From the above discussion, it was considered that the following three factors could influence the final selection of the optimum alternative that follows:

a) What was the acceptable noise level at Davao?

b) Should the airport remain at the existing site even beyond 2010?

c) Was the relatively large initial investments required for Alternative-BN acceptable?

At that moment, it was difficult to provide definite answers to these questions; hence, it was difficult to select one alternative from Alternatives-AS and -BS. Therefore, it was proposed to select the most optimum alternative through discussions between the JICA Study Team and DOTC in the course of Second Field Survey in the Philippines.

The JICA Study Team discussed about the above points with DOTC during the second Field Survey in the Philippines in September 1992 and the following answers were derived.

a) The estimated aircraft noise level at the airport surroundings will not be a major problem in the future as well.

b) For the airport master planning in the study, the airport should be planned so as to remain at the existing site as long as possible because the availability of a more feasible airport site is not known. Therefore, the future expansibility is a very important requirement for the selection of an optimum alternative.

c) The relatively large initial investments required for Alternative-BN will not pose a problem since the large-scale air transport projects* currently undertaken by DOTC are scheduled development to be completed by 1995.

*Note: The Nationwide Air Navigation Facilities Modernization Project, the Mactan International Airport Development Project and the General Santos Airport Development Project.

Through the discussions between the JICA Study Team and DOTC, the Alternative-BN airport master plan was selected as the basic concept of the airport master plan from the aspects of future expansibility, ease of construction quality control, improved runway profile, and accessibility to the proposed Davao Regional Industrial Center.

Upon the selection of Alternative-BN, it was confirmed by the Philippine side that they would take specific measures to ensure the availability of the land required for the implementation of the airport master plan.

7.6 Modification of Alternative-BN

After Alternative-BN was selected, as mentioned in Section 7.5, the Alternative-BN has been modified taking into account a new housing development and procedure for runway construction. In the course of the study for modification, firstly Alternative-M3, in which a new runway was located 110m apart from and parallel with the existing runway center line, was considered to be optimum. Subsequently the Alternative-SM, in which the new runway is located 140m away from and parallel with the existing runway center line, was selected as an optimum airport master plan. Details of the modification process are described below.

7.6.1 New Housing Development

The housing development project named La Verna Hills subdivision on the northern side of Runway 05 was known to the JICA Study Team during its first field survey in the Philippines from April 15 to June 13, 1992. The area of the development at that time was out of the reserved area by Davao City Municipal Government for the airport expansion which was confirmed by the officials of the Municipality. It was also confirmed then that no new development projects could take place within the said reserved area without permission by the Municipality. Accordingly, Alternative-BN was developed which places the new runway at northern side and 180m away from the center line of the existing runway. The proposed location created no conflict with the said housing development project.

On September 9 and 10, 1992 when DOTC, the JICA Advisory Committee and the JICA Study Team paid a visit to the airport, it was found that the housing development had encroached much closer to the airport. The field survey and the hearings conducted by the above-mentioned parties then revealed the following facts:

a) La Verna Hills housing development project consisted of 300 housing units in Phase-I and 500 units in Phase-II (a total of 800 units);

b) Davao Municipality had approved the Phase-I development which takes place outside of the reserved area for the airport expansion, but it did not approve the Phase-II development since its development site relative to the airport was unclear;

c) Nevertheless, the Phase-II development was commenced in July 1992. It was found that some 200 housing units were to be removed unless the location of the new runway was shifted to the south. The location and top elevation of those housing development are illustrated in Figure 7.6.1; and

d) On the other hand, the Housing and Land Use Regulatory Board (HLURB) had approved the La Verna Hills project as a low cost housing development.

In order to minimize the above-mentioned conflicts, it was agreed upon among the parties concerned to modify Alternative-BN.

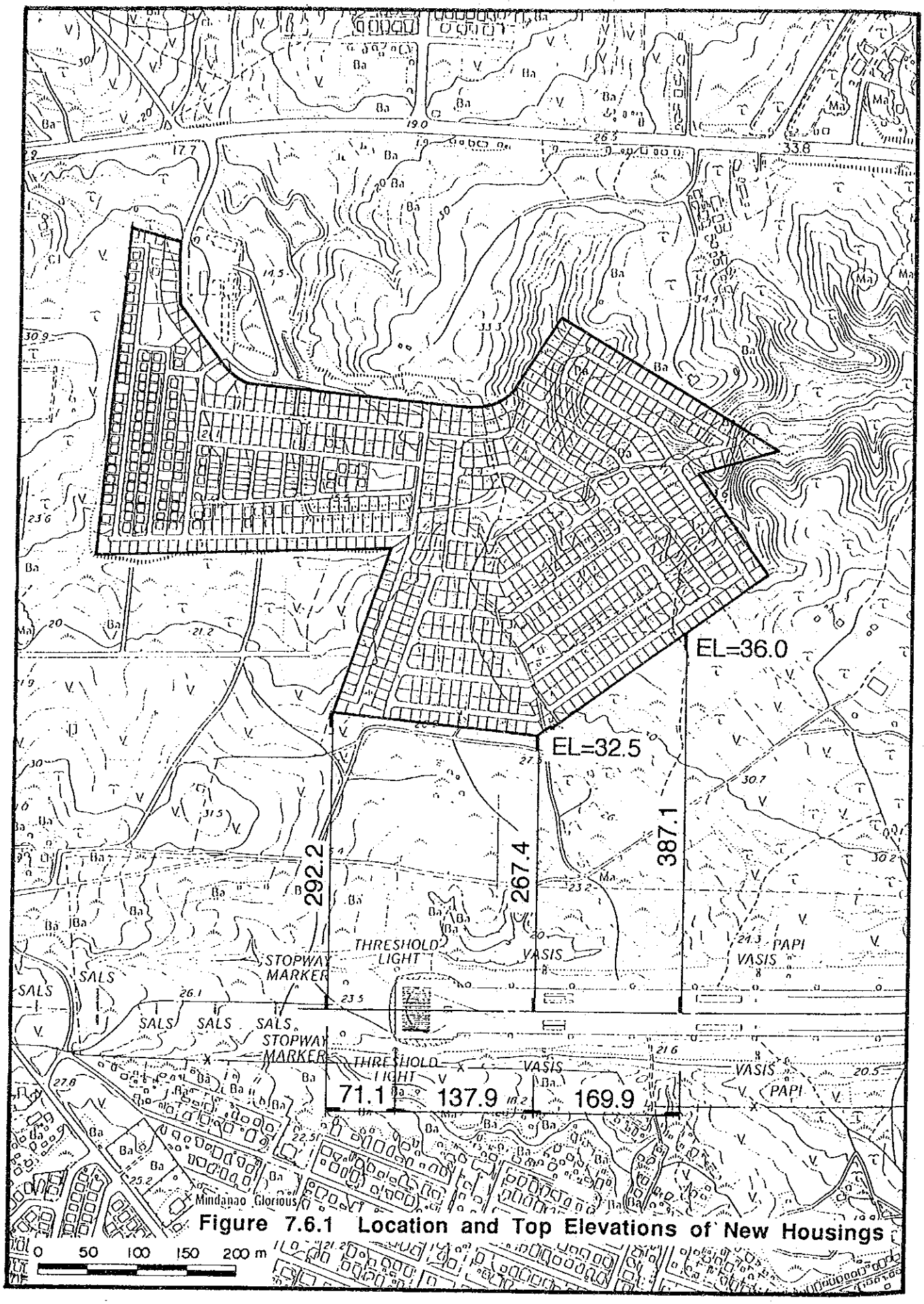


Figure 7.6.1 Location and Top Elevations of New Housings

7.6.2 Alternatives of Modified Alterative-BN

Cross section at RWY 05 threshold of Alternative-BN is shown in Figure 7.6.2. As seen in the Figure 7.6.2, constructing the runway and its strip as well as securing its transitional surface at this location requires removal of housing units. In order to ensure the 300 m wide runway strip for Phase-II without removal of houses, the new runway center line needs to be located at 110m or less from the existing runway center line as shown in Figure 7.6.3. If the transitional surface as well as the runway strip for Phase-II should clear the houses, the new runway center line should be located at 50m or less from the existing runway center line.

As seen in the Figure 7.6.3, no housing units intrude above the required transitional surface under Phase-I. Under Phase-II when the runway strip is widened to 300m, some 50 housing units intrude above the transitional surface. Whether or not to remove those houses intruding above the transitional surfaces could be decided at the implementation time of Phase-II by the Authority concerned after its aeronautical study.

On the other hand, it is desirable to provide a large enough separation distance between the two runways in order to enable an ideal setting of the runway profile as well as terminal area elevation which would minimize the total earthwork volume. The large separation distance between the two runways also enables easy construction of the new runway without disturbing daily aircraft operation at the existing runway. In reality, however, higher elevations of the prevailing terrain along the new runway and apron than the elevations of the existing runway makes it more difficult to create above-mentioned desirable situation. The higher the elevation of the new runway, the more the encroachment of the heels of its embankment toward the runway strip of the existing runway.

Apparently above-mentioned factors conflict with each other. Nevertheless, the following three alternatives were prepared to best modify Alternative-BN:

Alternative-M1	:	New runway is not parallel with the existing runway. Separation between the runways is 110 m to 180 m.
Alternative-M2	:	Not Parallel and the separation is 50 m to 180 m.
Alternative-M3	:	Parallel and the separation is 110 m.

Layout plans of Alternatives-M1, M2 and M3 are shown in Figures 7.6.5 to 7.6.7.

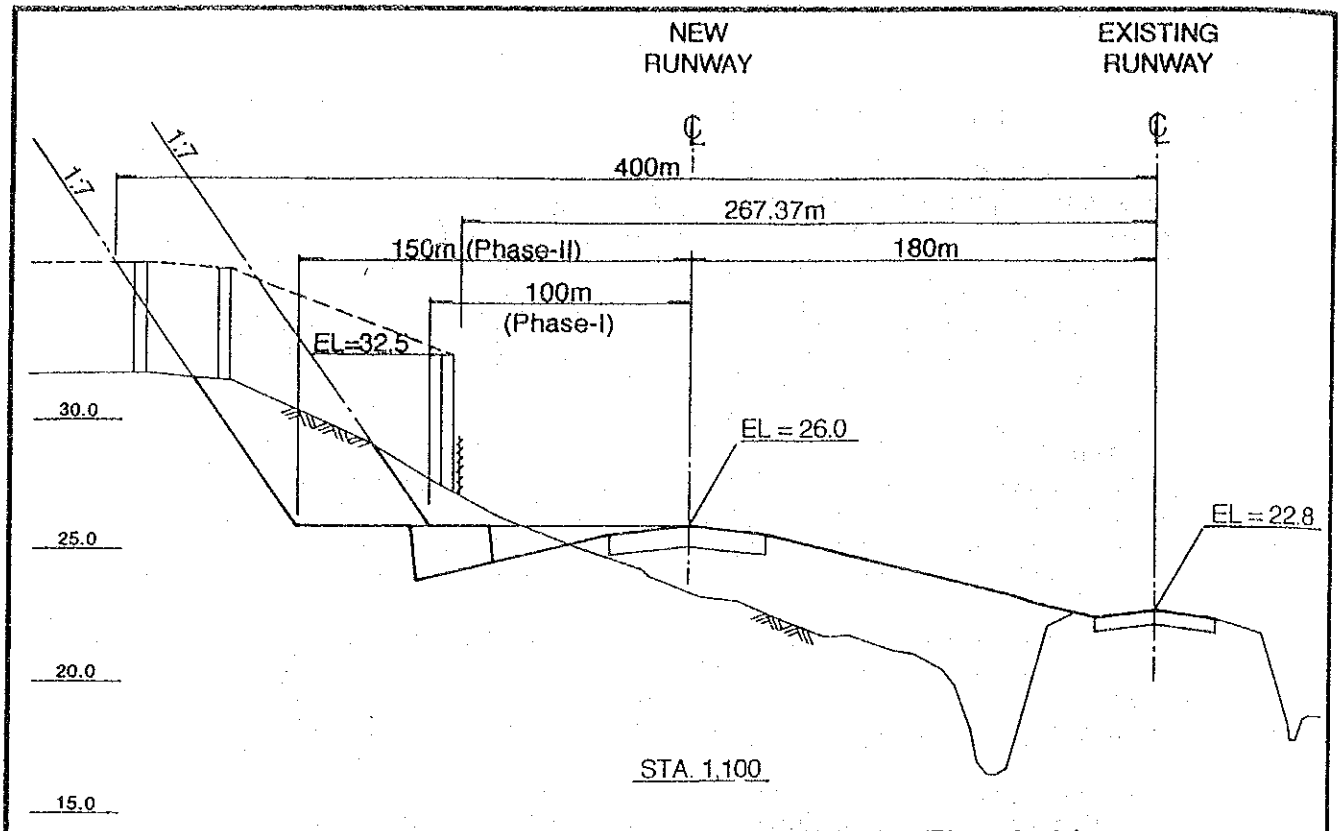


Figure 7.6.2 Cross Section at RWY 05 Threshold (In Case of Runway Separation 180m)

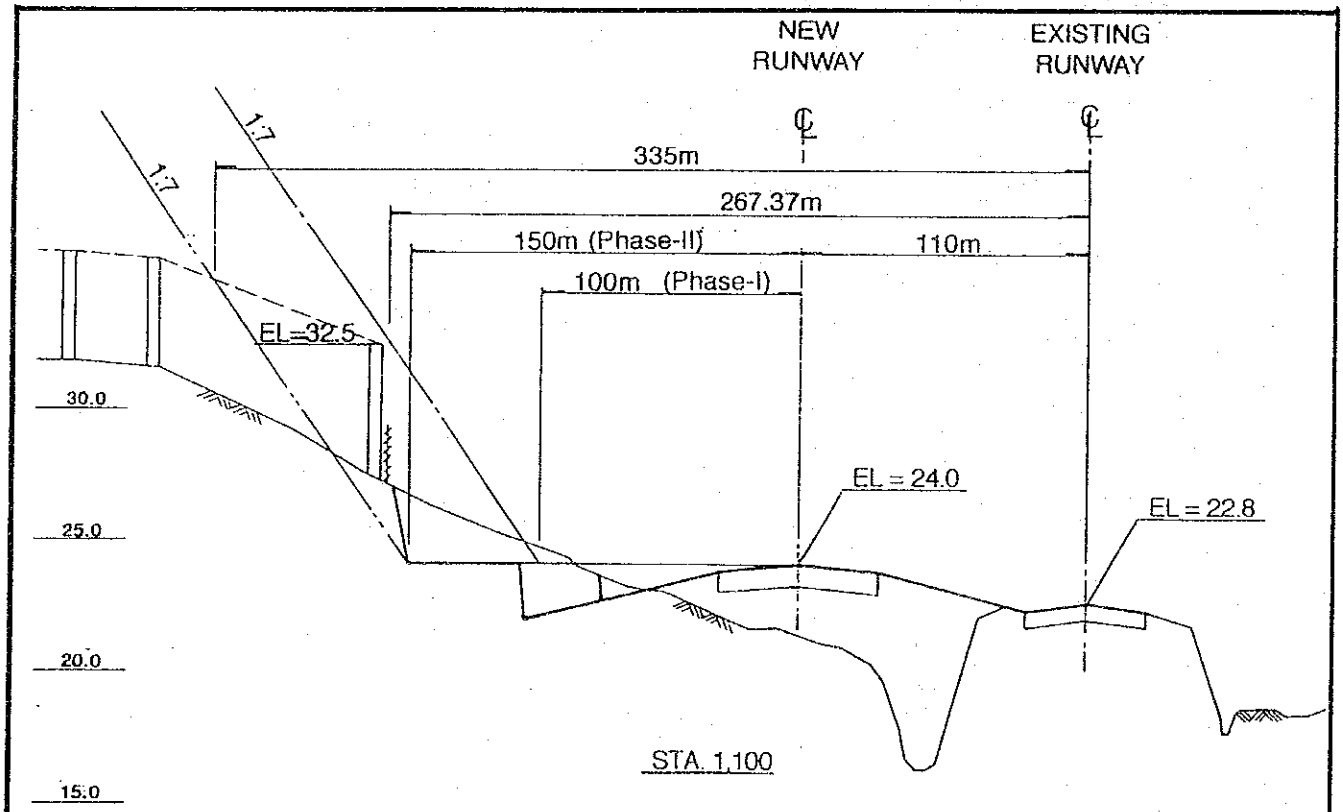


Figure 7.6.3 Cross Section at RWY 05 Threshold (In Case of Runway Separation 110m)

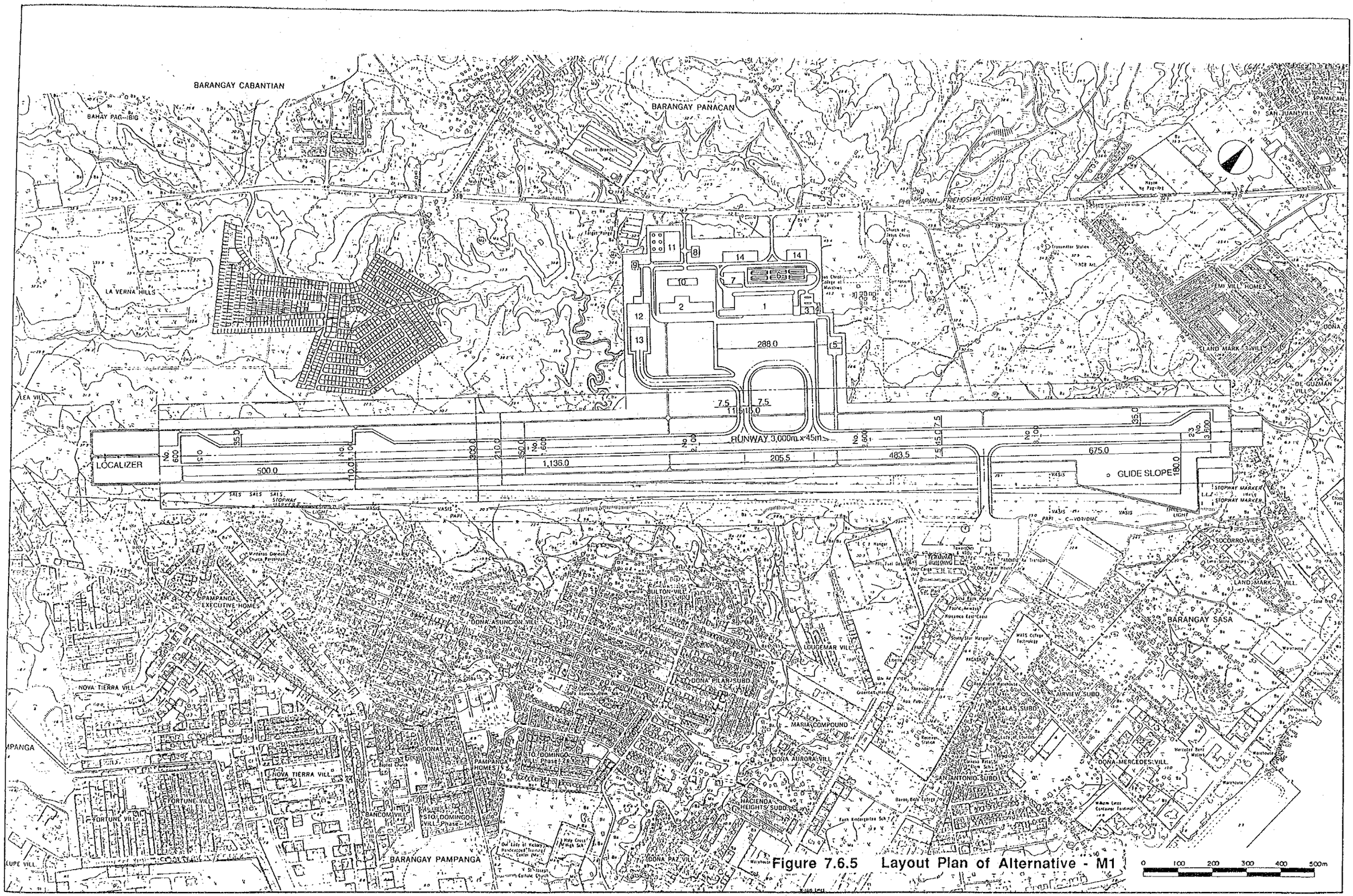


Figure 7.6.5 Layout Plan of Alternative - M1

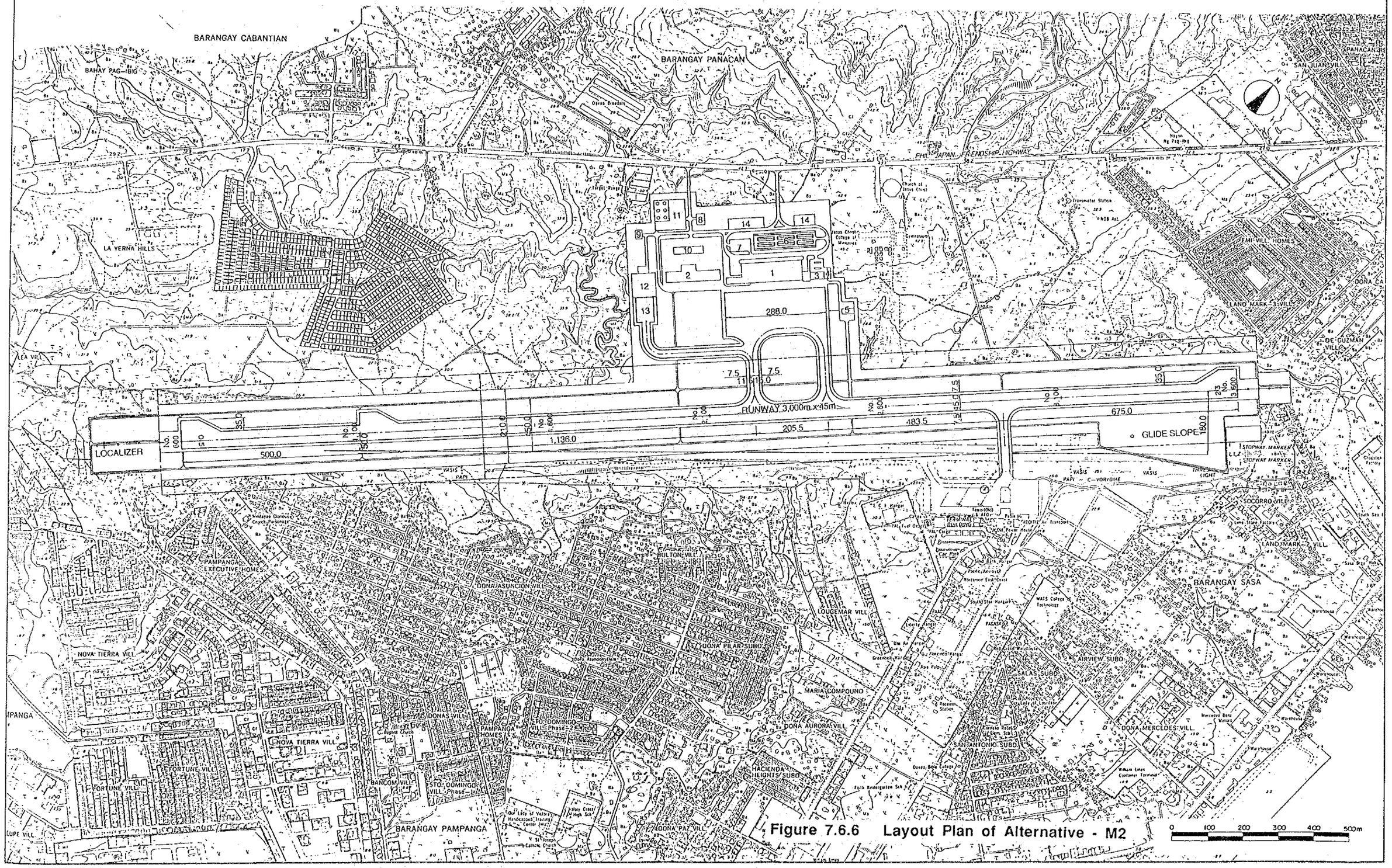


Figure 7.6.6 Layout Plan of Alternative - M2

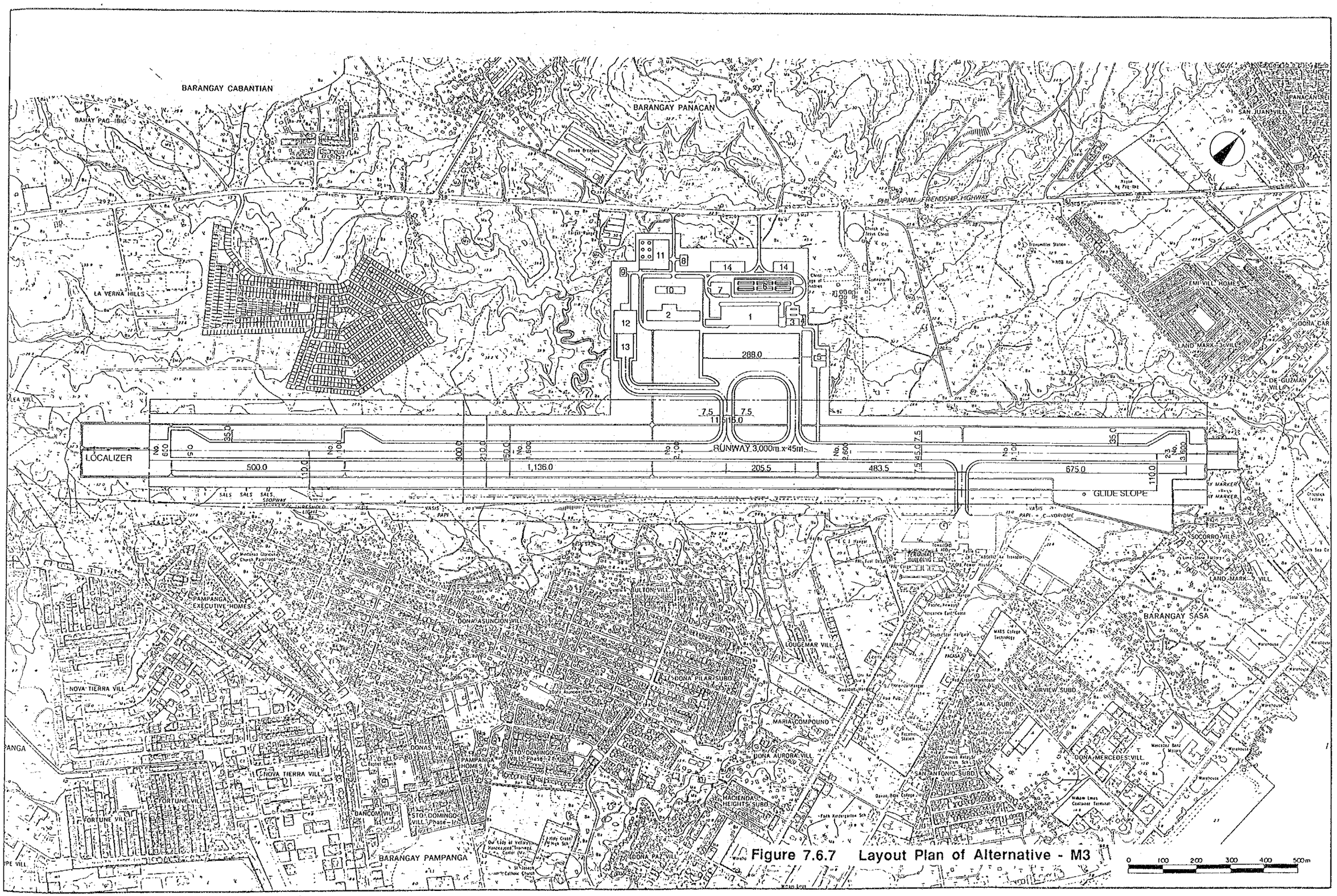


Figure 7.6.7 Layout Plan of Alternative - M3

7.6.3 Comparison of Alternatives for Modified Alternative-BN

Five alternatives including alternatives-M1, M2 and M3, original Alternative-BN, and the original Alternative-AN, are evaluated as tabulated in Table 7.6.1. It is noted that the original Alternatives-AS and BS are not included in the above evaluation because the terminal development at the north side of the runway is more preferable than that at south side in terms of expansibility and access from/to the proposed Regional Industrial Center.

As a result of the evaluation, Alternative-M3 was selected as the recommended scheme for the airport master plan under the recent conditions for the following reasons:

a) If the cost for improvement of the runway profile is included, Alternative-AN requires the highest total project cost among the five alternatives.

b) Alternative-M2 requires the highest total project cost among the five alternatives. The runway pavement work at locations much closer to the existing runway than other alternatives requires more stringent quality control of rapid curing concrete and poses more restrictions on aircraft operations at the existing runway.

c) Among the remaining three alternatives, i.e., Alternatives-BN, M1 and M3, Alternative-M3 is the most advantageous because it requires fewer house relocations and the least total project cost. (It is noted that the difference in total project cost between Alternatives-M1 and M3 is insignificant.)

The JICA Study Team presented the above alternatives for the modification of Alternative-BN and the comparative evaluation to DOTC and local government agencies.

As shown in the Memorandum in Appendix-1.5.5, DOTC and the local government agencies agreed to adopt Alternative-M3 as the optimum airport master plan and confirmed that specific measures and efforts would be taken by the Philippine side to ensure the availability of the land required for the implementation of the airport master plan.

Table 7.6.1 Comparison of Alternatives for Modified Alternative-BN

Item \ Alternative	Original BN	M1	M2	M3	Original AN
Illustration	New RWY / 180m / 180m / Existing RWY	New RWY / 110m / 180m / Existing RWY	New RWY / 90m / 180m / Existing RWY	New RWY / 110m / 110m / Existing RWY	Existing RWY
1 Description	To secure required runway strip, 92 houses of new housing need to be removed. An additional 107 houses of the same need to be removed to secure required transitional surface.	Runway strip is secured without disrupting houses of new housing, however 85 units of them need to be removed to secure transitional surface.	Required runway strip and transitional surface are secured without disrupting houses of new housing.	Same as Alternative M1.	Same as Alternative M2
2 Number of Houses to be Removed in Phase I and II					
2.1 La Verna Hills (Under Construction)	199	85	0	85	0
2.2 Others	260	230	260	200	360
2.3 Total	459	315	260	285	360
3 Area to be Acquired in Phase I and II					
3.1 La Verna Hills	4 ha.	2 ha.	0 ha.	2 ha.	0 ha.
3.2 Others	96 ha.	82 ha.	76 ha.	68 ha.	67 ha.
3.3 Total	100 ha.	84 ha.	76 ha.	70 ha.	67 ha.
4 Compensation Cost for House Relocation (Million PHP)					
4.1 La Verna Hills	36	15	0	15	0
4.2 Others	39	35	39	30	54
4.3 Total	75	50	39	45	54
5 Land Acquisition Cost (Million PHP)					
5.1 La Verna Hills	26	13	0	13	0
5.2 Others	480	410	380	340	335
5.3 Total	506	423	380	353	335
6 Use of Existing Apron	B737 class aircraft can be accommodated.	B737 class aircraft can be accommodated.	B737 class aircraft can be accommodated.	B737 class aircraft can be accommodated.	No aircraft can be accommodated.
7 Obstacles	No obstacles	No obstacles	No obstacles	No obstacles	Existing passenger terminal building shall be demolished.
8 Runway Profile	It will meet ICAO recommendations.	It will meet ICAO recommendations.	It will meet ICAO recommendations.	It will meet ICAO recommendations.	Improvement of runway profile to meet ICAO recommendations is costly and not practical.
9 Ease of Construction Works	Construction of runway pavement and its strip can be done without interfering with aircraft operations.	Construction of southside runway strip requires special measures at its western half.	Construction of runway pavement requires special measures to maintain regular aircraft operations.	Construction of southside runway strip requires special measures over entire length.	Runway overlay work requires nighttime construction.
10 Earthwork Volume (Million cu.m)					
Phase I	1.7	1.7	1.7	2.3	1.6
Phase II	0.5	0.5	0.5	0.5	1.6
Total	2.2	2.2	2.2	2.8	3.2
Cost (Million PHP)	286	286	286	364	416
11 Project Cost (Million PHP)					
11.1 Land Acquisition and Compensation	581	473	419	398	389
11.2 Construction Cost	2,066	2,066	2,263	2,144	2,273
11.3 Total	2,647	2,539	2,682	2,542	2,662
12 Aircraft Noise Influence					
WECPNL					
95-90	2	0	0	0	0
90-85	110	25	25	22	120
85-80	332	332	253	220	710
80-75	1,749	1,607	1,591	1,673	120
75-70	4,337	3,649	3,771	4,145	4,328
Total	6,530	5,613	5,640	6,060	5,278

7.6.4 Modification of Alternative-M3

The runway profile is planned based on the Alternative-M3 as shown in Figure 7.6.8.

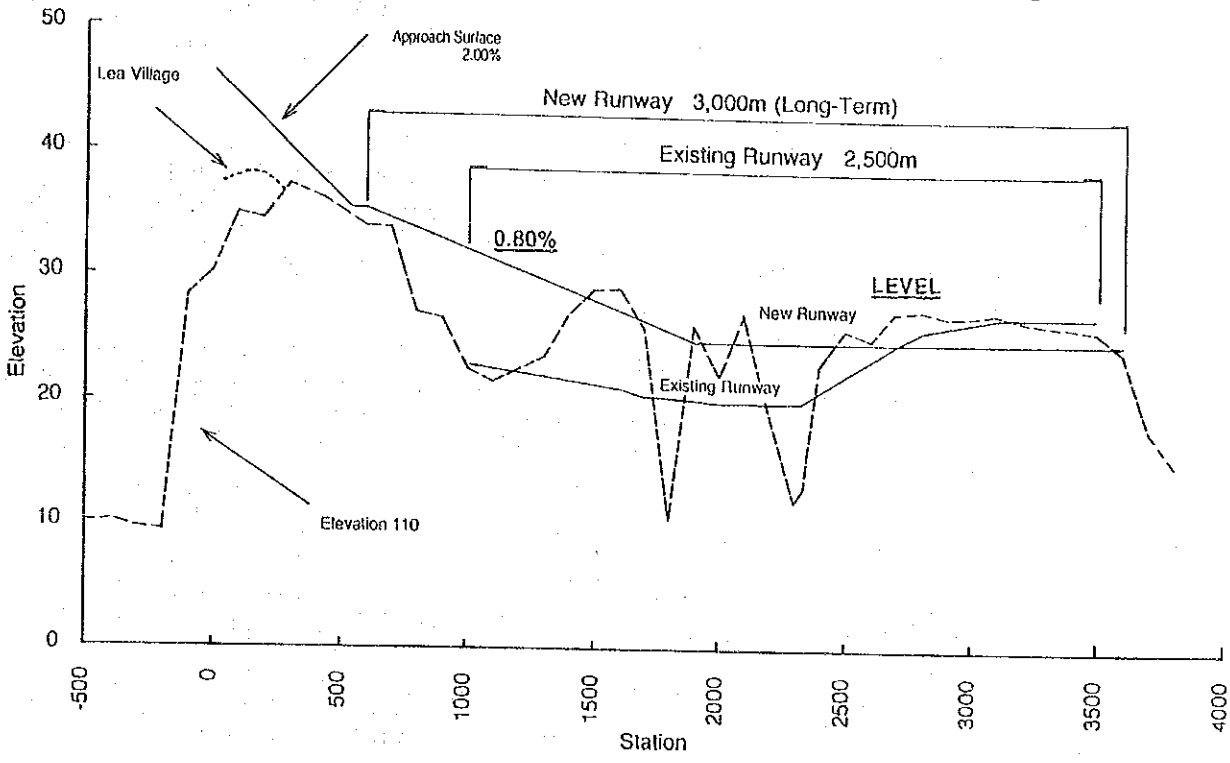


Figure 7.6.8 Planned Runway Profile Based on the Alternative-M3

The following points are considered for the planning of the runway profile.

a) To comply with ICAO recommendations.

b) To keep the clearance between houses of Lea Village and the approach surface in the long-term development plan in which the runway will be extended 500m to the west.

c) To balance between excavation and embankment volumes not only in the medium-term development but also in the long-term development. And to minimize the total volume of earthwork.

d) To minimize the total number of housing units that conflict with the transitional surface in the long-term development.

The runway profile planned, considering above-mentioned factors revealed that the maximum difference in elevation between the new runway and the existing runway would become about 9m as shown in Figure 7.6.9. Because of the difference, the portion of embankment of the new runway could be an obstacle for the existing runway in the course of construction. Even if the medium-term development project is divided into two stages, no-obstacle space for the existing runway will only be 50.5m on one side from the runway center line.

From the view point of safe aircraft operations, even in the temporary condition, a no-obstacle space of at least 75m from the runway center line on one side is needed as shown in Figures 7.6.10 and 7.6.11, even though no transitional surface is secured.

The graded area is to be maintained up to 23m from the edge of the new runway in the course of construction as shown in Figures 7.6.10 and 7.6.11, based on the ICAO manual. (Refer to ICAO Airport Service Manual Part 6 Control of Obstacles Chapter 3 Temporary Hazards)

Thus, the center line of the new runway should be located 140m from that of the existing runway. In this case, the transitional surface can be maintained as shown in Figure 9.3.1, even if the houses of La Verna Hills cannot be removed in the medium-term development. In the long-term development project, 50 houses of the new housing should be removed to maintain the 300m wide runway strip and transitional surface.

In the implementation of airport construction project, safety of the aircraft operations is the most important matter. Accordingly, location of the new runway is changed to 140m from the existing runway center line. The runway profile in this case is shown in Figure 7.6.12, and the earthwork volume is shown in Table 7.6.2.

Table 7.6.2 Earthwork Volume

	Embankment	Excavation	Balance
Phase - I	1,704	2,281	387
Phase - II	584	377	-271
Total	2,288	2,658	116

Note: Conversion factor from excavation volume to embankment volume is 0.9.

Airport master plan was finally decided as shown in Figure 7.6.13.

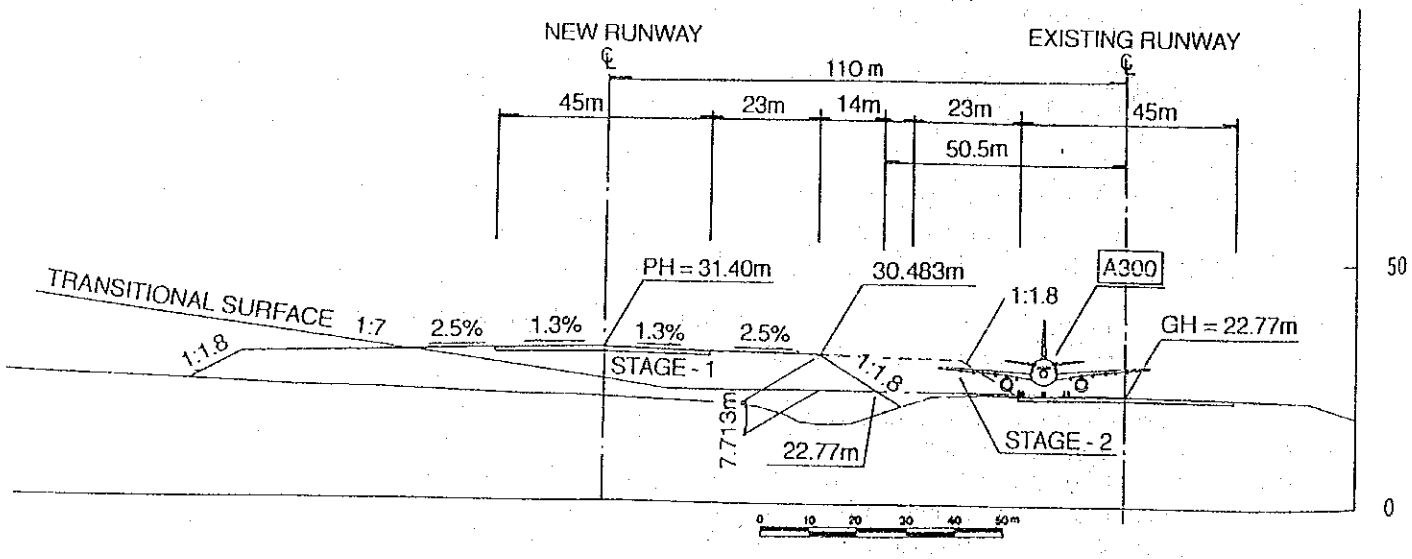


Figure 7.6.9 Embankment Schedule (Runway Separation of 110m)

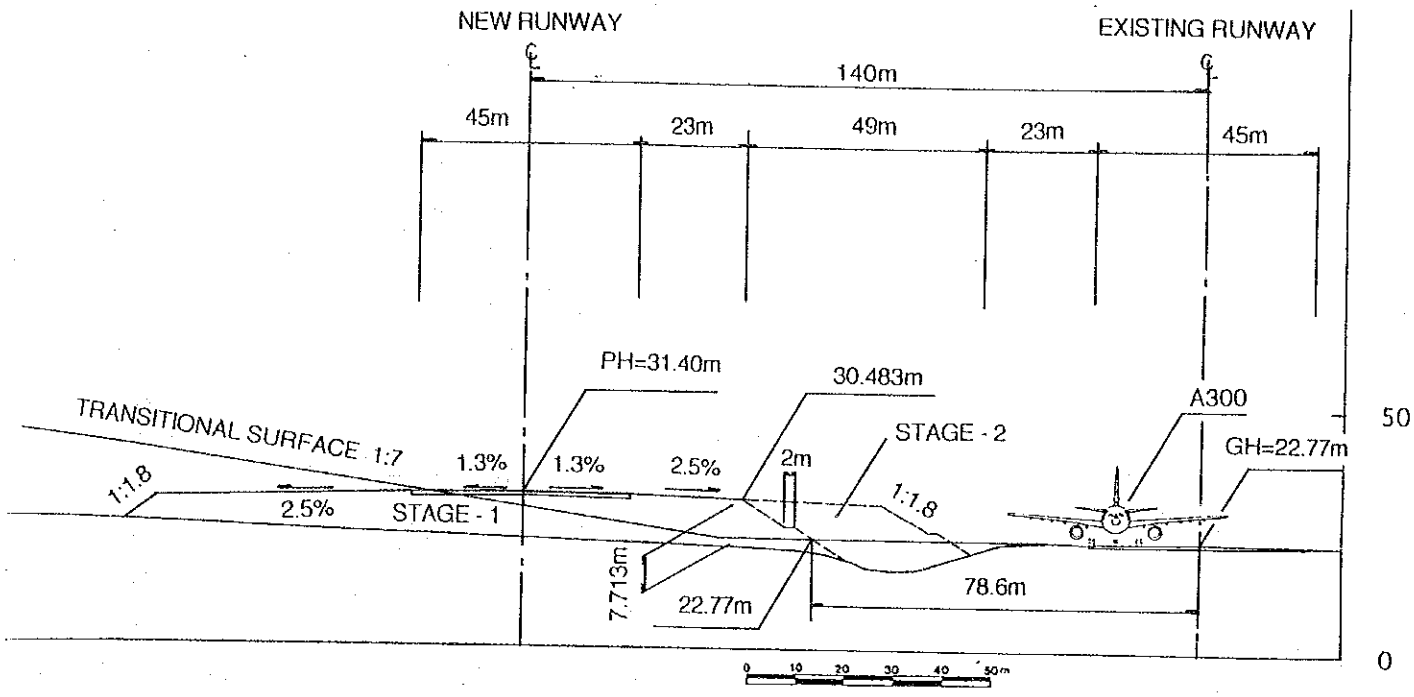


Figure 7.6.10 Embankment Schedule (Runway Separation of 140m)

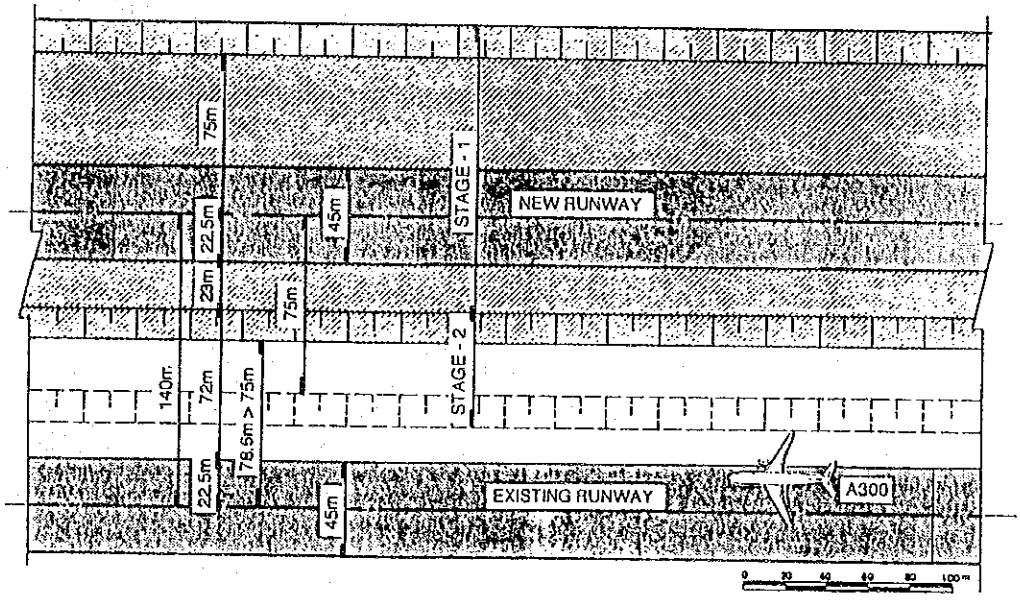


Figure 7.6.11 Plan of Embankment (Runway Separation of 140m)

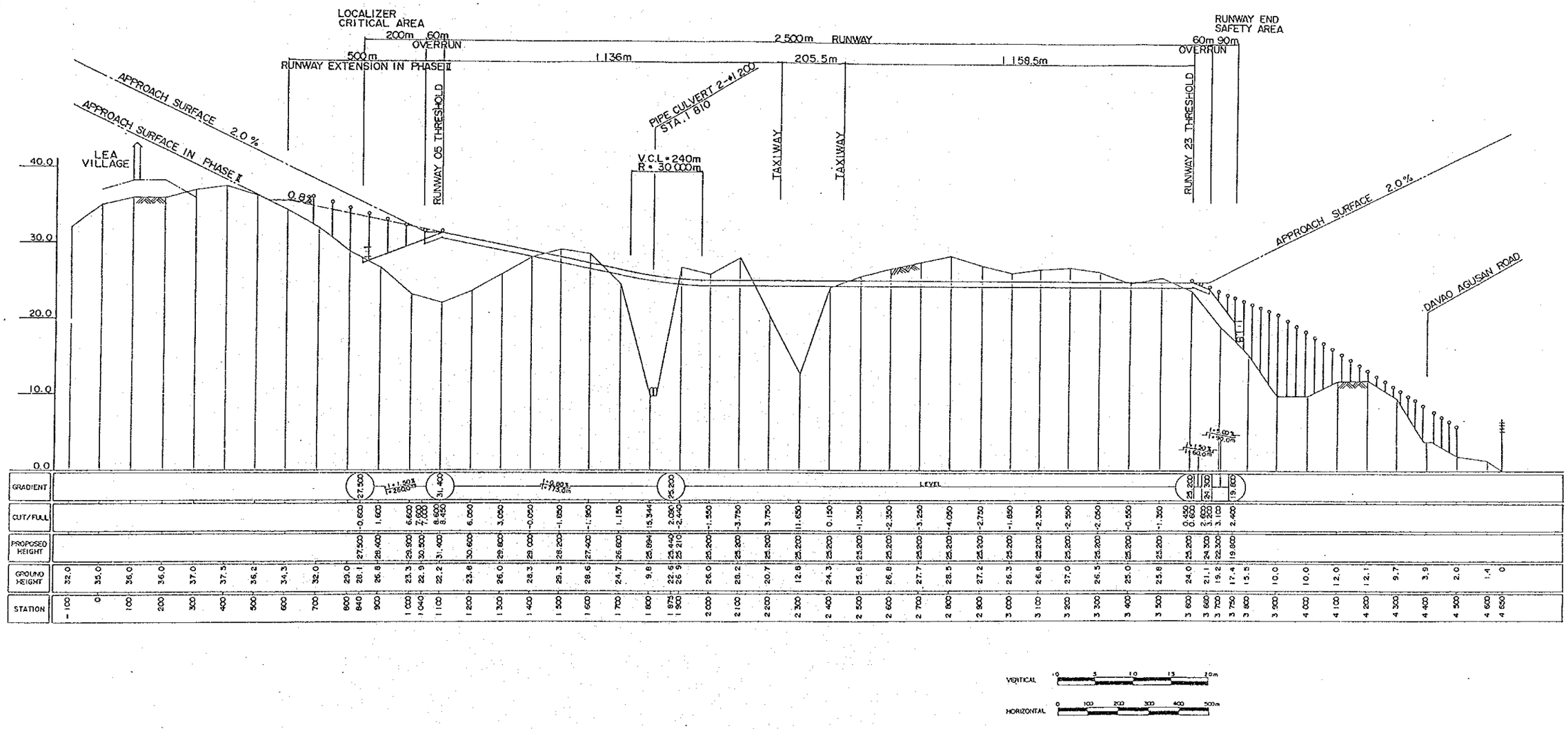
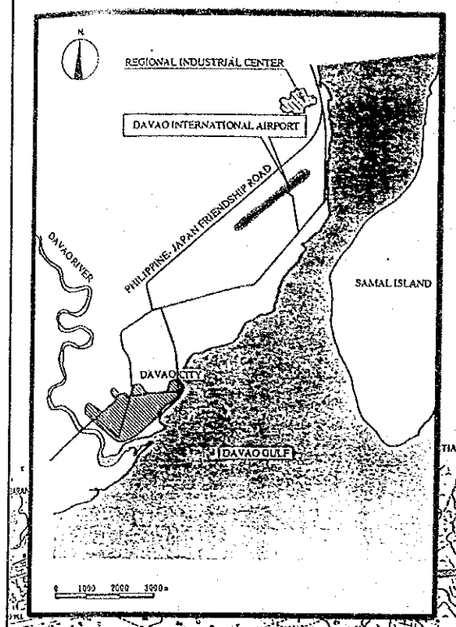


Figure 7.6.12 The Runway Profile



	BUILDING
1	PASSENGER TERMINAL BUILDING
2	CARGO TERMINAL BUILDING
3	ADMINISTRATION BUILDING WITH CONTROL TOWER
4	MAIN POWER HOUSE
5	FIRE STATION
6	CAR PARK
7	TAXI POOL
8	WATER SUPPLY STATION
9	SEWAGE TREATMENT PLANT AND INCINERATOR
10	RESERVED AREA FOR CARGO AGENTS BUILDING
11	RESERVED AREA FOR FUEL FARM
12	RESERVED AREA FOR AIRCRAFT MAINTENANCE HANGAR
13	RESERVED AREA FOR AIRCRAFT MAINTENANCE APRON
14	RESERVED AREA FOR CANTEENS

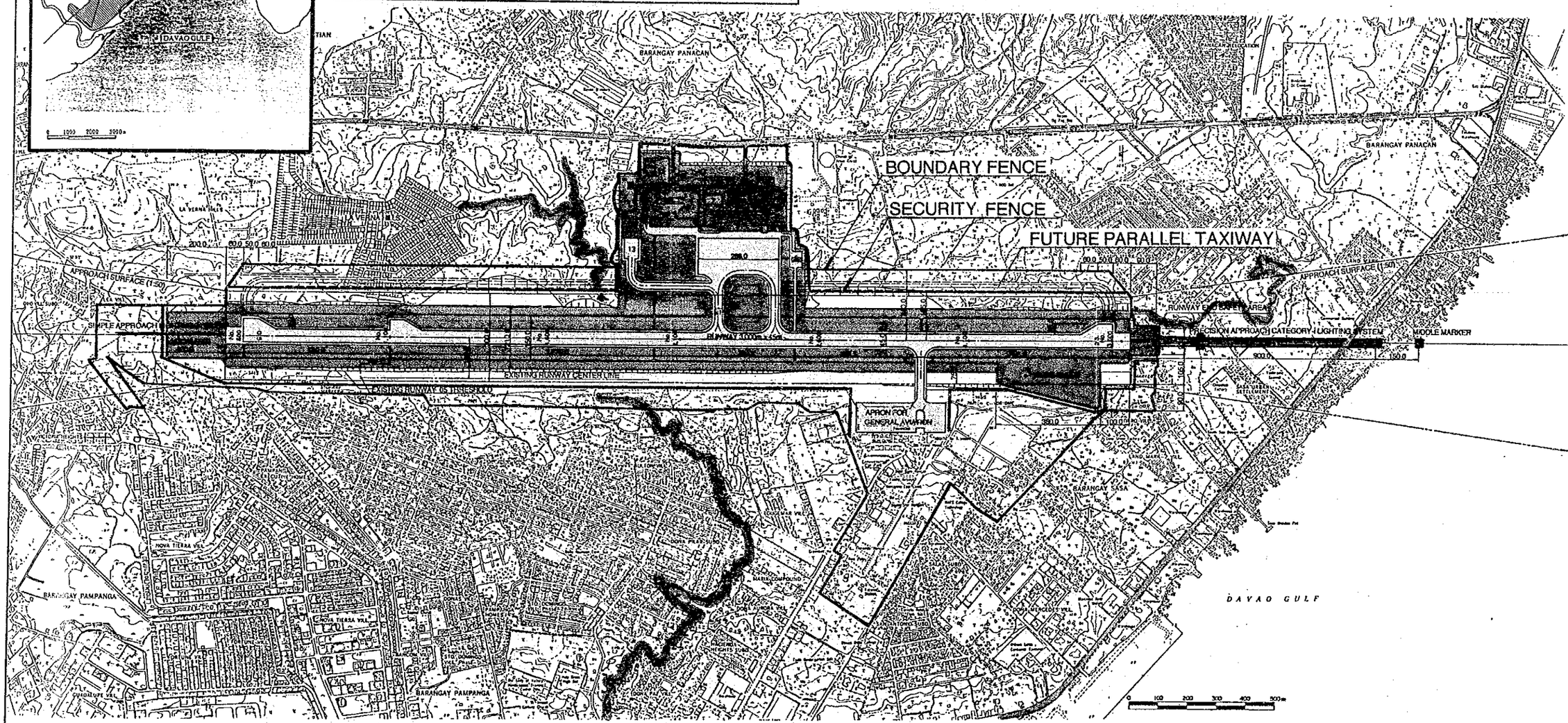


Figure 7.6.13 Airport Master Plan

CHAPTER 8 SCOPE OF MEDIUM-TERM DEVELOPMENT PROJECT

CHAPTER 8 SCOPE OF MEDIUM-TERM DEVELOPMENT PROJECT

8.1 General

This chapter lists the construction work items of the medium-term development project which has been determined within the framework of the airport master plan. This chapter also lists the construction work items of the immediate improvements for DOTC/ATO's reference in order to solve the urgent problems of the existing airport facilities.

8.2 Construction Work Items of Medium-Term Development Project

The construction work items are listed with the priorities in order to clarify their necessity/urgency and to facilitate the division of the project in the implementation stage if so required.

A definition of the priority is tabulated in Table 8.2.1.

Table 8.2.1 Definition of Priority

Priority	Definition
Priority-I	Work items indispensable for safety of aircraft operations or incidental to the Priority-I work items
Priority-II	Work items required to accommodate air traffic demands or incidental to the Priority-II work items
Priority-III	Work items which may be dispensed with but implementation desirable

The construction work items of the medium-term development project are shown in Table 8.2.2.

Table 8.2.2 Construction Work Items of Medium-Term Development Project

Priority	Work Item
I	1. Site preparation for the new runway and new terminal area 2. Construction of new runway with 2,500m length and 45m width 3. Construction of two connecting taxiways with 23m width 4. Construction of new administration building with about 1,800sq.m. floor area and new control tower 5. Construction of new fire station with about 550sq.m. floor area 6. Relocation of Instrument Landing System (ILS) 7. Installation of new air traffic control system 8. Installation of new aeronautical telecommunication system 9. Installation of new meteorological observation system 10. Installation of new airfield lighting system 11. Provision of new power supply system
II	1. Construction of new apron to accommodate one (1) DC-10 class, two (2) A300 class and one (1) F50 class aircraft 2. Construction of new connecting taxiway for general aviation 3. Construction of new passenger terminal building with about 11,000 sq.m. floor area including airlines office area. 4. Construction of new cargo terminal building with about 3,500sq.m. floor area 5. Construction of new car park to accommodate about 310 vehicles 6. Construction of new airport access road 7. Provision of new telephone system 8. Provision of new water supply system 9. Provision of new sewerage system
III	1. Installation of an incinerator 2. Procurement of one (1) ambulance 3. Installation of fuel hydrant system at new apron

In addition to the facilities listed in Table 8.2.2 to be constructed by the DOTC, the following facilities/equipment will be constructed or provided by other organizations in the medium-term development.

Table 8.2.3 Construction Work Items of Medium-Term Development by Other Organizations

Work Item	Organization
1. Construction of new fuel tank farm	PAL and/or other oil company
2. Construction of new cargo agent building	Cargo agent

The following facilities will be provided by other organizations in the medium-term development or subsequently as required.

Table 8.2.4 Construction Work Items by Other Organizations

Work Item	Organization
1. Construction of aircraft maintenance hangar and the incidental facilities	Airlines
2. Construction of Canteen at car parking area	Private Sector

8.3 Construction Work Items for Immediate Improvements

Immediate improvements are recommended to cover the minimum work items which are considered to be of very urgent necessity and can possibly be carried out within the present budget of DOTC/ATO.

These items are as follows :

a) Improvement of the runway surface

The rough surface of the existing asphalt concrete pavement of the runway should be overlaid by asphalt concrete to a minimum thickness of 3 cm to prevent further loosening of the aggregate and to provide a smooth runway surface.

b) Improvement of the perimeter fence

The broken portions of the existing perimeter fence should be repaired in order to deter the access of unauthorized persons and domestic animals onto the air side operational areas.

It is noted that items a) and b) above were already implemented by ATO in 1992 and 1993 based on the recommendation in this Study.

c) Grading of the runway strip

The runway strip within 75 m from the runway center line should be graded to provide a smooth surface. This work will include cut and embankment, extension of drainage crossing the runway strip and sodding on the graded area.

d) Installation of a belt conveyor

A baggage claim device should be installed at the baggage claim area in order to improve the baggage handling system as shown in Figure 8.3.1.

e) Installation of CIQ facilities

CIQ facilities, such as customs inspection, passport control, health control and terminal fee counters, should be installed for international departure and arrival passengers as shown in Figure 8.3.2.

f) Installation of security equipment

Security equipment with X-ray devices for checking baggage should be installed at the check-in lobby in order to ensure security control.

g) Renovation of the the baggage claim area

In connection with d) above, the existing baggage claim area should be renovated.

h) Improvement of the airfield lighting system

The existing airfield lighting system, such as runway edge lights, runway threshold lights and runway end lights, should be repaired so as to secure the safety of the aircraft operations.

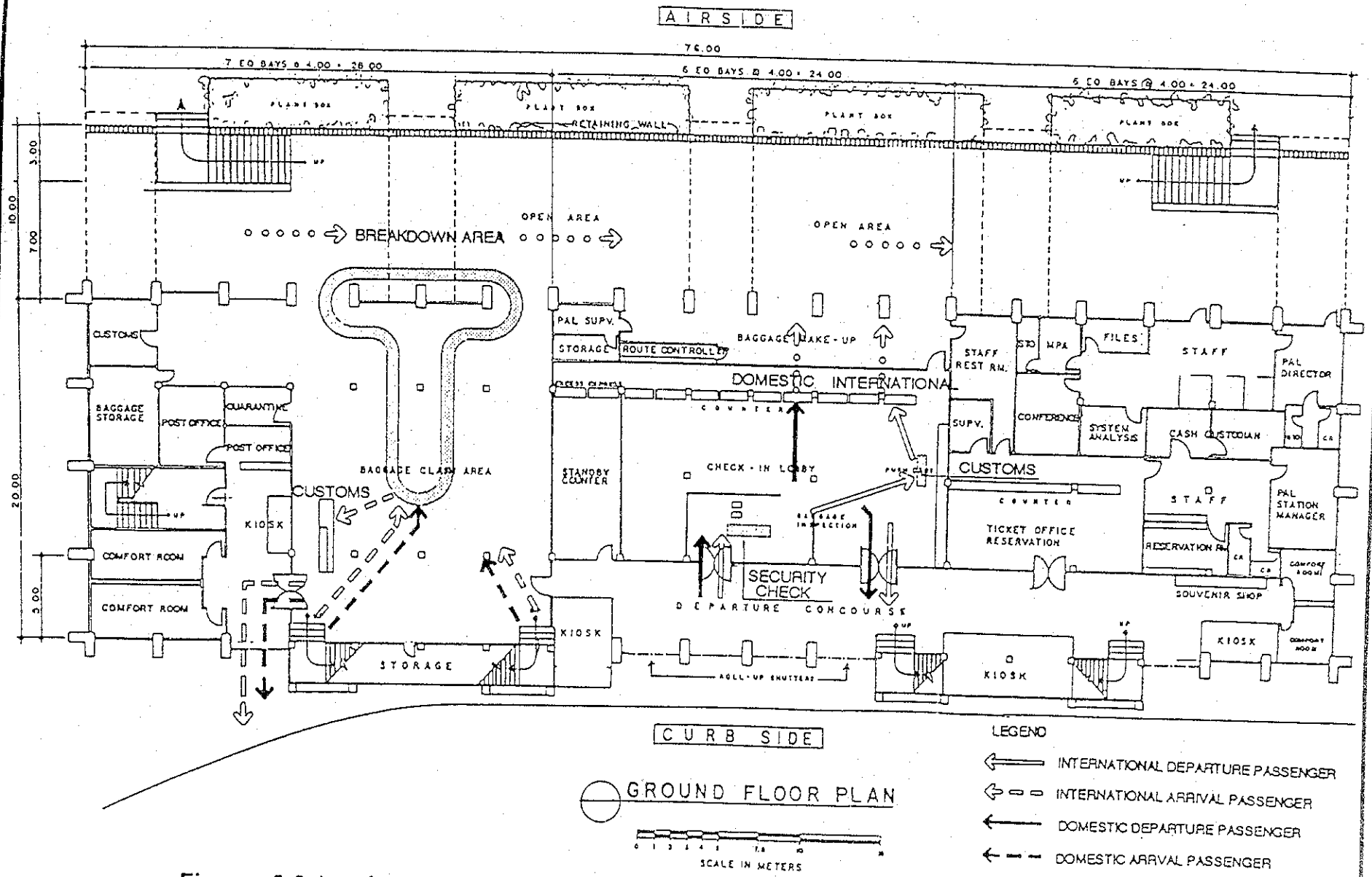


Figure 8.3.1 Immediate Improvement Plan Existing Passenger Terminal Plan - Ground Floor

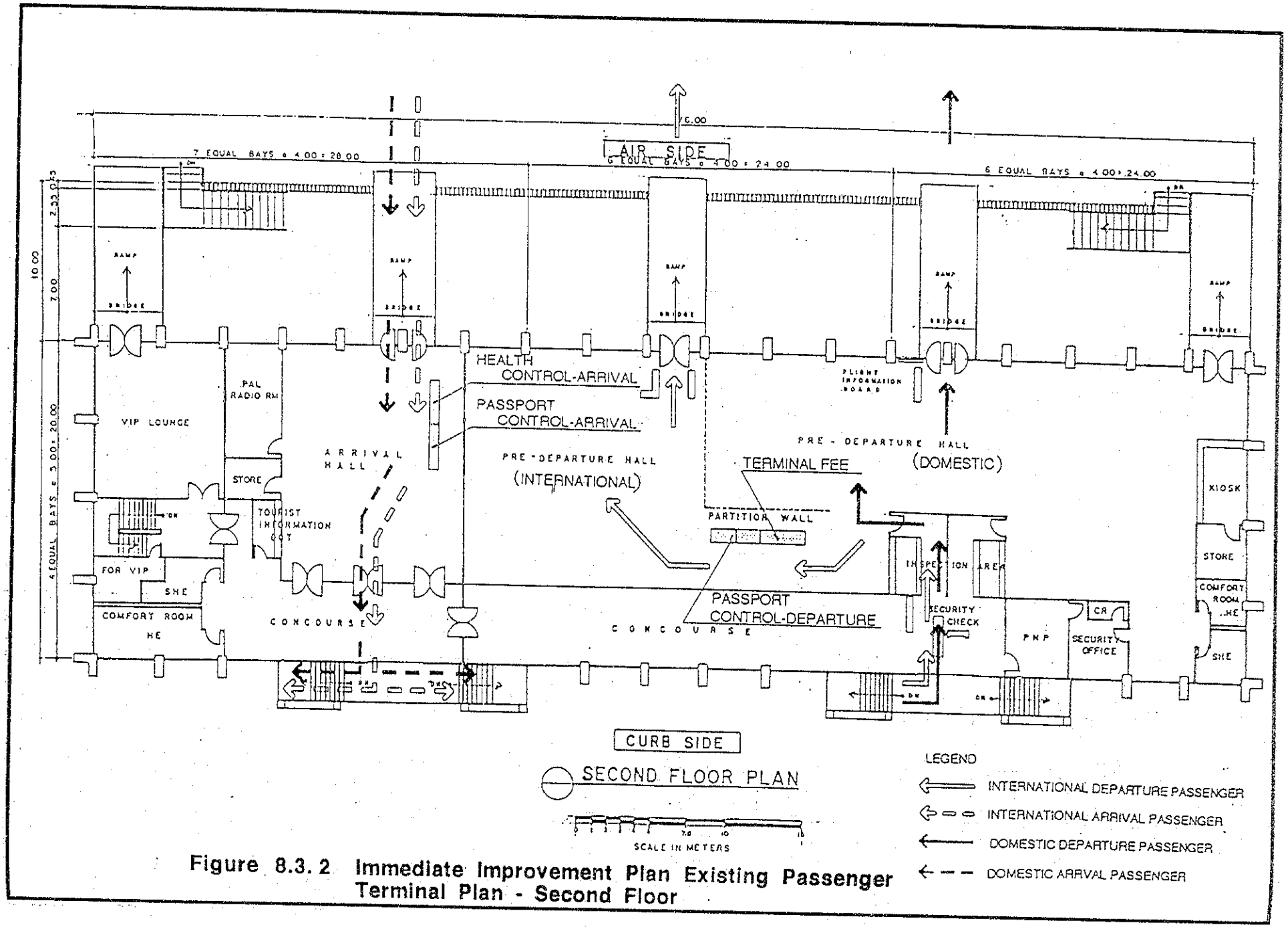


Figure 8.3.2 Immediate Improvement Plan Existing Passenger Terminal Plan - Second Floor

CHAPTER 9 PRELIMINARY DESIGN

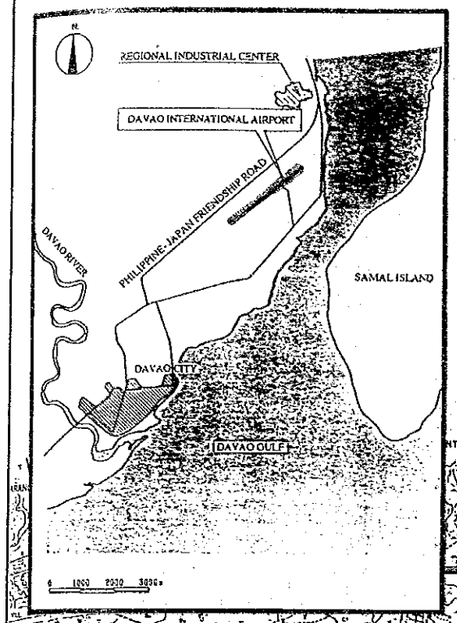
CHAPTER 9 PRELIMINARY DESIGN

9.1 General

The preliminary design of the facilities for the medium-term development is made for the selected airport master plan shown in Figure 7.6.13.

The airport layout plan and terminal area layout plan in the medium-term development are shown in Figures 9.1.1 and 2 respectively.

The objective of the preliminary design is to clarify the basic concept and design criteria, and to outline specifications and dimensions of the facilities for cost estimating purpose.



	BUILDING
1	PASSENGER TERMINAL BUILDING
2	CARGO TERMINAL BUILDING
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13	RESERVED AREA FOR AIRCRAFT MAINTENANCE APRON
14	RESERVED AREA FOR CANTEENS

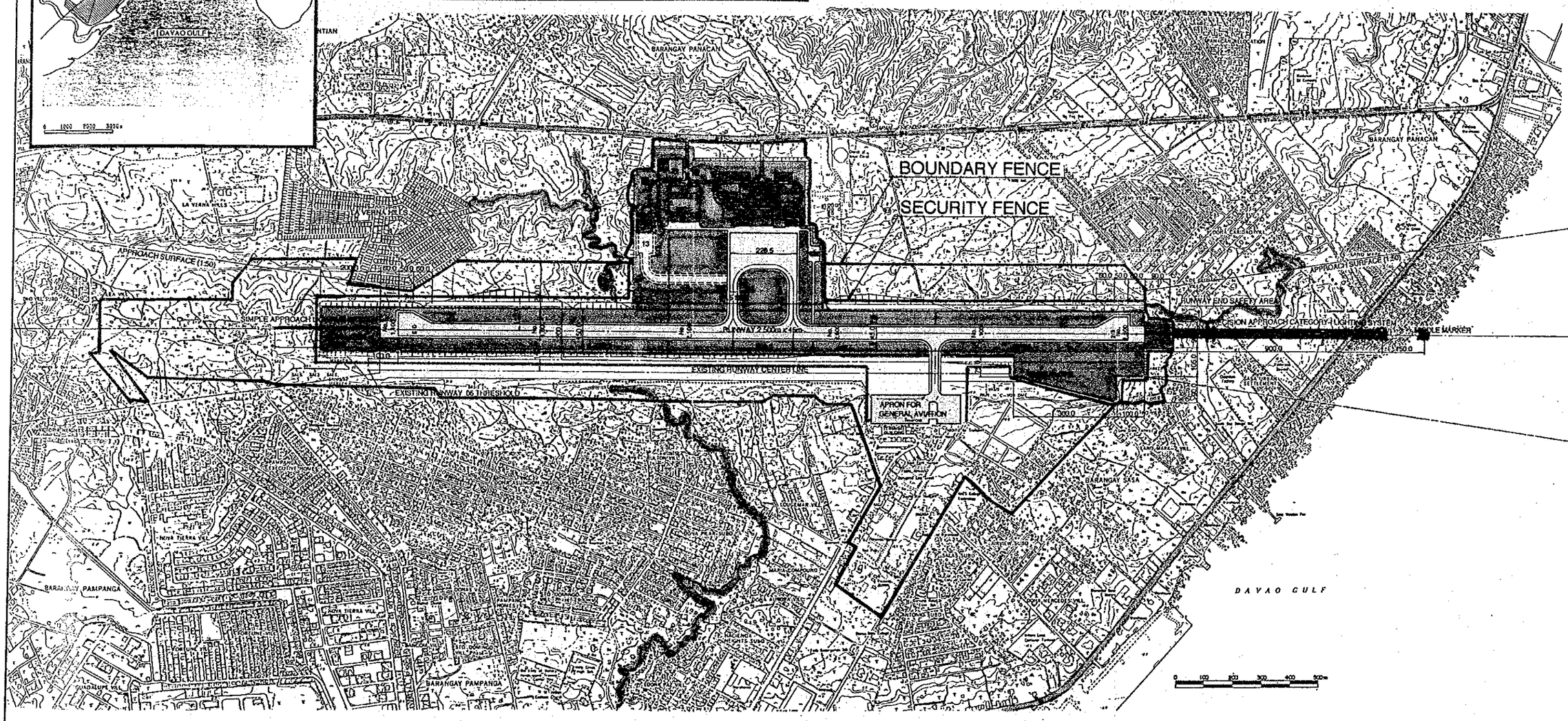

Figure 9.1.1 Airport Layout Plan of Medium-Term Development Plan

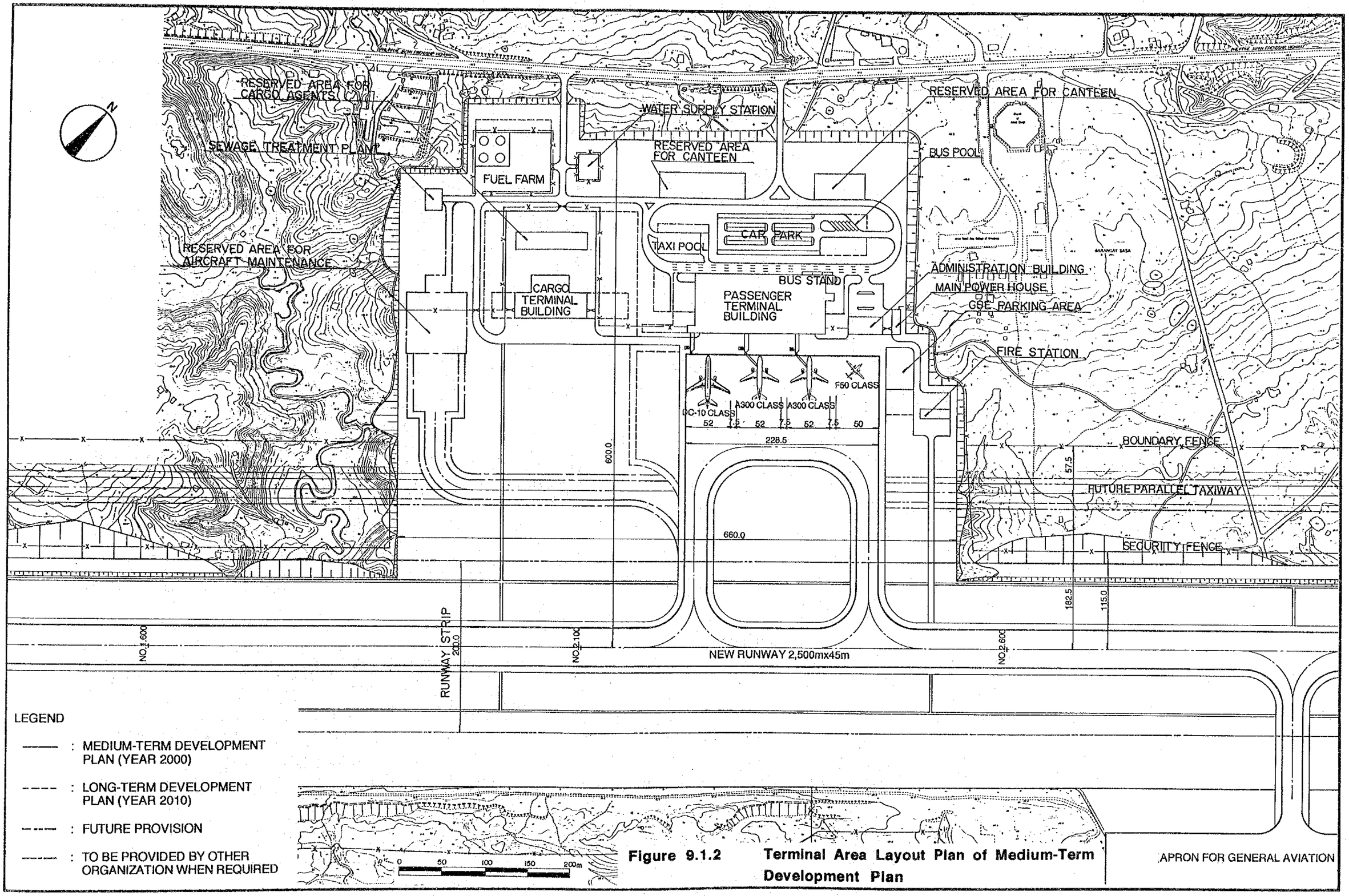

Figure 9.1.2 **Terminal Area Layout Plan of Medium-Term Development Plan**

9.2 Layout of Terminal area

9.2.1 Zoning of the Terminal Area

Three major buildings, i.e., passenger, cargo and administration buildings will be located in front of the apron as a linear concept in order to secure the expansibility of the apron in future.

Principal facilities, such as passenger terminal facilities, will be located on the cut area. The banking area will be prepared for the future expansion and the reserved area for indefinite facilities, such as aircraft maintenance facilities. Since the cutting area ranges at the eastern part of the terminal area, the passenger terminal facilities and the control tower will be located at the eastern part of the terminal area.

9.2.2 Passenger Terminal Building

As described in section 9.2.1 above, a passenger terminal building will be located in front of the apron.

9.2.3 Cargo Terminal Building

A cargo terminal building will be located west of the passenger terminal building considering the access from/to the apron.

9.2.4 Administration Building and Control Tower

An administration building and control tower will be integrated into the same building for the convenience of the administrative staff and for the reduction of the construction cost. The building and tower will be located east of the passenger terminal building facing the apron so as to ensure the visibility from the tower cab to the approaching aircraft.

9.2.5 Fire Station

A fire station will be located east of the apron taking into account the clearance from the parallel taxiway in the future provision and the response time required for the fire vehicles to reach the end of runway.

9.2.6 Aviation Fuel Supply System

A fuel farm will be constructed by PAL and PETRON in the medium-term development. From the viewpoint of disaster prevention and security, the fuel farm should be located far away from the public area, such as the passenger terminal building and the apron. On the other hand, it is preferable for the fuel farm to be located near the apron for the convenience of refueling operations and/or for the economy of the construction cost of the hydrant. Based on the above considerations, the fuel farm will be located north of the cargo area.

9.2.7 Reserved Area for Aircraft Maintenance Facilities

The area for aircraft maintenance facilities will be reserved on the western side of the expansion area for the cargo terminal.

9.2.8 Sewage Treatment Plant

A new sewage treatment plant will be located west of the fuel farm so as to be near the river into which the treated sewage will be discharged and to be far from the public area so that the passengers would not be affected by the bad odor.

9.2.9 Water Supply System

Potable water at the airport will be supplied from a deep well. From the viewpoint of sanitation, the location of the new well will be east of fuel farm so as to be far from the sewage treatment plant.

9.2.10 Terminal Road

Since the new terminal area is near the Philippine-Japan Friendship Highway, terminal roads for the passenger terminal and the cargo terminal will be provided separately in order to prevent cargo trucks from mixing in with passenger vehicles.

9.2.11 Reserved Area for Canteen

The existing canteens are supposed to be relocated to the new terminal area in the medium-term development. The area for the canteens in the new terminal area will be reserved north of the car park. The size of the area will be the same as that of the existing canteen area.

9.2.12 Size of Terminal Area

As a result of the terminal area layout plan described from items (2) to (11) above, the width of the terminal area will be planned 660m and the depth from the new runway center line will be 600 m.

9.2.13 General Aviation Area

Facilities for the general aviation will basically remain at the existing general aviation area. Since the new terminal area will be provided on the north side of the new runway, the existing apron will be used for general aviation purposes.

9.3 Civil Works

9.3.1 Runway

The length and width of the new runway in the medium-term development will be 2,500m and 45m respectively.

Turn pads will be provided at both thresholds of the runway to give B747-400 enough room to maneuver and turn.

Overruns will be provided at the both runway thresholds in order to prevent the blowing of dust caused by jet blast. The width and length of each overrun will be 60m and 60m respectively.