.m and 50 sq.m on an average per housing unit are assumed at this stage of the Study, actual costs and time to be incurred for relocating houses could have a much greater influence on the total project costs.

   The acceptable noise level, however, could vary over a wide range by factors, such as individual's tolerance capability and sociological nature. For example, the 1,600 housing units affected under Alternative-BS is considered high by Japanese practice in terms of administrative measures for aircraft noise pollution. On the other hand, there have been no complaints about aircraft noise according to the City of Davao although the influence of aircraft noise at the present is nearly the same as that in 2010. This may be due to the difference in tolerance and consciousness to noise between the two nationals.

e) If the tolerance and consciousness to aircraft noise is changed and the existing airport is to be moved out of the existing site in the near future, Alternative-AS is recommended so that the unnecessary investment could be avoided by adopting incremental expansion.