

BARRANQUILLA

THE COMPREHENSIVE URBAN TRANSPORT STUDY
IN BARRANQUILLA METROPOLITAN REGION
OF THE REPUBLIC OF COLOMBIA

FINAL REPORT

SUMMARY VOLUME

MARCH 1985
JAPAN INTERNATIONAL
COOPERATION AGENCY

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COOPERATION AGENCY**

国際協力事業団	
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PREFACE

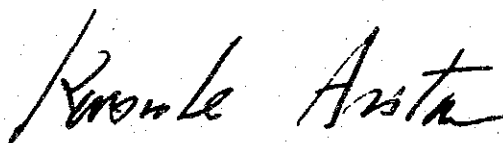
In response to the request of the Government of the Republic of Colombia, the Government of Japan decided to conduct a study on the Comprehensive Urban Transport System in Barranquilla Metropolitan Region and entrusted the study to the Japan International Cooperation Agency (JICA). The JICA sent to Colombia a study team headed by Mr. Takeo SATO from July 1983 to March 1985.

The team exchanged views on the Project with the officials concerned of the Government of Colombia and conducted to survey in Colombia. After the team returned to Japan, further studies were made and the present report has been prepared.

I earnestly hope that this report will serve for the development of the urban transport system in Barranquilla Metropolitan Region as well as for the urban renewal development in Barranquilla Central district and contribute to the promotion of friendly relations between our two countries.

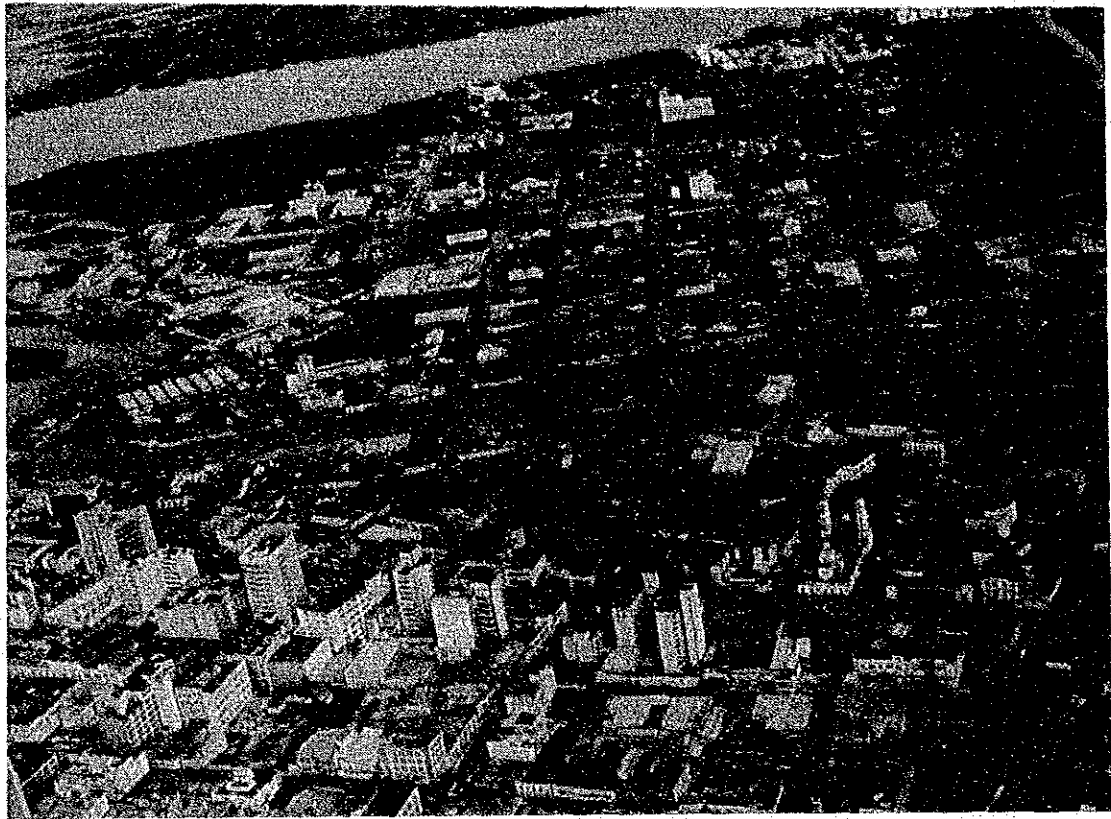
I wish to express my deep appreciation to the officials concerned of the Government of the Republic of Colombia for their close cooperation extended to the team.

March 1985

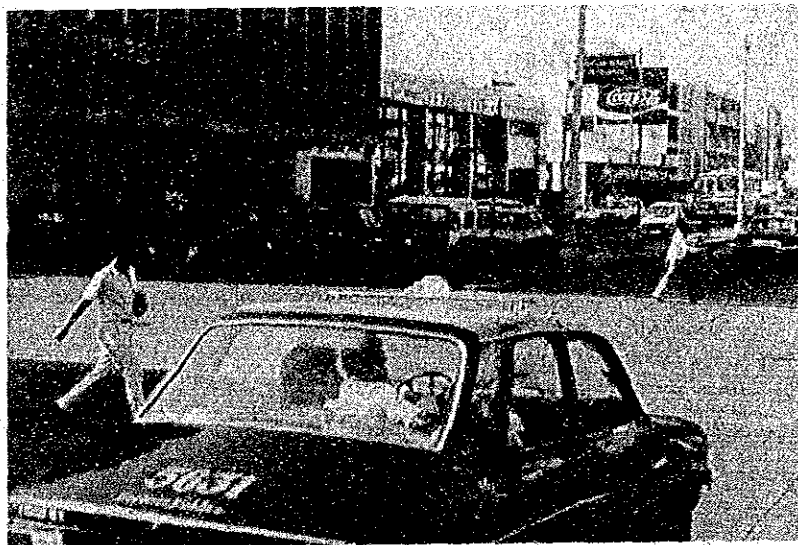


Keisuke Arita
President

Japan International
Cooperation Agency



Barranquilla City



Main Street in Barranquilla

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1. INTRODUCTION

Background

Due to the rapid expansion in population and economic activities, the Barranquilla Metropolitan Region has already been faced with various urban transport problems. The main streets in the Central District are heavily congested with traffic and pedestrians particularly during the peak hours. The bus transport, which is the major transport mode for person trips, is served in a radial pattern mostly destinating to the Central District. However there is no coordination among the bus companies, thus, the bus route pattern as a whole is intricate and not well organized, particularly in the Central District.

The Central District itself faces many problems, such as concentration and mixture of various activities, flight of business and commercial activities from the District, high vacancy of buildings, and an environmental deterioration, etc.

In view of above problems, it is imperative to improve the urban transport system in Barranquilla Metropolitan Region, and to undertake the redevelopment of the Central District. To accomplish this effectively, it is urgently necessary to establish a master urban transport plan and to prepare a renewal plan of the Central District.

In response to a request from the Government of Colombia, the Government of Japan, through its implementing body, the Japan International Cooperation Agency (JICA) initiated this study jointly with the Government of Colombia in July, 1983.

Objectives

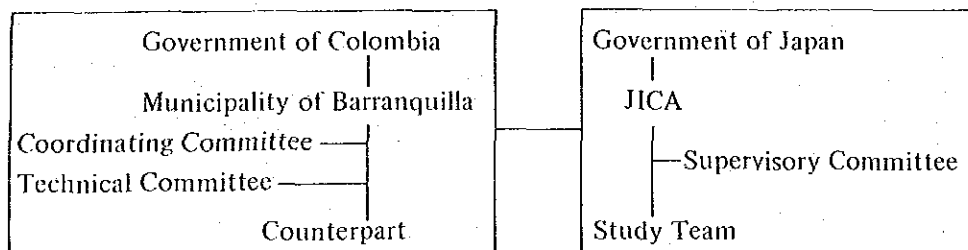
The objective of the Study is to formulate: a) A transport master plan including transport policies and development plan and program for the short and long terms; and, b) An urban renewal plan for the Central District, that will effectively serve the present and future transport needs and contribute to the orderly urban development in the Barranquilla Metropolitan Region.

Study Area

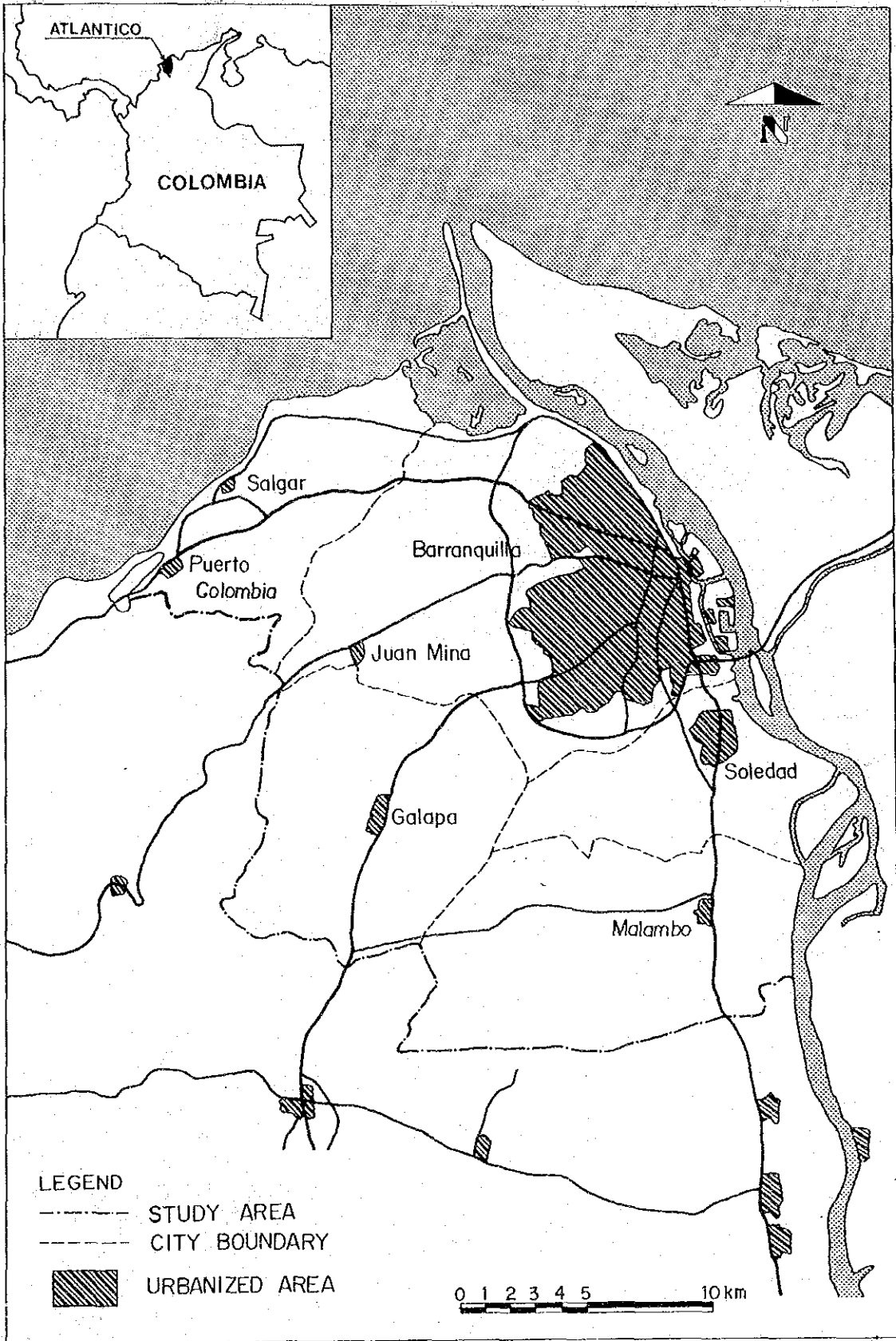
The Study Area covers the present and future urbanized area of the cities of Barranquilla, Soledad, Malambo, Galapa and Puerto Colombia. Although the Study Area covers these cities, the actual study is focussed on the urbanized area in Barranquilla and Soledad, where a person trip survey has been conducted.

Organization

The Study was carried out in Colombia jointly by JICA and the Government of Colombia in coordination with other agencies.



Study Organization



Study Area

2. EXISTING PROBLEMS

Urban Structural Problems

- (1) Concentration of Various Urban Functions in the Central District.
Major administrative, financial, commercial and transportational activities are highly concentrated in the Central District. This concentration is one of the main causes for traffic congestion.
- (2) Mixture of Various Activities in the Central District.
The market area and the bus operation centers are located close to the business district. Additionally, various activities such as small industries, shops, street vendors and residences are all mixed together. This condition is creating traffic confusion in the Central District.
- (3) Deterioration of Environmental Condition in the Central District.
As proof of the deterioration of environmental conditions in the Central District, the following items are pointed out:
 - a. Vacant buildings are increasing in number.
 - b. Permanent settlements of squatters can be observed.
 - c. Disorderly conversion of building use is found.
 - d. Contamination of Caño Ahuyama causes sanitary problems.
- (4) Disorderly Development and Sprawl of Built-up Area.
Disorderly development of residential urbanizations has been created by squatters in the southwest part of Barranquilla. In addition, a sprawl of built-up areas outside the Circunvalar is being promoted by private developers as well.

Urban Transport Problems

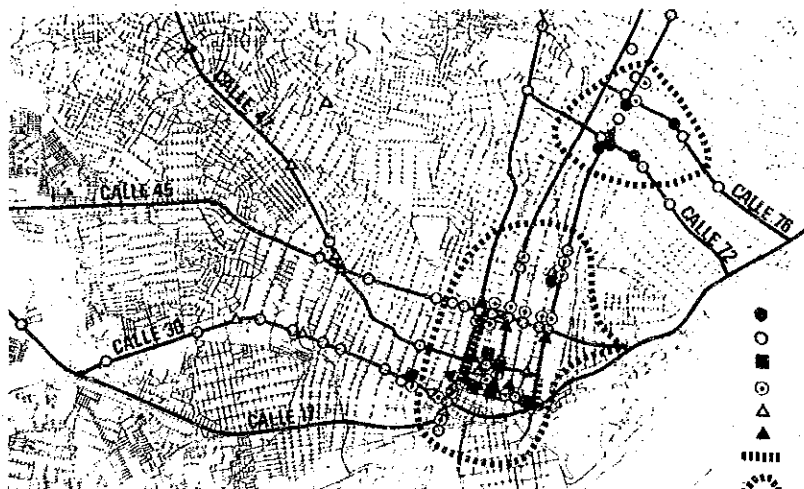
- (1) Problem Areas on Major Streets.
The urban transport problem areas are mostly found in the Central District, where a chronic traffic congestion is observed particularly at three peak periods, morning, noon, and evening. The traffic congestion in the Central District is mainly attributed to the following:
 - a. The traffic capacity of arterial streets is not sufficient.
 - b. There exist several factors for the disturbances of traffic flow: indiscriminate crossing by pedestrians, illegal road-side parking, inundation by Arroyo system, etc.
 - c. The traffic management system, particularly for buses, is not properly applied.
- (2) Public Transport Problems
At present the bus route pattern is characterized by an outstanding concentration in the Central District. Most of the bus routes have been radially extended onto the peripheral area of the city in accordance with the expansion of the urbanized area. The extension in the service area and the increase in the service frequency have caused heavier traffic congestion in the Central District. At the same time, the expansion of the urbanized area has been changing the trip pattern of passengers in terms of its origin and destination. This conflict in the route pattern between the supply and demand for bus transport is evidenced by the transfer of a large number of bus passengers from one route to another in Centro.



LEGEND

- | | | |
|----------------------------------|------------------------|---------------------------|
| RESIDENTIAL | TRANSPORTATION | GAS PIPE LINE |
| EDUCATIONAL, MEDICAL & RELIGIOUS | PUBLIC SERVICE | ELECTRICAL LINE |
| COMMERCIAL | ADMINISTRATION | PDAMB PERIMETER YEAR 1990 |
| INDUSTRIAL | COMMERCIAL RESIDENTIAL | PDAMB PERIMETER YEAR 2000 |
| RECREATIONAL | VACANT | SANITARY PERIMETER |

Existing Land Use



LEGEND

- Influence of cars turning to the left
- High frequency of traffic accidents
- Indiscriminate crossing of pedestrians
- Signalized intersection with bottleneck
- Congestion of buses near bus stop
- Demand/capacity > 1.0 at signalized intersection
- Merging and diverging from/to alley
- High parking density and traffic congestion area

Existing Traffic Problems

3. SOCIO-ECONOMIC FRAMEWORK

Population

The population in the Study Area has grown from about 809,000 in 1973 to about 1.2 million in 1983 at an average growth rate of 4.0% per annum, and is expected to continue to grow at the annual growth rate of 3.5% in the 1980's and 2.9% in 1990's. As a consequence, it is projected that the population will grow to 1.53 million in 1990 and 2.04 million in 2000.

The population composition by age group will change from a pyramid type at present to a barrel type in 2000 owing to the declining tendencies in fertility and mortality rates.

Gross Regional Domestic Product (GRDP)

Gross Regional Domestic Product (GRDP) of Atlantico accounts for approximately 5.7% of Gross Domestic Product (GDP) and has grown by 4.1% annually during the past decade.

The leading sector in Atlantico is the tertiary industries such as commerce, service, etc., which have a percentage share of more than 60% of GRDP. It has shown a steady growth during the past decade, and is expected to continue to grow at the highest rate among the sectors, i.e. 6.2% annually.

The growth of the secondary industries (manufacturing industries and construction industries) in the recent years is rather stagnant due to the unfavorable economic circumstances throughout the country, however it is expected to recover gradually and increase at the annual growth rate of 4.5%.

The primary industries, which have the percentage contribution of only 6.7% to GRDP, are expected to grow at 4.0% per annum in line with the agricultural growth of the country projected in the National Development Plan.

As a whole, the GRDP of Atlantico is projected to grow at 5.4% annually in 1980's and 5.7% annually in 1990's.

Employment

The annual growth rate of employment in the Study Area is projected at 4.5% from 1983 to the year 2000, with the employment increase from 347,000 to 728,000 during that period.

Most of the employment increase will be absorbed by the tertiary industries, reflecting its major share in the GRDP.

Population Projection in Study Area

(in thousand)

	1983	1990	2000	Average Annual Growth Rate	
				1983-1990	1990-2000
B/Q & Soledad	1108.0	1409.7	1875.3	3.5	2.9
Malambo, Galapa, Puerto Colombia	92.2	124.6	167.5	4.4	3.0
Study Area Total	1200.2	1534.3	2042.8	3.6	2.9

Projection of Future GRDP of Atlantico

(1975 Constant Prices)

Industrial Sector	GRDP (Million Pesos)			Average Annual Growth (%)	
	1983	1990	2000	1983-1990	1990-2000
Primary Industries	2,100	2,760	4,090	4.0	4.0
Secondary Industries	10,030	18,440	21,060	4.3	4.6
Tertiary Industries	19,030	28,720	52,870	6.1	6.3
Total	31,160	44,920	78,020	5.4	5.7

Employment Projection in Study Area

Industrial Sector	1983	1990	2000
Primary Industries	6,900 (2.0)	7,600 (1.5)	8,200 (1.1)
Secondary Industries	82,300 (23.7)	103,200 (20.7)	150,000 (20.6)
Tertiary Industries	257,900 (74.3)	388,600 (77.8)	569,700 (78.3)
Total	347,100 (100.0)	499,400 (100.0)	727,900 (100.0)

Note: The figures in parentheses show percentage distribution by sector.

4. LAND USE PLAN

Development Pattern

The Barranquilla Metropolitan Region covers an area of 51,400 hectares, of which 12,000 hectares are urbanized at present. From the large built up area surrounded by the Circunvalar, urbanization extends southward to Malambo and northwestward to Puerto Colombia. Heretofore, the west part of Barranquilla outside the Circunvalar has not been confronted with urbanization pressure, but recently some spot developments are gradually progressing.

For the future development of the Metropolitan Area, a linear development North-South pattern was set up taking into account the Study background, the planning needs and the external conditions. By establishing this development pattern, the following advantages are expected.

- a. The existing and proposed road network will be used more effectively.
- b. This pattern is compatible with the current execution of on-going projects such as Central de Gran Abastos, Malambo Industrial Park, Site Relocation of Atlantico University and Resort Development in Puerto Colombia.
- c. The future public services such as water supply and drainage etc. can be developed more economically.

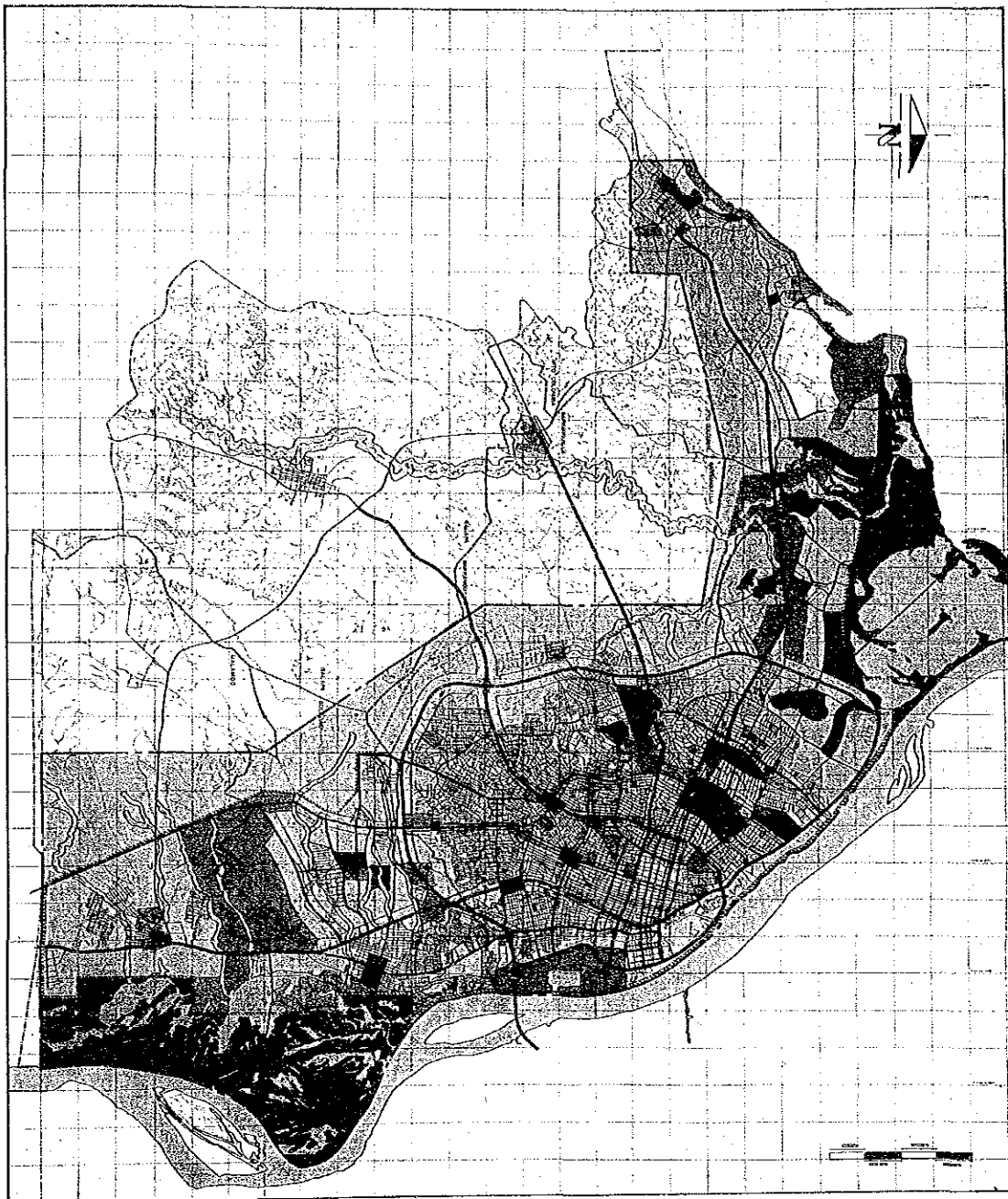
According to this pattern, the urbanized area will expand from 12,000 ha. in 1983 to 15,400 ha. in the year 2000.

Land Use Plan for the Year 2000















The urbanized area will mainly expand to the northwest and the south outside the Circunvalar. By 1990, almost all of the vacant land inside the Circunvalar will be occupied by residences, and a number of housing projects in southern suburbs will also be completed. Between 1990 and 2000 the remaining vacant land outside the Circunvalar will also be occupied. A belt of industrial zones along the Rio Magdalena will continue to be maintained by expanding the existing industries and establishing new industrial parks near the airport and Malambo.

As for business and commercial activities, some of them will be dispersed to the peripheral area in order to alleviate the excessive burden on the Central District. In addition to the existing centers, such as the Central District of Barranquilla, the commercial area along Calle 72 and the administrative center of Soledad, two new subcenters are planned in the suburban area; one is located at the area adjacent to Soledad 2000 in the south, the other near the construction site of Universidad Atlantico in the northwest.

On the other hand, the Central District is expected to function as an upgraded administrative, business and commercial center of the Metropolitan Region after its renewal and redevelopment.



LEGEND

- | | | | |
|---|--|---|--------------------------|
|  | SPECIALIZED ACTIVITY AREA METROPOLITAN AND INSTITUTIONAL SERVICE |  | RESERVE AREA |
|  | SPECIAL STUDY AREA CENTRAL DISTRICT |  | SUBURBAN AREA |
|  | RESIDENTIAL ACTIVITY AREA |  | ARROYO PRESERVATION AREA |
|  | MULTIPLE ACTIVITY AREA |  | SANITARY PERIMETER |
|  | COMMERCIAL ACTIVITY AREA |  | MUNICIPAL PERIMETER |
|  | INDUSTRIAL ACTIVITY AREA |  | YEAR 1990 PERIMETER |
|  | RECREATIONAL ACTIVITY AREA AND PARKS |  | YEAR 2000 PERIMETER |

Land Use Plan for the Year 2000

5. POPULATION AND EMPLOYMENT DISTRIBUTION PLAN

Population Distribution Plan

The basic policy of the population distribution plan is as follows.

- (1) The Central District will introduce a new housing estates in Barranquillita for the more effective use of the high potential area.
- (2) The built-up area will maintain the existing tendency of moderate population increase.
- (3) The Southwest suburbs will accomodate a large portion of the incremental population projected for the year 2000 with a gross density of about 200 person/ha.
- (4) The Northwest suburbs will be developed as a new residential area offering higher grade housing and apartment houses with a gross density of about 150 persons/ha.

As a result of the distribution plan, the following points are noted.

- (1) Of the increased population between 1983 and 2000, 173,000 persons will live in the Southwest suburbs, 257,000 in the Northwest suburbs and 235,000 in the South suburbs.
- (2) The new urbanized area will extend initially to the south, and following 1990 will extend mainly to the northwest.
- (3) The built up area of Barranquilla and Soledad, including the Central District, will absorb 102,000 persons by the year 2000.

Employment Distribution Plan

The employment distribution plan was prepared by taking into account the existing distribution pattern, the future population increase, the expansion of the existing activities and new projects which would create new job opportunities.

The result of the employment distribution plan is as follows.

- (1) About 30% of the incremental employment during the years from 1983 to 2000 will be generated in the Barranquilla built-up area.
- (2) While the employment in the Central District will grow 1.4 times the existing level, its share to the total employment in the Metropolitan Region will gradually decrease.
- (3) The suburban areas will receive a total employment of 177,000 persons, reflecting the population increase and the policy of sub-center promotion.

6. PERSON TRIP IN BARRANQUILLA METROPOLITAN REGION

Trips by Purpose and Mode

The total number of person trips in the Barranquilla Metropolitan Region is estimated to be 2,674,000 trips on an average week day. 97% of these i.e., 2,581,000 trips, were made by the residents of Barranquilla and Soledad.

The most prominent trip purposes were "to home" (48.5%), "to school" (16.5%) and "to work" (14.5%). These three purposes constitute the main portion of the peak hour traffic.

By type of transport mode, buses are used most often by the people in Barranquilla, accounting for 1,367,000 trips (53.0%). The mode with the second highest share is by walk, about 25.6% (excluding access to Bus and Taxi). Passenger cars are used for only 10.9% of the total trips.

Trip Production Rate

The gross trip production rate is calculated as 2.69 trips per day, which is obtained by dividing the total trip production by the total population (5 years old and older). The trip production rate significantly differs when personal characteristics are classified by industry. It ranges from 2.38 for non-workers to 5.23 for the workers in the transport sector.

There does not exist a large difference in the trip production rate by car ownership. The trip production rate for car owning family members is about 1.2 times that of non-car owning family members. Only the trip production rate for business purposes shows an obvious difference by car ownership.

Existing Origin-Destination Pattern

Generally, the existing O-D pattern shows an huge concentration into Centro and its surrounding zones, of which the main flows are those between the Central District and the densely populated area located in the south and south-west parts of Barranquilla. Another concentration can be seen in the zone located along Calle 72, though not as heavy as Centro.

Although radial type trips are predominant, there exists a significant number of circular type trips among the zones inside of the Circunvalar.

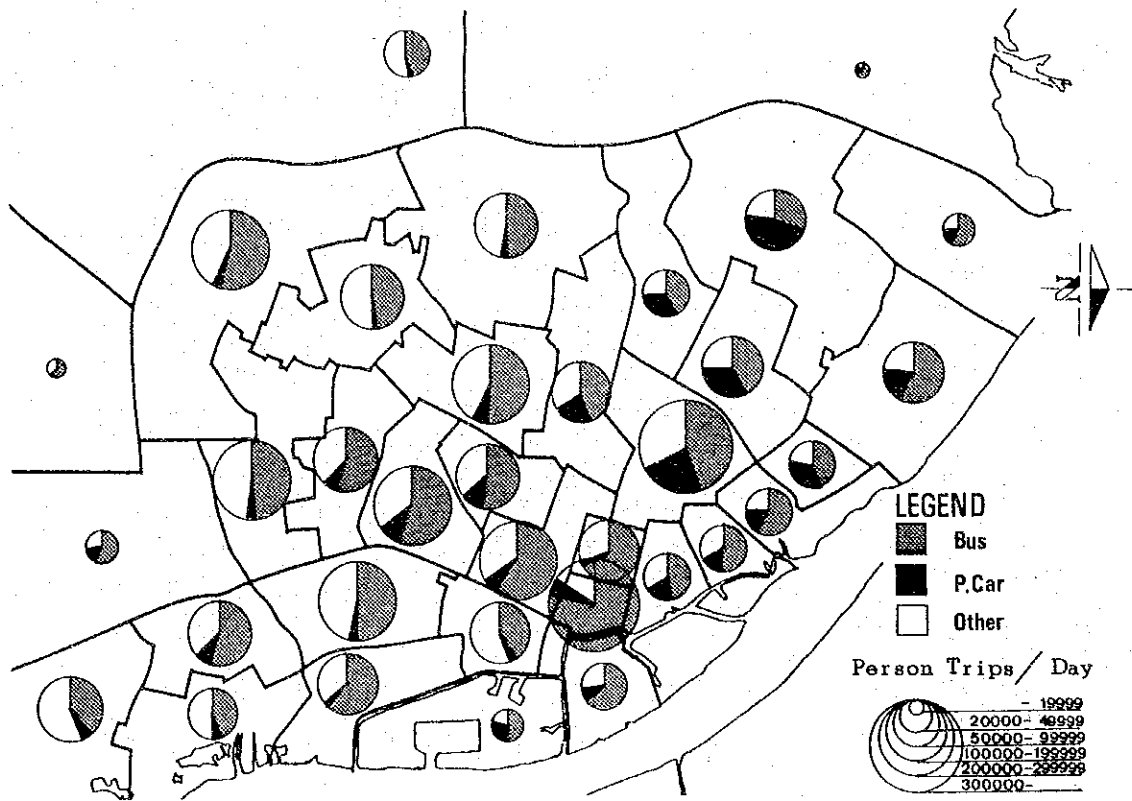
Trip Production by Purpose in 1983

Trip Production by Mode in 1983

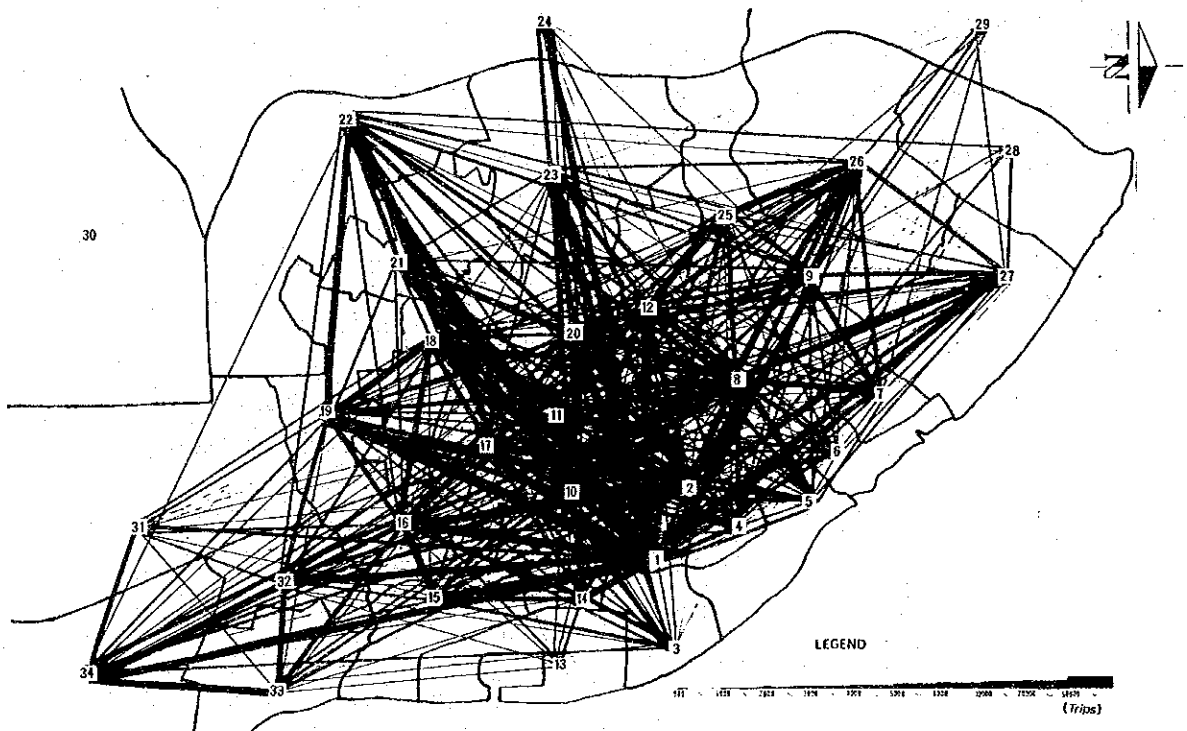
Trip Purpose	Trip Production (1000 trips/day)	Composition Rate (%)	Transport Mode	Trip Production (1000 trips/day)	Composition Rate (%)
Work	375.5	14.5	Passenger Car	282	10.9
School	424.5	16.5	Taxi	129	53.0
Home	1,225.5	48.5	Bus	1,367	5.0
Business	97.0	3.8	Truck	107	4.1
Shopping	191.8	7.4	Motorcycle	36	1.4
Private	266.7	10.3	Walk	661	25.6
Total	2,581.0	100.0	Total	2,581	100.0

Note: Excluding the trips by the non-residents of PT Survey area.

Source: Person Trip Survey in 1983



Trip Generation/Attraction by Zone



OD Pattern in 1983 (All Purpose)

7. FUTURE TRANSPORT DEMAND

Growth of Transport Demand

Based on the future land use plan and population/employment distribution plans, the future transport demand was estimated by using the forecasting models, which were established by analyzing the relationships between the existing trip characteristics and the present socio-economic conditions.

The total trip production by the residents of Barranquilla and Soledad grows from 2,581,000 in 1983 to 4,690,000 in the year 2000 with a growth rate of 1.81.

The trips for work and business purposes will increase at higher growth rates than the other purpose trips, owing to the high growth of the employment in the Study Area. As for the trips for school, however, the growth rate of those trips is predicted to be lower than the others, reflecting the tendency for the decrease in fertility rate.

The growth rate of trip generation outside the Circunvalar is extremely high, for example, in the newly developed area of Soledad (zone 30, 31), the trip generation grows from 22,000 trips in 1983 to 415,000 trips in 2000.

On the other hand, the growth rate of the built up area inside of the Circunvalar is relatively low; the total trip generation in 2000 is about 1.6 times that in 1983. The Central District has a particularly low growth rate, only about 1.3 times.

Modal Share

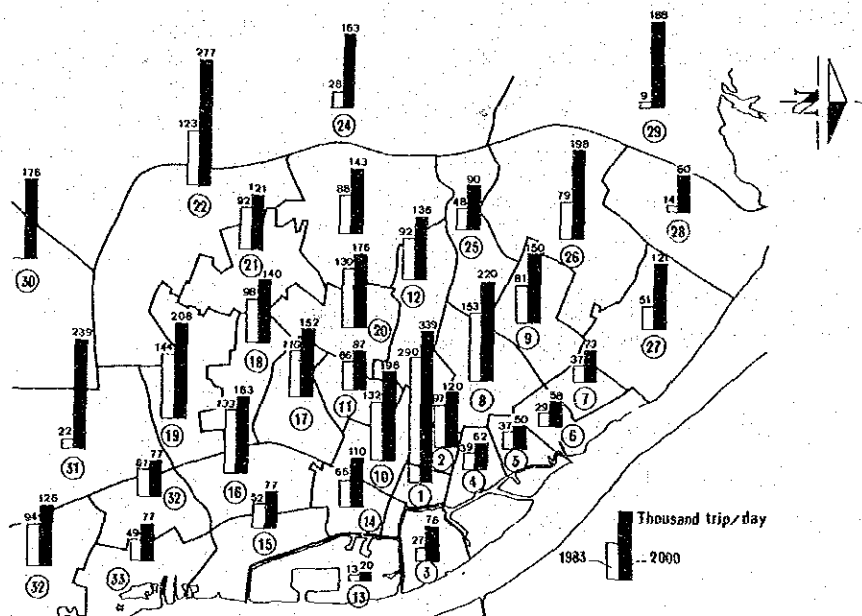
The number of person trips by vehicles is estimated to increase to twice the existing trips. Particularly the trips by private vehicles are expected to grow by 2.4 times, while the average growth of the total modes is 1.8 times the existing level. Accordingly the percentage share of private vehicle use will expand from 19.9% to 26.1% of the total person trips. Although the share by public mode does not grow as much as by private vehicles, it is noted that more than half of the total trips will be made by public transport even in the year 2000.

The person trips can be converted into vehicle trips by using the average occupancy rate. The total traffic volume in terms of vehicle trips will increase by about 2.1 times. The growth of private vehicle traffic during the period 1983-2000 is about 2.2 times, with an increase of the modal share from 79% to 81%.

Number of Trip Production by Purpose in 2000

	No. of Trip Production (trips/day)		Growth Rate
	1983	2000	
Work	375,500	718,900	1,915
School	424,500	736,000	1,724
Home	1,225,500	2,208,100	1,802
Business	97,000	205,400	2,118
Shopping	191,800	342,300	1,784
Private	266,700	479,300	1,797
Total	2,581,000	4,690,000	1,817

Note: Excluding the trips by the non-residents of the PT survey area.



Trip Generation in 1983 and 2000

Modal Share of Person Trips

	1983		2000		Growth Rate '83-2000
	Number of Trips (thousand trip)	Composition (%)	Number of Trips (thousand trip)	Composition (%)	
Walk	697	26.1	903	18.4	1.3
Private Cars	531	19.9	1,277	26.1	2.4
Public Transport	1,446	54.0	2,720	55.5	1.9
Total	2,674	100.0	4,899	100.0	1.8

8. FUTURE TRAFFIC FLOW

Future Origin-Destination Pattern

The total number of person trips related to the Barranquilla Metropolitan Region will increase from 2.7 million in 1983 to 4.9 million in the year 2000.

The growth rate of person trips between the inside area of Circunvalar and the outside area is comparatively high, about 3.2 times the existing level, while the movement inside of Circunvalar will only grow to 1.5 times the trips in 1983, reflecting the high population growth in the suburban area.

By the year 2000, the trips originated or destined from/to the Central District will increase by only 30% of the present trips. The incremental number of trips, however, is considerably large, about 250,000 trips/day are additionally expected. This suggests that the Central District will suffer from more serious traffic congestion in the future.

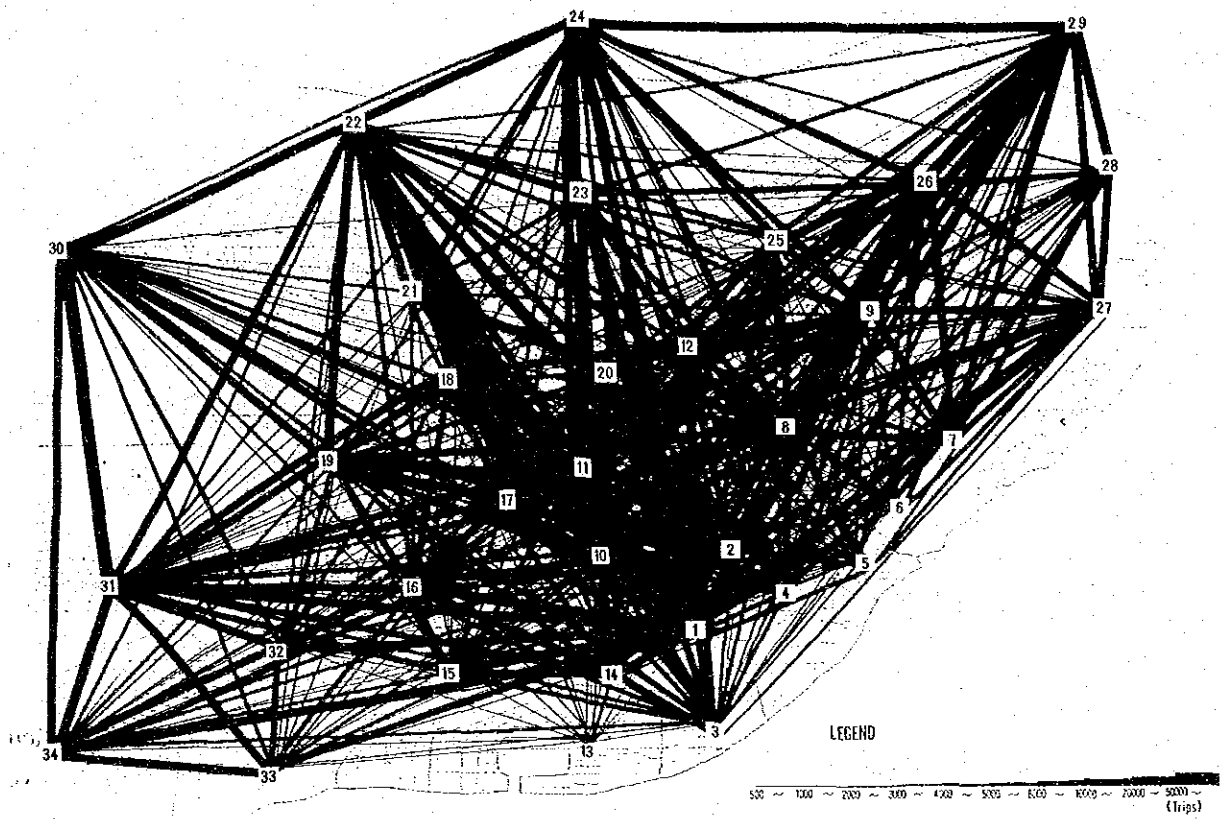
The transport demand between Barranquilla and the new urbanized area of Soledad will remarkably increase from 2500 person trips in 1983 to about 600,000 person trips in 2000, owing to the large number of housing developments in Soledad.

The transport demand between the existing built up area and the north-west new urbanized area of Barranquilla is also forecasted to have a high growth rate: from 18,000 person trips in 1983 to 250,000 person trips in 2000.

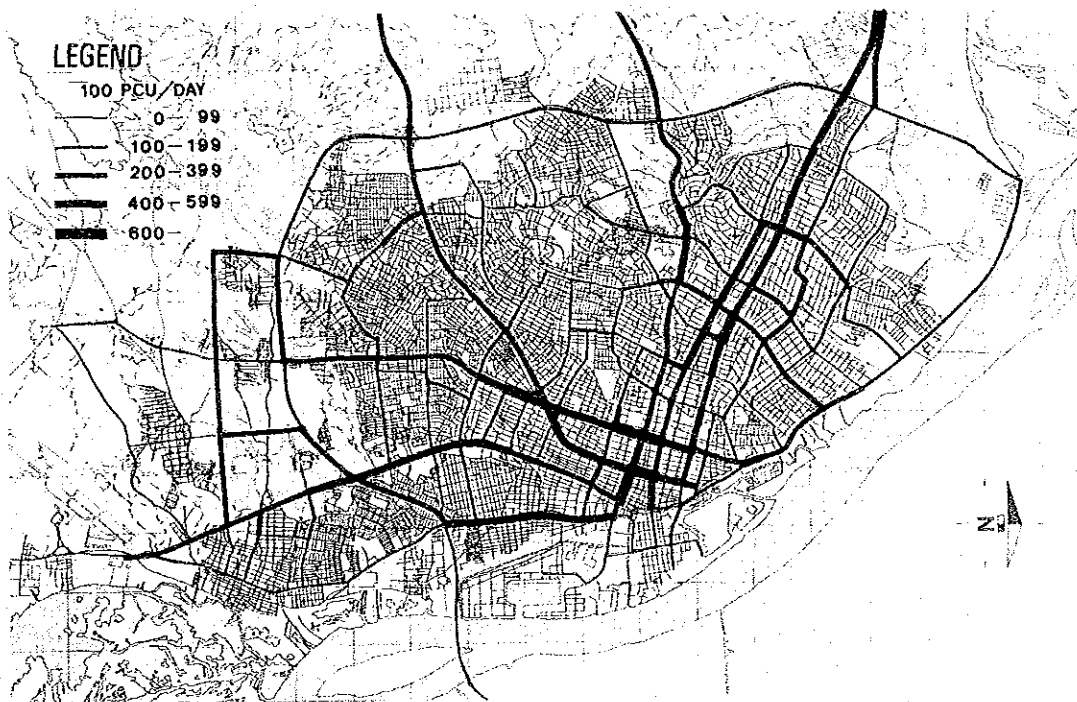
Traffic Flow on Road Network

As a whole, the pattern of traffic flow does not drastically change from 1983 to 2000, however, it is noted that the road links with a large traffic volume are extended toward the peripheral area of the existing built-up area and the volume on the arterial roads is expected to increase to 2 or 3 times of the present volume. Particularly the growths of traffic between the Central District and Soledad including the new sub-center area in the south, and between the Central District and the new sub-center area at the north-west, are extremely high. These growths of traffic demand reflect the changes in the land use pattern and the population distribution.

The comparison of future traffic demand and existing road capacity indicates that among others the transport facilities from the new urbanized areas to the Central District should be adequately developed to meet these demand patterns and at the same time the counter-measures to cope with the increasing traffic congestion in the Central District should be applied.



OD Pattern in 2000 (All Purpose)



Traffic Demand in 2000 (Existing Network)

9. ALTERNATIVE TRANSPORT NETWORK PLANS

In preparing alternative network plans, the main axes to be considered are the linkages shaped by letter L which connect the Central District with two new sub-centers. The alternatives are prepared for these axes from the aspect of how effectively the plan can provide a higher level of transport services with less investment.

In this study the following two factors are considered for setting alternatives.

- (1) Physical pattern of the main axes
- (2) Public transport service method

The first factor (physical pattern of the main axes) is concerned with collection and dispersal of traffic by each direction. The following 3 alternative patterns can be considered.

(1) Intensive Pattern

This network pattern will serve the traffic intensively by establishing bold axes with high capacity. The traffic is then collected and dispersed through the semi-arterial or collector roads and mainly flows on the major axes.

(2) Dispersal Pattern

This pattern serves the demand in a dispersed way by establishing several axes which run in parallel. In this case, each axis does not have as much capacity as the Intensive Pattern.

(3) Mixed Pattern

This pattern is a mixed type of above two patterns.

The second factor (Public Transport Service Method) is concerned with providing public transport services to meet the transport needs for the majority of residents. It would study whether or not public transport system is innovated by introducing a new transport mode such as a rail transit system. Accordingly the following 2 alternative systems can be considered.

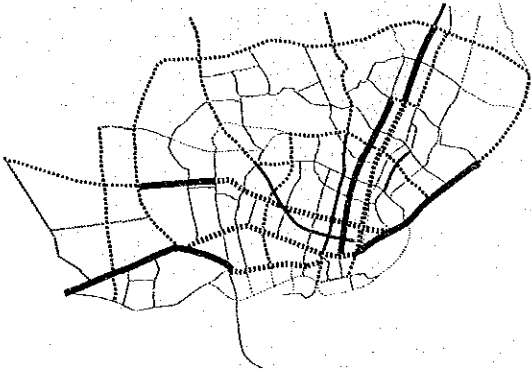
- (1) Without introducing any new mode, only the transport capacity of bus services will be expanded.
- (2) Public transport system is innovatively developed by introducing a rail transit system.

By combining above factors, the alternative network plans are conceptually represented as follows.

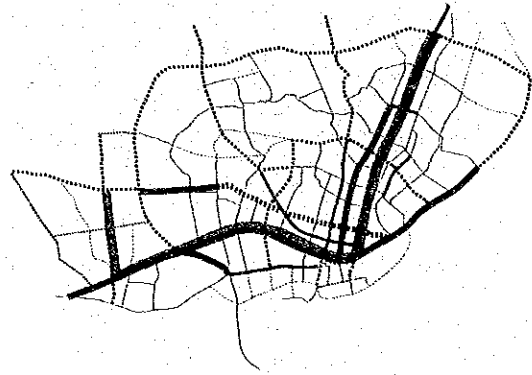
Alternative Network Concepts

Physical Pattern of Network	Public Transport System	
	(1) Without Innovative System (Bus service only)	(2) With Innovative System (Rail transit system)
(1) Intensive Pattern	Alternative 1	Alternative 4
(2) Dispersal Pattern	Alternative 2	—
(3) Mixed Pattern	Alternative 3	Alternative 5

Alternative 1



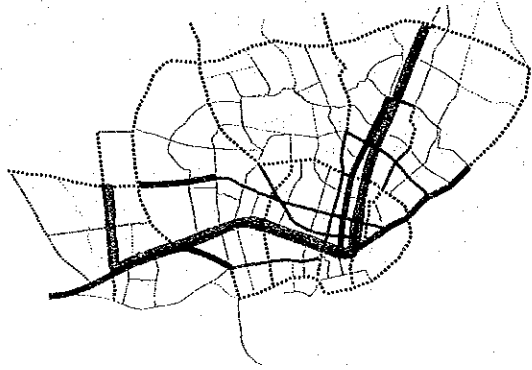
Alternative 4



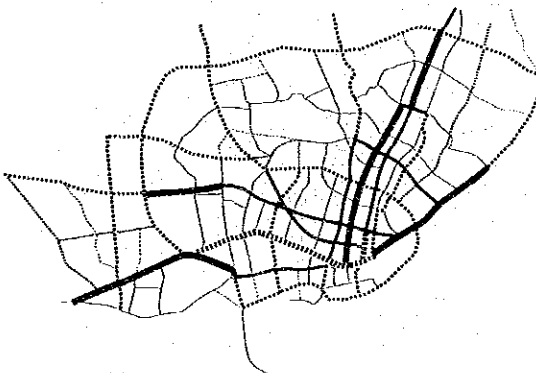
Alternative 2



Alternative 5



Alternative 3



LEGEND

EXISTING ROADS

- 6 LANES
- 4 LANES
- 2 LANES

CONSTRUCTION AND WIDENING

- ⋯ 6 LANES
- ⋯ 4 LANES
- ⋯ 2 LANES
- RAIL TRANSIT

Alternative Network Plans

10. TRANSPORT NETWORK MASTERPLAN

Evaluation of Alternative Network Plans

In order to assess the viability of the alternative network plans from the national economic viewpoint, a benefit-cost analysis was made. It is found from the result that the benefit substantially exceeds the cost in every case. There is a considerable difference in the total project costs among the alternatives, while relatively less difference can be found in the savings in the vehicle operating costs and travel time. Hence, the alternatives without a rail transit system have preferable economic indicators.

A particularly high B/C ratio is shown by Alternative 3, which is a mixed type of physical road development patterns without a rail transit system.

However, the bus transport system has an expansion limit in terms of its transport capacity as well as the road capacity around the bus terminal facilities in the Central District, since it is difficult to drastically expand the road spaces inside of the built-up area. A rail transit system will be also necessary sooner or later in the future.

The transport network masterplan is prepared based on the Alternative 3, however, it should be consistent with and facilitate the introduction of a rail transit system.

Network Masterplan

In the regional context, the transport network of the Barranquilla Metropolitan Region in the year 2000 will be characterized by the enhanced linkages among the Central District and the two new sub-centers.

As for the axis between the Central District and the south sub-center, Calle 30 and its extension to the airport and Malambo will function as the main arterial. In addition, Calle 45 and its extension to Malambo, Riverside Bypass, and Calle 45D and its extension are also expected to work as the trunk road in this direction.

In the corridor to the north-west sub-center, Cra. 46 and its extension to Puerto Colombia as the main arterial, Cra. 50 and Cra. 54, Cra. 60 and Via 40 will be developed.

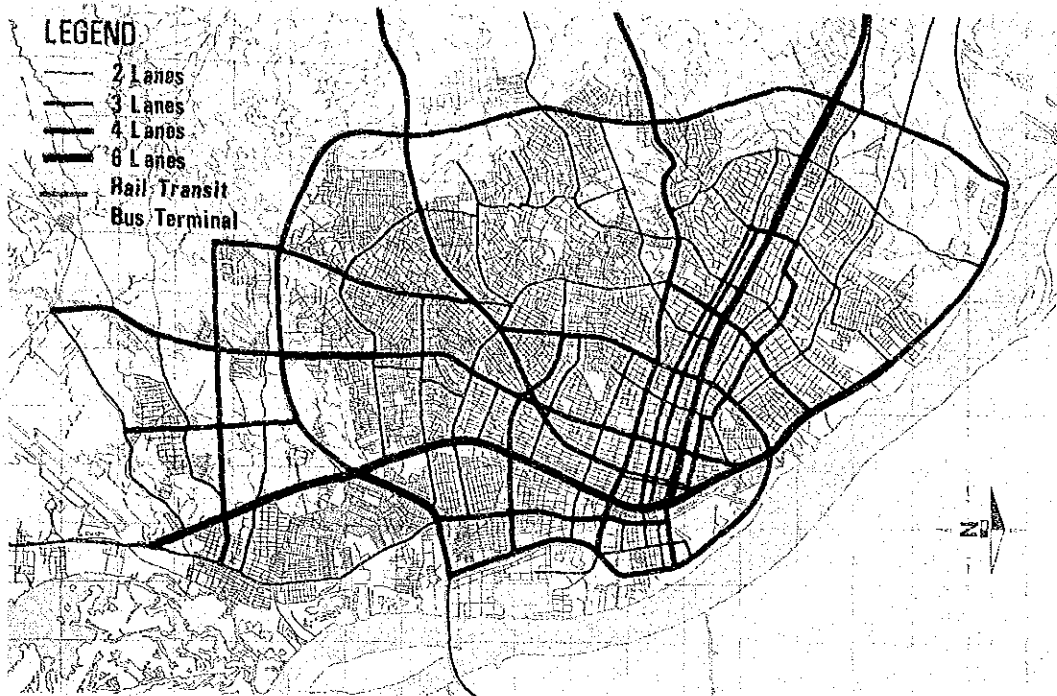
In addition, a preparation of a rail transit system plan connecting the Central District and the two sub-centers should be started in terms of physical, social and institutional requirements, so as to enable its smooth implementation whenever the surrounding conditions become matured.

For developing the bus transport system, interdepartmental and intermunicipal bus terminals are constructed at the south sub-center and at Barranquillita respectively. At the same time a bus circular system in the Central District with several Gran Paradas will be introduced.

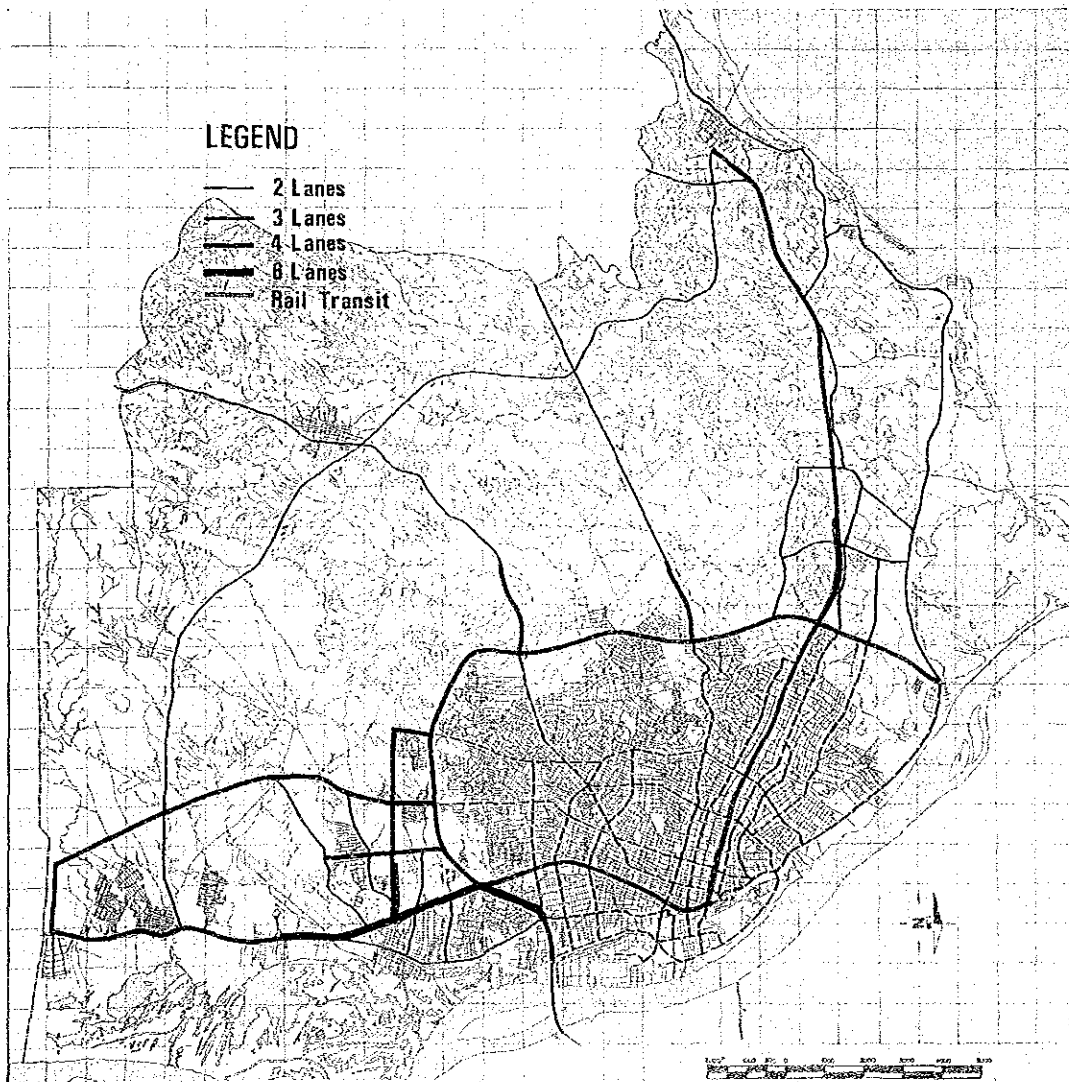
Evaluation of Alternative Network Plans

Alternatives	Total Cost (million \$)	B/C Ratio	Net Present Value (million pesos)	IRR(%)
1	25,265.4	1.98	6,847.3	24.2
2	25,572.0	2.24	8,527.0	26.9
3	25,205.4	2.53	10,370.4	30.4
4	56,891.9	1.16	2,436.3	14.6
5	56,608.8	1.32	4,980.9	17.7

Note: The base year is assumed to be 1984.
The annual discount rate is 12%.



Transport Network Master Plan for 2000 Barranquilla



Transport Network Master Plan for 2000 Metropolitan Region

11. ROAD DEVELOPMENT PLANS

Calle 30 and Its Extension

The road section between Via 40 and Circunvalar will be expanded to a 6-lane road and utilized as the main axis to the Central District for public transport services. The section from the Airport to Malambo will be widened to a 4-lane road.

Riverside Bypass

The section from Puente Pumarejo to Cra. 46 is planned to be constructed by 1990 with the aim to develop the Barranquillita area and promote the construction of the Intermunicipal Bus Terminal in Barranquillita.

Immediately after the completion of this section, the rest part of Riverside Bypass will be constructed to serve the traffic related with industrial zones along Via 40, and to contribute to a further development of Barranquillita area.

Inner Circunvalar Road (Cra. 22, Av. Arenosa)

In order to mitigate the traffic congestion in the Central District, the Inner Circunvalar Road is established mainly by widening the existing roads such as Cra. 22, Calle 53, etc.

Cra. 50, Cra. 54

For the purpose of alleviating the excess load on Cra. 46, these streets in the section from Via 40 to Calle 54, and the section from Calle 54 to Calle 84 respectively, will be widened to 4 lanes.

Cra. 46

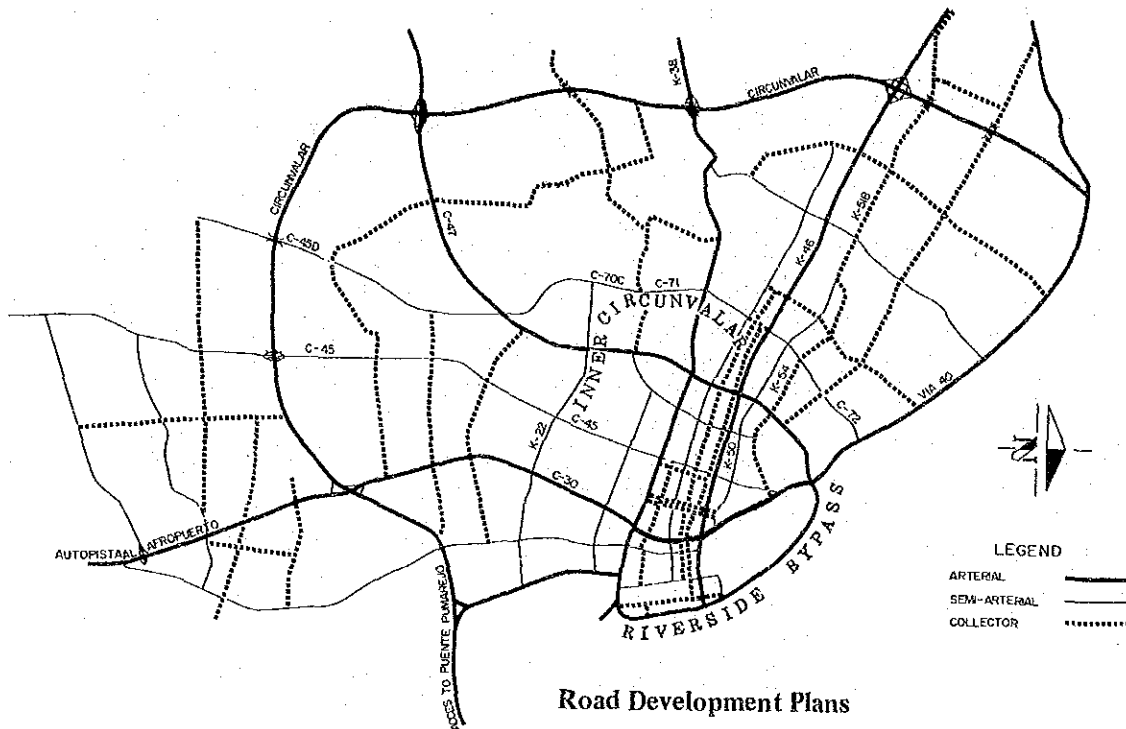
The section between Calle 45 and Calle 30 is widened to 6 lanes and the section between Calle 30 and Riverside Bypass is reconstructed as a 4 lane road. This improvement is expected to effectively contribute to the more enhanced linkage between Centro and Barranquillita.

Circunvalar

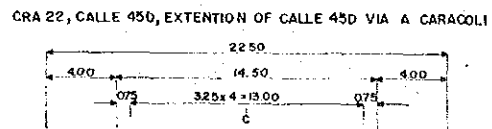
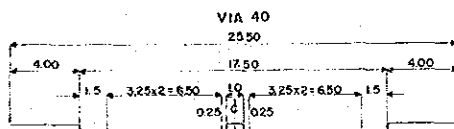
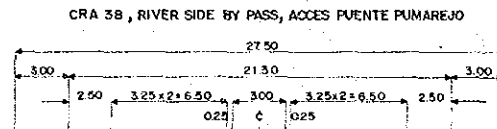
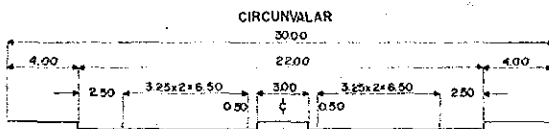
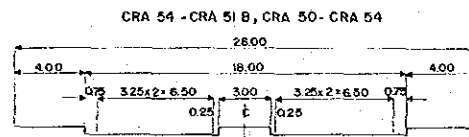
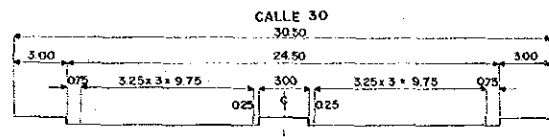
As a 4-lane road, Circunvalar will serve for the traffic among the newly urbanized area along Circunvalar, particularly the traffic related with two new sub-centers.

Road Project Cost

The road construction and improvement costs were calculated by estimating the unit construction cost per km, taking into account the site conditions of each road. Also the construction costs of bridges and interchanges were estimated individually. In addition, the costs for land acquisition and compensation were calculated by considering the land prices and the existing road conditions. As a result, the total project cost is estimated as 28,264.9 million pesos.



Road Development Plans



Cross Section for the Streets Plan in Barranquilla

Total Road Project Cost

	Total Length (km)	Total Project Cost (million pesos)
Road Construction	62.75	13,606.7
Road Improvement	83.80	14,658.2
Total	146.55	28,264.9

12. STORM WATER DRAINAGE IMPROVEMENT PLAN

Arroyo

Most of the streets in Barranquilla are not equipped with a drainage facility, therefore, the rain water flows down on the surface of the streets to the Magdalena River. This drainage system is called "Arroyo" in Colombia. Whenever it rains, the traffic is heavily affected, sometimes interrupted by the run-off on the streets. Accordingly this improvement plan was proposed to minimize the traffic interruptions on the arterials.

Improvement Plans

The improvement plan for storm water drainage consists of the following 3 types.

(1) Drainage through box culvert

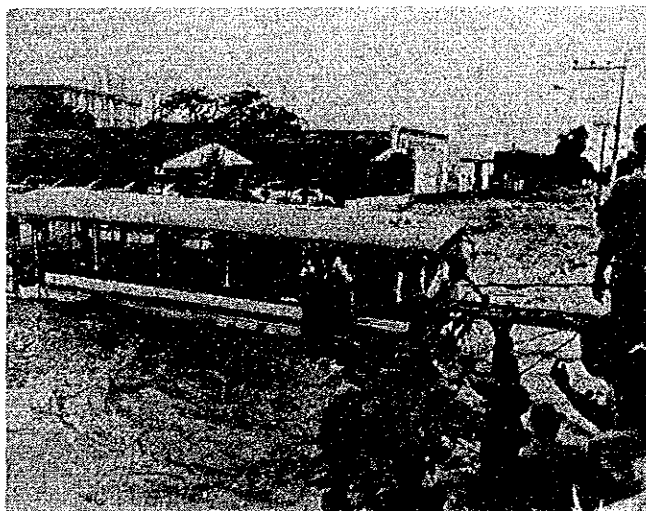
This will serve to drain the water by installing some inlets at the curbs, and box culverts under the streets to convey the water.

(2) Drainage through channel

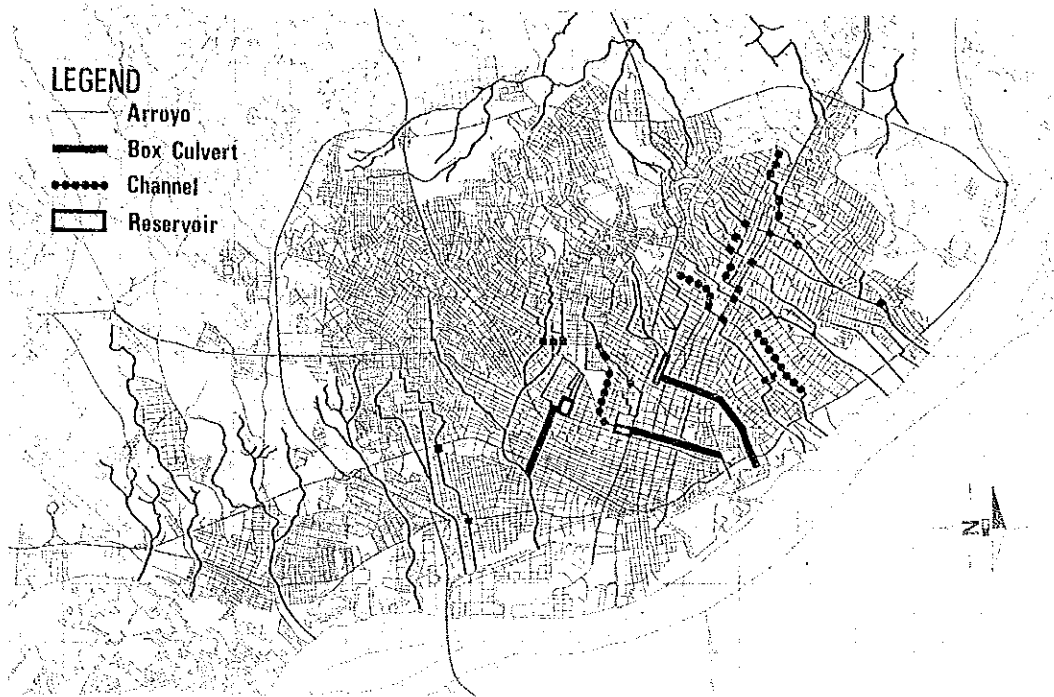
In stead of box culvert, a channel is installed along the sidewalk curbs to drain the water.

(3) Construction of water reservoir

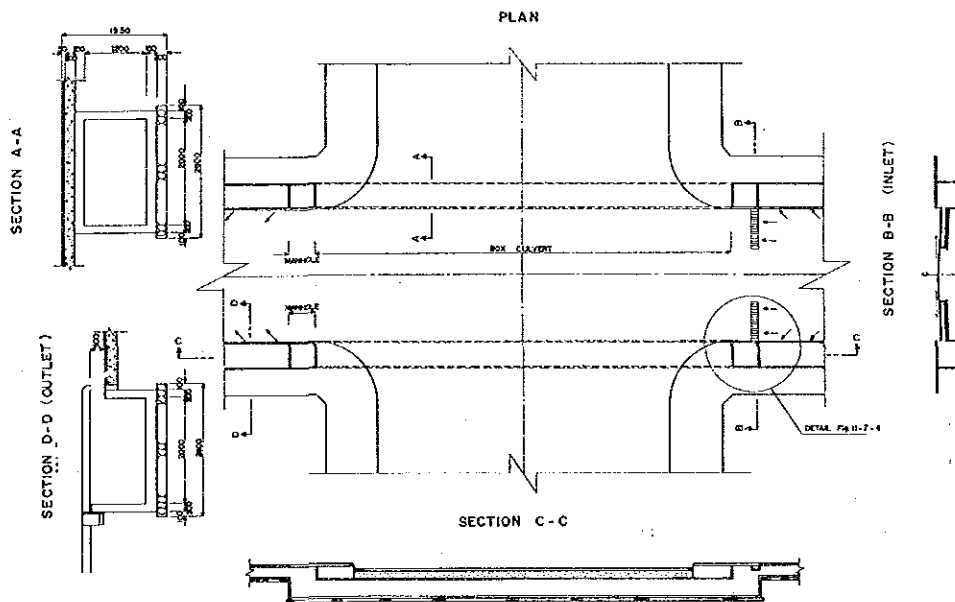
In order to minimize the inflow to the Central District, three water reservoirs are constructed at Parque Universal, Talleres EPM and Cra. 41. The water gathered in the reservoirs will be drained through a box culvert to the Magdalena River.



Emergency of Urban Bus due to Arroyo



The Future Plan of Arroyo Routes



The Arroyo Counterplan for the Critical Point

13. TRAFFIC MANAGEMENT PLAN

Basic Policy

Except for those which require a drastic improvement of road facilities, the traffic management improvement plan can be carried out without large amount of investment and time. Also trials and experimental work are possible by monitoring the changes in the traffic flow. The traffic management system should be updated year by year in response to the changes in the traffic conditions. Therefore, the main objective of traffic management plan is to solve the short term problems.

The area subject to this planning will be the Central District and the new commercial area around Calle 72 where most of the existing traffic problems are concentrated.

Signal Control Plan

The existing signals will be improved and new signals will be installed at the intersections which are identified as the traffic bottlenecks through the diagnosis of the existing traffic conditions.

Most of the signals to be installed will be of traffic-actuated type which can select best combination of control patterns in response to traffic flow. Pre-timed signals will be also installed where deemed applicable.

Coordinated control with traffic-actuated signals will be introduced in the area on the roads with high density of intersections such as Calle 30, Cra. 46, etc. in Centro.

Intersection Improvement Plan

For the improvement of bottleneck intersections, the improvement of signal phases, the widening of approach and traffic channelization, etc. will be carried out by taking into account the traffic volume/capacity ratio and the traffic accidents rate.

Traffic Safety Facilities Plan

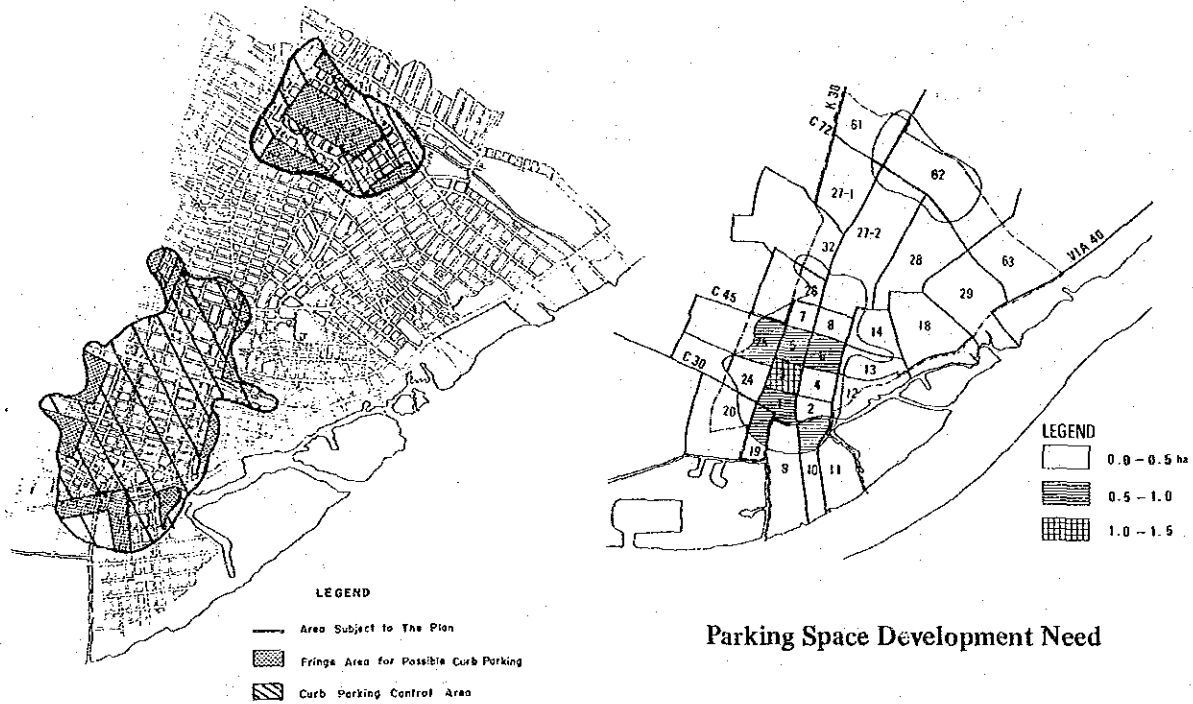
In order to secure the traffic safety of vehicles and pedestrians, traffic safety facilities will be provided particularly for the locations where vehicles and pedestrians intermingle. The facilities include pedestrian crossings, traffic signs, guard fences, road markings and reflectors.

Parking Regulation

Centro is a highly congested area with a high density of curb parking, therefore, the parking on the major streets and on the section within 100 m from an intersection should be prohibited to increase the road capacity. The prohibited area should be gradually expanded to the whole of Centro by providing off-street parking spaces and time limited control.



Intersection Improvement Plan



Curb Parking Control Area

14. PUBLIC TRANSPORT SYSTEM

Existing Problems

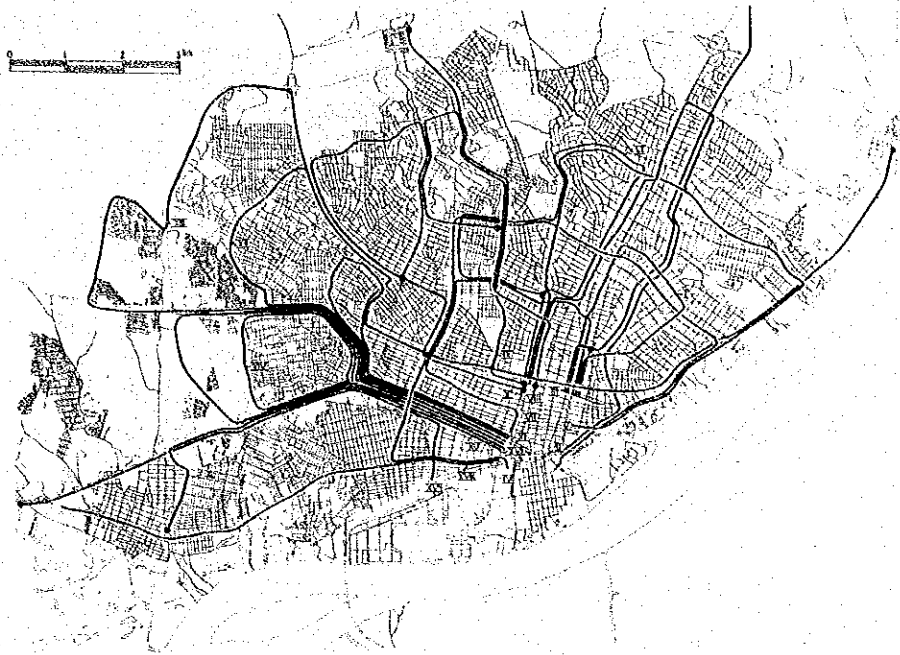
The most fundamental bus transport problem at present is the discrepancy between the passengers needs and bus services in terms of their route pattern. The existing bus routes show a centripetal pattern to the Central District, whereas a considerable number of passengers have a desire route forming a circumferential pattern; therefore those passengers may have to make a trip to Centro and make a transfer in spite of no adequate terminal facilities. This is because the bus route system has not been revised for many years, while the demand pattern has been changing in accordance with the expansion of the urbanized area. The concentration of bus routes in Centro highly contributes to the immense traffic congestion during peak hours.

The insufficient bus services in terms of frequency and coverage areas can also be pointed out. There are many bus routes where the supply of bus services does not sufficiently meet with the transport demand, particularly during the peak hours. In addition, some of the newly urbanized area are not covered by the frequent bus service network.

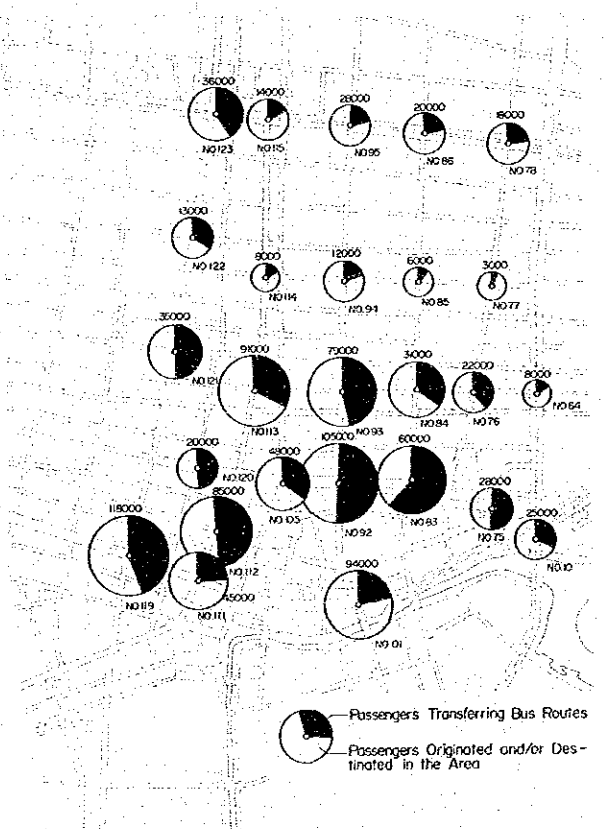
Basic Policy

The basic policy to cope with the existing problems above and to develop the public transport system toward the year 2000 is summarized as follows.

- (1) The bus routes will be reorganized to provide a better service, particularly for the passengers who now transfer from one route to another at Centro.
- (2) The bus routes should be categorized by major corridor where the bus services are provided.
- (3) For some of the trunk bus routes, an exclusive bus lane, a bus bay will be introduced if possible, so as to realize a smoother and safer traffic conditions. These spaces will be replaced by the right of way or stations for a rail transit system when it is introduced.
- (4) As for the bus re-routing in the Central District, the bus routes will be reorganized to make more effective use of road network not only for buses but also for private cars.
- (5) Two kinds of bus terminals, for the interdepartmental and intermunicipal buses, will be constructed to improve the bus service.



Integrated Bus Routes (Present)



Bus Transfer Passengers in Centro

15. PROPOSED BUS TRANSPORT SYSTEM

Urban Bus Transport System

Future urban bus transport system is proposed from the following viewpoints.

(1) Principle for Bus Routing

At present, the principle for bus routing is not clearly identified. For this reason, the existing bus routes are disorderly set up irrespective to the functional classification of streets. This is inconvenient and confusing to passengers and bus operators alike.

Accordingly the principle for bus routing is proposed as follows. At the outset, the service area is determined by each bus route. Within the service area, the bus route will cover various streets, but outside the service area, the bus route should be set up on the arterial or semi-arterial streets.

(2) Requirements from Transport Demand

As stated before, there exist a substantial transport demand in the circumferential direction. In accordance with the expansion of urbanized area, particularly with the progress in the formation of two new sub-centers outside of Circunvalar, the transport demand will have a variety of additional patterns. In order to meet this demand, the rearrangement of bus route pattern including the enhancement of the circumferential route is indispensable.

Based on the above policies, 17 bus route patterns are proposed. By applying this proposed route patterns, the percentage of the transfer passengers can be reduced. Owing to the extension of bus routes, and enhanced circular type routes, the percentage of the "transfer passengers" will decrease from about 34% in 1983 to 20% in 2000.

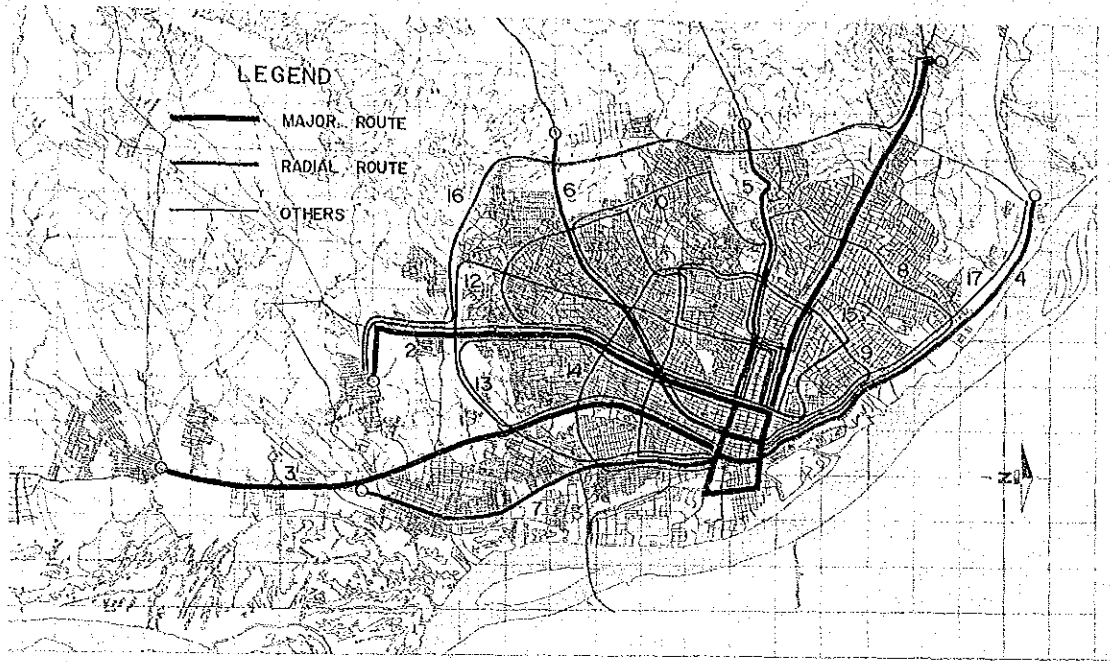
Bus Transport System in the Central District

As stated earlier, most of the streets in the Central District are already congested with buses and private vehicles. The congestion is anticipated to be more serious in the future. To cope with this problem, the following bus transport system in the Central District is proposed.

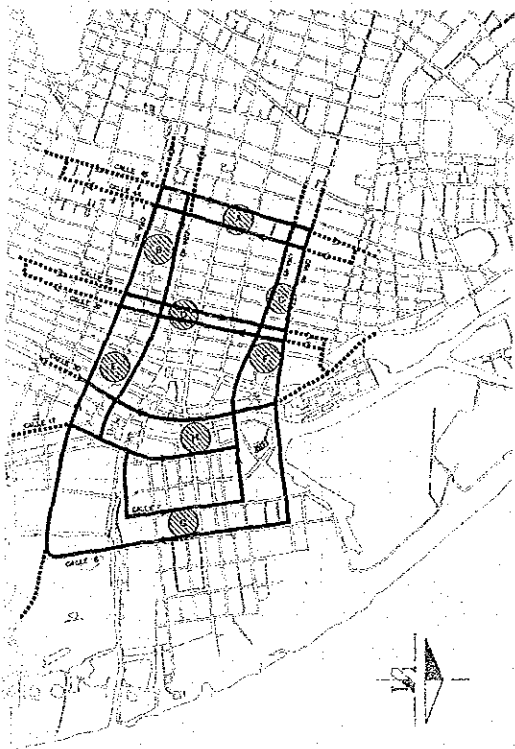
Buses travel around the Central District to serve passengers, but the route to be operated is limited to certain streets in order to reserve enough road capacity for private vehicles.

In order to ensure a smooth bus traffic flow, a pair of parallel streets will be utilized as a "one-way" bus route.

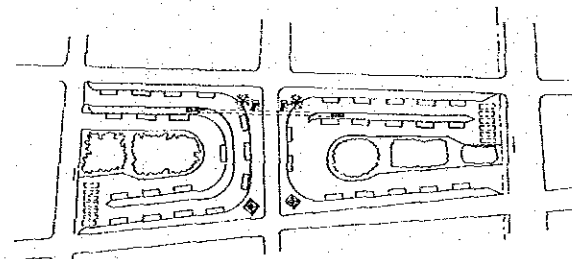
As part of this system, several Gran Paradas are proposed to be placed between the pair of bus route. The Gran Parada is one type of bus stop with exclusive space for the bus platforms and will function as the entrance and exit to/from the city center for bus passengers. It will also function as a bus stop for bus transferring.



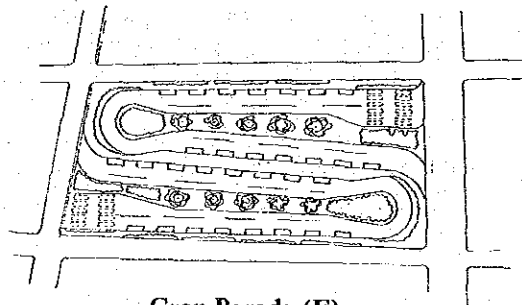
Future Bus Route Network



Bus Circular System in Central District



Gran Parada (E)



Gran Parada (F)

16. TERMINAL FACILITIES

Interdepartmental Bus Terminal

Most of the interdepartmental bus companies are located along Calle 34 with small spaces for buses. The buses must park along the roadside around the offices of the bus companies causing traffic problems in the center of the city. There is hardly any space for passengers or for bus operation.

Consequently, the relocation of the interdepartmental bus terminal is in the best interests of bus passenger service and road traffic control.

After examining the various aspects such as compatibility with the existing and future land use, accessibility, possibility of future expansion, etc., the site near the south sub-center has been selected as the best location for its construction.

The terminal is expected to accommodate about 600 buses/day in 1988 and about 900 buses/day in 2000. The total construction cost is estimated to be 326 million pesos in 1984 price (236 million pesos as Stage I in 1987 to 1989 and 90 million pesos as Stage II in 1994 to 1996) including the cost of 4.7 ha. of land to be acquired.

This project is extremely profitable under the current tariff system regulated by law. Its financial IRR would be as high as 26% and B/C ratio as 2.3. Although enough capital can easily be introduced from the private sector in such a profitable project, government participation in the management is recommended because of the public nature of the service.

Intermunicipal Bus Terminal

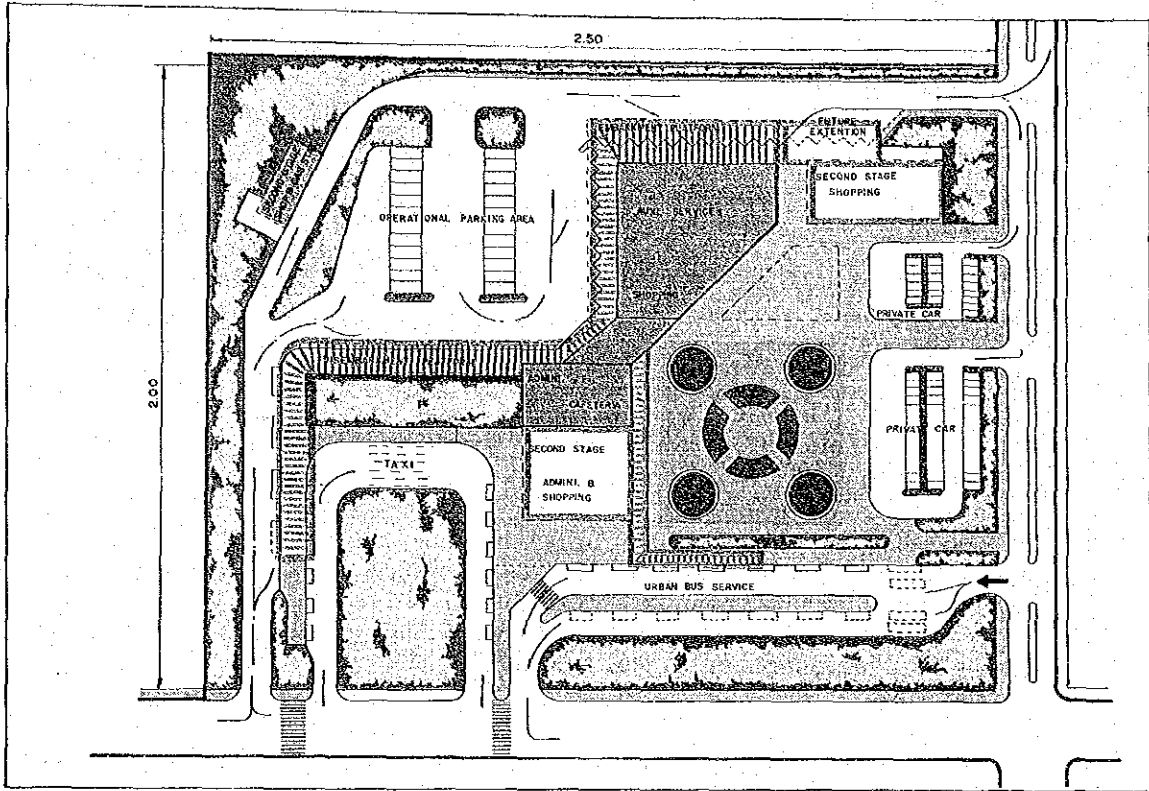
There are 9 intermunicipal bus companies, which are mainly located at Centro. Since they do not have their own terminal spaces for passengers and/or parking, Cra. 38 and the small space in front of Aguila Beer Company are used for the parking.

In order to solve the traffic problems caused by the bus parking and the roadside service for passengers, the construction of intermunicipal bus terminal is proposed. As the characteristics of the intermunicipal bus passengers are similar to those of the urban bus passengers, the location of this terminal should be near the city center.

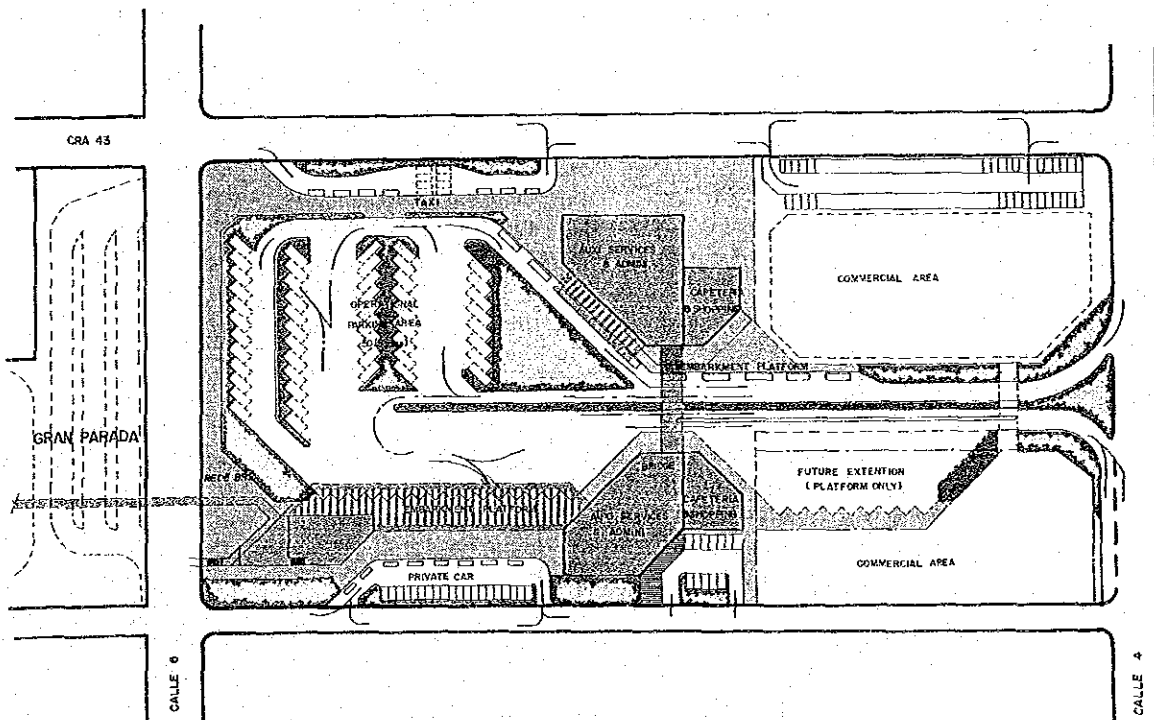
Barranquillita is the only place where a large enough site near the center can be found and the area between Calle 4 and 6 is one of the appropriate sites for the terminal. This site will also be able to connect it with the bus circular system in the Central District and the Riverside Bypass.

The construction of this project is scheduled in mid-nineties. The total cost is estimated at 246 million pesos, about one half of which is for land acquisition, compensation and site preparation.

As the financial IRR of the project would fall in the critical range of feasibility, slightly lower than 12%, a loan with favourable conditions, should be sought for the project. It is also suggested that the same entity as the interdepartmental bus terminal should manage this terminal.



Interdepartmental Bus Terminal Plan



Intermunicipal Bus Terminal Plan

17. RAIL TRANSIT SYSTEM

Necessity of Rail Transit System

The projects proposed in the masterplan mostly require land acquisition of built-up areas, as well as a large amount of investment, therefore, there may be a delay in their implementation. In this case, the transport system in Barranquilla may reach its limits much earlier than the present projection. Consequently the preparation for a rail transit system should be considered in this masterplan.

Alignment and Number of Passengers

The alignment of the rail transit is proposed to be along Calle 30 and Cra. 46, which are connecting the two new sub-centers in the south and north with the Central District, 21.3 km in total length.

The total daily number of passengers in the year 2000 is estimated to be about 292,000 for the whole line and about 130,000 for the maximum section. Route I (Centro-South Sub-Center) has more demand than Route II (Centro-North Sub-Center), although the operational length of both routes are nearly the same. Therefore Route I is given a higher priority. To accommodate, this transport demand, the rail transit to be considered is of intermediate type such as the monorail or light-rail systems.

Investment and Viability

The total construction cost of Route I (Centro-Soledad) rail transit of 10.1 km long is estimated at 20,600 million pesos (at 1984 prices), or 1,980 million pesos per kilometer. Assuming that the uniform tariff of the rail transit be 20 pesos per ride, slightly higher than the current urban bus tariff of 15 or 16 pesos, the first year revenue would amount to 1,578 million pesos in the year 2000. In the same year the expenditure will be 516 million pesos, leaving a current net income of 1,062 million pesos. The financial IRR is calculated at only 6.4% and B/C ratio is 0.51.

The less profitable project could, however, be viable, if any one of the following conditions is satisfied.

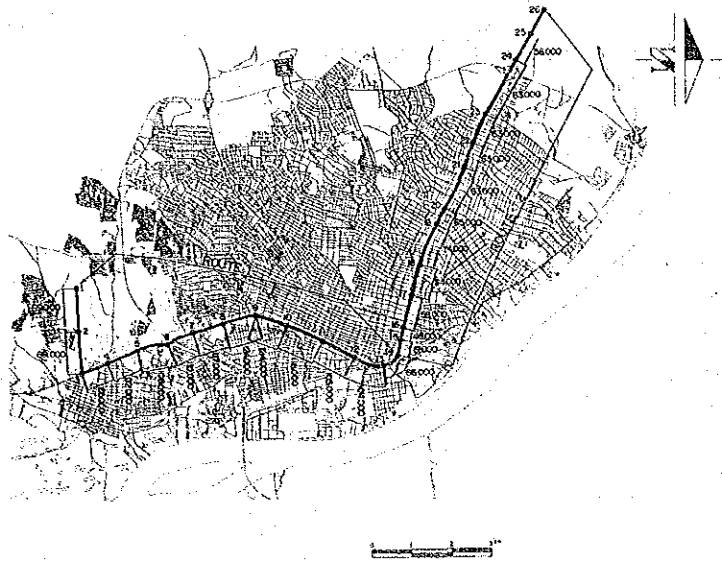
- A higher tariff can be applied as the result of future rise in citizens' income (For example, higher than 35 pesos per ride)
- In case soft loan is available. (For example, below 5% of interest rate)
- In case high inflation continues to lessen the burden of interest payment. (For example, the domestic inflation rate as high as 20% per annum and the foreign, 6%)
- In case sufficient owned capital is available. (For example, more than 45% of owned capital ratio)

Even if the above conditions are satisfied, the participation or subsidies by the central or local government would be required, since the project might not be profitable.

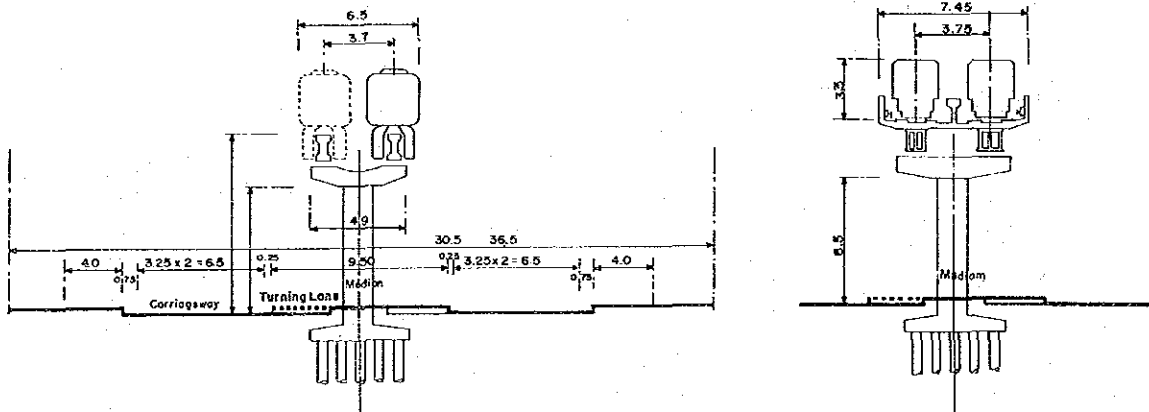
Recommendations

To cope with the future necessity for a rail transit in the Barranquilla Metropolitan Area, there is need to prepare and preserve the space for the rail transit and to control the urban development so as to be consistent with, at least, not in conflict with the future rail transit system. More specifically, the following actions are recommended.

- To determine the route and locations of the stations and a yard.
- To coordinate the urban development in Centro, especially in and around the future Central Station with the rail transit plan.
- To study the citizens' willingness to pay for rail transit, modal preference and adaptability to the rail transit service.
- To designate an organization responsible for abovementioned work.



Route of the Rail Transit



Proposed Cross Section with Rail Transit

Characteristics of Rail Transit System

Total length of rail line	20.5 km (Route 1: 10.4 km, Route 2: 10.1 km)
Number of stations	26.0 (Major station; 5, standard; 21)
Average station interval	Approx. 800 m.
Train operation	A crew of 3 (2 motorman and conductor) Standard operating system
Number of passengers	Total passengers; 292,400 passengers/day Max. passengers; 129,900 passengers/day in a section
Number of cars in a train	4 cars
Max capacity of train	Approx. 880 passengers
Train operating interval	5 minutes
Schedule speed	28 km/hr
No. of cars required	80 cars (20 trains)

18. LAND USE PLAN FOR CENTRAL DISTRICT

Urban Renewal Policy

The Central District was once the very focus of urban activities. Changing conditions and the concentration and accumulation of major urban functions in the district led to the stagnation of activities, traffic congestion, and environmental degradation.

In the context of the future development of the region, the district is expected to be the most important core for urban functions. To meet this, a renewal policy is established as the framework for future urban functions, transport and the environment of the district.

- (1) Urban functions, primarily those of business and commerce, have to be reinforced and expanded to form a regional center for the revitalization of business activities, including the civic center. As for commercial functions, up-grading is essential. Services for daily life have to be relocated as much as possible to local sub-centers for easy access to the people. More resident population has to be housed in the District.
- (2) A safe and rational transport system has to be realized in the District. Major targets are the rearrangement of street systems, systematization of public transport, introduction of pedestrian network, and reorganization of traffic control system including the installation of parking space.
- (3) Environmental deterioration of the channel has to be resolved and integrated with an open space system to be created in close relation with the pedestrian network. The storm sewer system has to be provided as the basis of future reinforcement of urban activities.

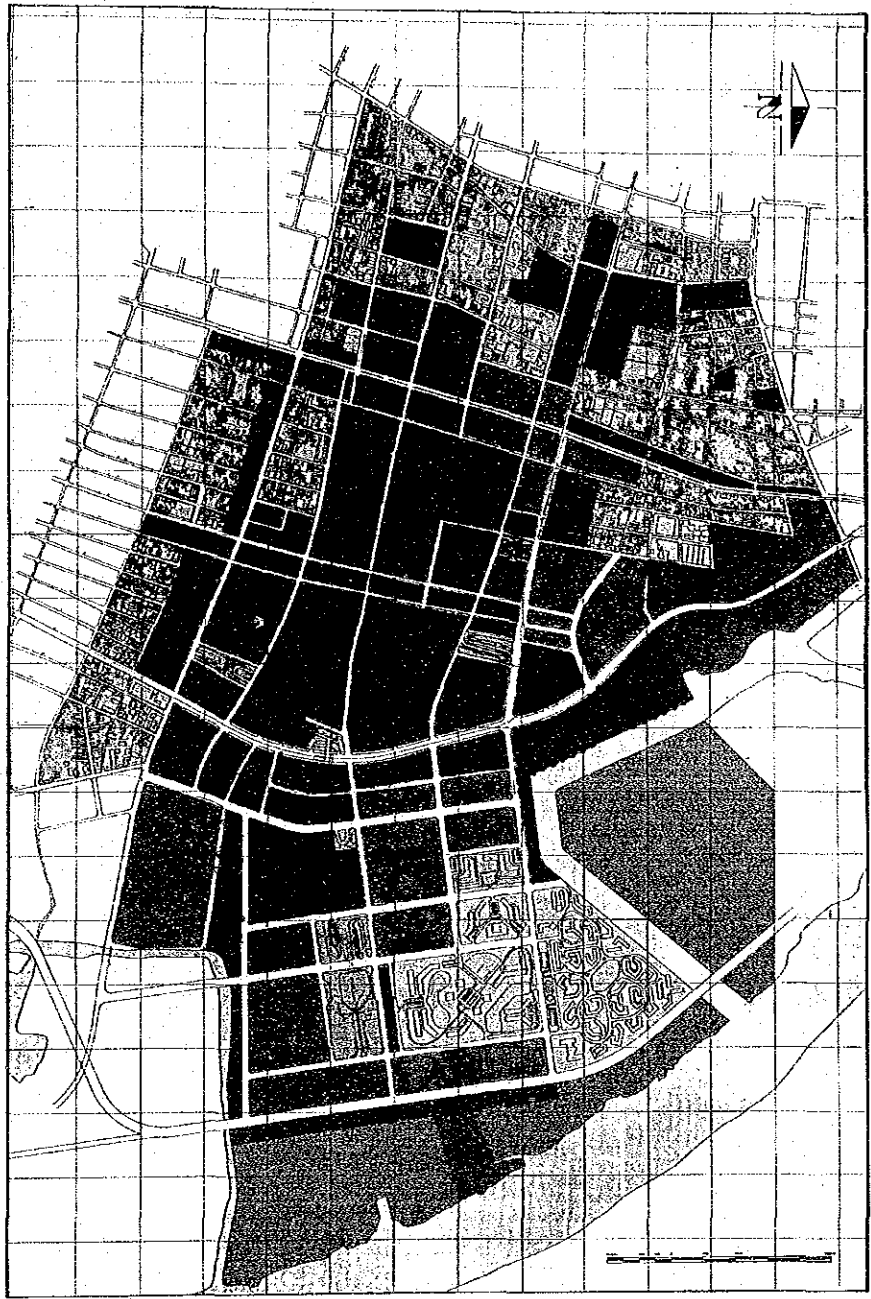
Reorganization of Spatial Structure

The renewal policy requires a drastic reform of the spatial structure of the District. Barranquillita with low-intensity land use has to be developed and integrated into the reorganization of the District. For this, it is vital to introduce an east-west activity axis through the district connecting with a regional transport network. Various activities will be developed on this axis to form the major activity center of the region.













Land Use Concept

The land use concept will emerge from the future framework of the population and employment in the District, the land use density study, and the idea of spatial restructuring. As a whole, the resident population and employment will increase up to 1.5 times that of 1983, and the land use density will be intensified according to the local features of the areas. In Barranquillita, major changes in commercial and industrial land use are proposed.

- (1) Residential land use should be maintained with environmental improvement. New housing areas must be established in Barranquillita.
- (2) Commercial land use is kept and intensified in Centro with a renewal action. The market areas in Barranquillita will be rearranged in the south-west part.
- (3) Business land use will be extended (including the civic center) to the west and north, and the area along the channel will be converted into a high-intensity business property.
- (4) Industrial land use will be rearranged in Barranquillita in the south-east part, and the existing major industrial use will not be transferred outside Barranquillita area.
- (5) Green space is extensively introduced to form a system integrated with pedestrian network.



LEGEND

- | | | | |
|---|-----------------------------|--|------------------|
|  | Residential |  | Institutional |
|  | Residential (Mixed) |  | Industrial |
|  | Commercial |  | Transport |
|  | Mixed (Commercial+Business) |  | Urban Park |
|  | Business |  | Sports Park |
|  | Public Administration |  | Reserve Greenery |

Land Use Plan (2000) in the Central District

19. RENEWAL PROJECT AREAS

Selection of Project Areas

To realize the overall renewal, the Central District is divided into two parts: one is the "renewal project areas", and the other is the "renewal guidelines and/or control areas". The former covers the areas where renewal projects are executed by some renewal measures, while the latter covers the areas to be renewed through various planning guidelines or control methods.

The physical conditions have been checked throughly in terms of land use, infrastructures and building conditions to identify the gap between existing problems and renewal policy or future land use idea. Several criteria are established to identify the project areas such as the following:

- (1) Some problems are identified or foreseen in and around the area.
- (2) Change or intensification of land use will take place to conform with the principal urban functions in the Central District.
- (3) Spatial rearrangement is required to improve the street network system in the Central District.
- (4) Some study or project relevant to the renewal of the area is under way.
- (5) Public or quasi-public land is preferably located in and around the area for the public sector's easier involvement in the renewal process.

Features of Project Areas

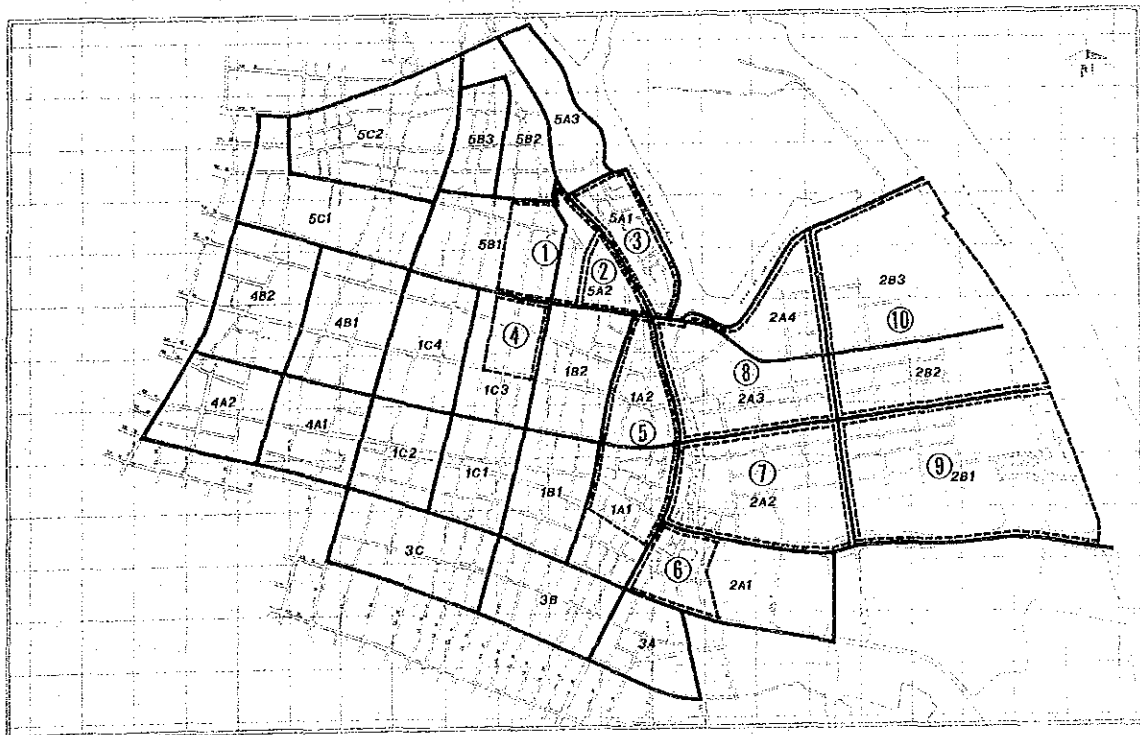
As the result of the selection of areas, 10 areas of some 168.7 ha. in total are identified as the project areas. The major features of these areas in terms of the present situation and the future image are as follows:

- (1) Project Area 1: The present land use is the mixture of residential – commercial – industrial activities including some old buildings. Major factors affecting the renewal are the restoration of the old custom house, and the widening of Cra. 46 and conversion of alignment of Cra. 50. The future function of the area is mainly up-graded business.
- (2) Project Area 2: At present, the area has low-intensity land use with warehouses and others. An urban park is proposed as one of the principal open spaces in the district.
- (3) Project Area 3: The area is to be changed over from the existing squatter zone to a business core facing the waterfront of the channel.
- (4) Project Area 4: The existing civic center will be expanded and redeveloped to meet the future demand for public services. One of the Gran Paradas will be integrated with this area.
- (5) Project Area 5: The area is the old commercial and business center of Barranquilla with several buildings worth restoring. Widening of Calle 30 causes spatial rearrangement along it, and commercial function will be reactivated with the introduction of pedestrian network and open space.
- (6) Project Area 6: The present mixture of commercial and industrial activities will be reorganized spatially with the converted Calle 17.
- (7) Project Area 7: The deteriorated channel, mixture of market and industry and vacant land are the features of the area. The converted Calle 17, the change over of the channel to open space, and the relocation of the market function into the area are the major factors of the renewal.
- (8) Project Area 8: The area features are almost the same as the area (7), but the major renewal targets are the creation of business and housing functions with the new alignment of Cra. 46.
- (9) Project Area 9: The area is mostly vacant and will be the site for the relocation of industries in Barranquillita. The inter-municipal bus terminal is proposed in the area.
- (10) Project Area 10: With the relocation of existing industries and using vacant land in the area, a new housing development is proposed.

Physical Conditions by Sub-Division

Zone No.	Land Area (sq.m)	Land Use				Average Lot Area (sq.m)	Infrastructure						Building			Unit Land Value (p/sqm)	
		Land Use Ratio (%)					Road Density (m/ha.)	Bad Road Ratio (%)	Atrotyo Road Ratio(%)	Water Supply	Sewerage Service	Poor Drainage	Av. Area (sq.m)	Build Area Ratio(%)	Old Building Zone		
		Residen	Commer	Indust	Vacant												
1A-1	150,171	0.0	84.3	1.6	5.2	486	253.4	34.0	28.1	o	o	•	412	84.8	•	3,400	
1A-2	101,215	0.0	71.4	3.6	4.9	940	295.9	12.5	30.1	o	o	•	728	82.8	•	3,970	
1B-1	133,978	0.0	82.6	7.1	1.7	580	259.0	16.4	27.6	o	o	•	455	78.5	•	5,030	
1B-2	151,515	0.4	74.8	5.8	7.9	593	233.8	—	29.5	o	o	•	486	82.6	•	6,020	
1C-1	116,940	14.5	52.0	4.3	6.4	456	286.0	3.9	26.2	o	o	•	323	70.9	•	2,820	
1C-2	117,931	20.0	39.3	9.0	6.3	470	254.8	—	45.4	o	o	•	349	54.2	•	2,160	
1C-3	138,899	11.5	30.6	6.6	5.5	700	240.5	—	41.0	o	o	•	368	53.7	•	2,370	
1C-4	145,180	15.2	36.4	7.6	11.4	648	212.8	—	25.9	o	o	•	332	52.6	•	2,700	
2A-1	225,211	0.4	16.2	78.9	0.4	1,709	163.6	14.5	17.5	o	o	•	811	47.4	•	940	
2A-2	273,116	0.4	2.8	22.5	43.1	1,833	173.9	3.7	—	o	x	•	655	46.4	•	980	
2A-3	196,255	0.7	46.3	22.4	23.4	2,353	239.5	25.3	—	o	x	•	1,077	46.0	•	980	
2A-4	115,241	0.0	10.8	62.7	16.8	7,746	167.9	—	—	o	x	•	2,481	32.0	•	710	
2B-1	467,051	10.0	0.8	25.2	44.5	1,792	78.0	79.9	—	o	x	•	126	7.0	•	480	
2B-2	204,466	0.0	0.0	59.7	22.5	5,708	111.0	37.7	—	o	x	•	1,169	41.4	•	440	
2B-3	339,833	0.6	0.0	20.4	79.0	17,316	43.6	—	—	o	x	•	265	2.7	•	300	
3A	109,286	49.5	15.0	10.7	7.4	452	259.4	57.1	16.4	o	o	•	239	65.2	•	900	
3B	151,194	21.2	44.8	10.6	3.2	374	272.3	19.7	28.5	o	o	•	210	51.7	•	640	
3C	182,986	47.9	14.7	14.5	7.7	411	225.4	—	14.5	o	o	•	210	51.7	•	640	
4A-1	132,288	23.0	18.2	11.2	4.1	503	236.2	—	16.8	o	o	•	245	48.7	•	1,880	
4A-2	148,843	39.3	5.4	13.8	1.7	540	221.0	5.3	44.7	o	o	•	215	39.8	•	2,320	
4B-1	180,278	9.4	32.3	10.9	17.0	1,216	186.8	6.6	37.2	o	o	•	433	55.4	•	2,850	
4B-2	182,488	23.5	11.6	15.7	15.3	955	193.2	6.4	19.6	o	o	•	331	54.6	•	2,890	
5A-1	110,588	55.5	5.0	3.6	13.1	185	368.6	58.5	18.0	x	o	•	66	35.7	•	630	
5A-2	99,171	1.8	12.5	41.1	2.2	536	235.5	—	27.0	o	o	•	571	37.4	•	1,910	
5A-1	88,549	0.0	12.7	45.0	0.0	5,116	88.7	—	41.4	o	o	•	2,013	39.4	•	740	
5B-1	188,503	35.7	12.8	26.0	7.7	464	226.0	3.3	23.2	o	o	•	241	53.4	•	1,690	
5B-2	107,475	7.7	8.3	25.0	2.7	1,501	288.9	35.4	28.5	o	o	•	398	59.2	•	1,000	
5B-3	84,873	65.3	7.1	22.7	5.8	331	314.0	46.5	75.1	o	o	•	156	48.9	•	1,380	
5C-1	206,964	73.0	19.7	11.4	25.0	732	194.2	3.0	18.7	o	o	•	252	34.8	•	2,410	
5C-2	241,337	78.0	7.2	7.5	5.0	305	270.1	36.4	23.8	o	o	•	120	40.3	•	1,510	
TOTAL	5,091,945	17.4	22.3	22.6	19.6	746	199.5	20.3	27.3				310	40.3		1,705	

Source: IGAC, JICA Note: • = Below Average, o = Good, x = Bad, * = Identified.



Sub-Division of Central District and Project Areas

20. RENEWAL PLAN

The renewal plan focuses on the public facilities in the project areas. However, as to the development of some infrastructures which will be the basis of the reorganization of the urban structure, the whole planning area is taken into account.

Infrastructure

(1) Street System

The functional street network is composed of four categories of streets; arterial, semi-arterial, collectors, and local. The arterial and semi-arterial streets are the existing Calles 17 and 30, Cras. 38, 46, and 50, and the proposed riverside bypass. With the widening or new alignment of some of the streets, they will form the skeleton of the reorganization of the new spatial structure. The collectors are integrated with the future bus circulation routes and will be developed with widening Local streets are those other than arterial, semi-arterial and collectors.

(2) Arroyo Measures and Drainage

Water inflow in the Central District (down to the east from Calle 45) is prevented by changing the Arroyo routes on Calles 47 and 59, and Cras. 25 and 65. However, on account of the limited capacity of the installed box culvert along these streets, reservoirs are provided for temporary holding. For rainfall in the District, gutter drainage systems are provided, leading the water to a channel. In Barranquillita a drainage system is installed at the same time when land preparation is implemented in the area.

(3) Other Infrastructures

A water supply system has to be expanded and a sewerage system newly introduced.

Public Facilities

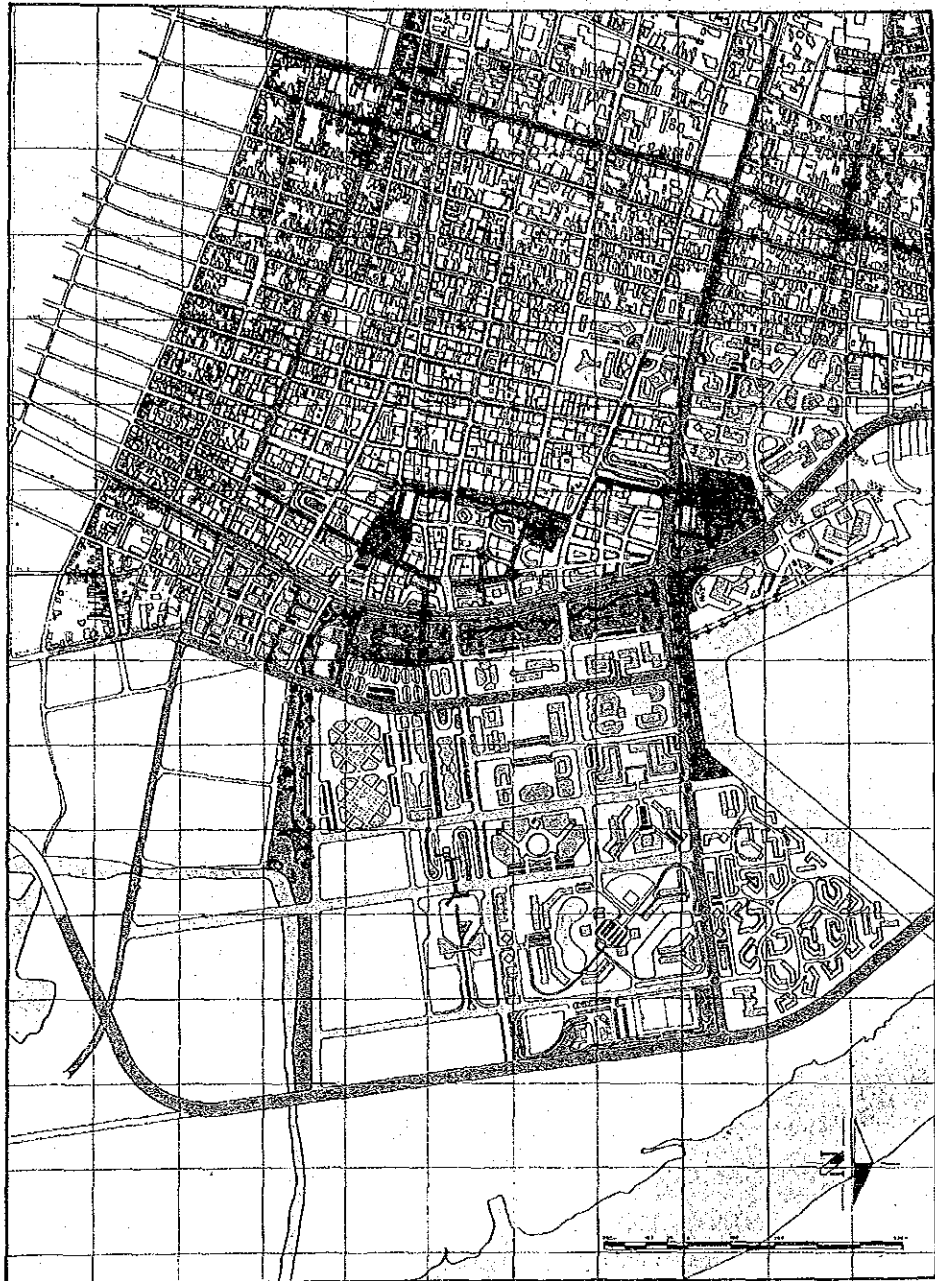
(1) Park and Greenery System

The park and greenery system is intensively introduced in the plan. This is an important factor to enhance the central district as well as to provide some recreational facilities to the citizens in the very central areas of the city.







- Caño Ahuyama between Centro and Barranquillita is converted to a park through the reclamation of the channel. Some water stream will be created as an improved urban landscape factor. The park will also serve as a major pedestrian mall.
- An urban park is proposed at the corner of the intersection of Cra. 46 and Calle 30. This will be the principal urban park of Barranquilla. Public events can be performed here.
- Paseo Bolivar is rearranged in the interest of the driving public as well as pedestrians.
- A public sports park is created in Barranquillita along the Riverside Bypass near the housing development.
- Green spaces are provided in the area between the Magdalena River and the Riverside Bypass, due to the fact that land use needs will not cover the whole Barranquillita area at the present, but rather necessitate to reserve the land for future use.

(2) Pedestrian Network

A pedestrian network is proposed to be integrated with the park and greenery system and to connect the location of major activities center and proposed Gran Paradas.



LEGEND

	Arterial & Semi-Arterial Street		Public Greenery
	Collector Street		Plaza
	Pedestrian Space		New or Renewal Building

Renewal Plan

21. RENEWAL MEASURES

To ensure the implementation of the idea of the urban renewal, some new measures have to be introduced. In general, land purchase or expropriation has been a principal measure to carry out urban renewal. This would impose too much burden on the executing agency whose financial resources are rather limited. This is one of the reasons why renewal actions are apt to fall into stagnation. Two procedures are introduced to ease the difficulties of land purchase or expropriation.

(1) Replotting (or Land Substitution) System

In a specific urban area undergoing development of infrastructures, public facilities such as roads and parks are developed or improved through replotting land and rearranging the shape of land. Each landowner or leaseholder is solicited to offer a portion of his land on some equitable terms in order to create land for public facilities or share in the financial costs of development. This land acquisition is justified because of the substantial increase in land value due to the improved public facilities and ordered sites.

(2) Right Conversion (or Exchange of Property Rights) System

This system is a further development from the replotting system. Following the clearing of an area, buildings are constructed along with improvement or up-grading of public facilities. Existing property rights on land and buildings are equitably converted to the newly arranged and improved land and buildings.

Thus, generally speaking, the replotting system rearranges land, and the right conversion system takes care of the three-dimensional redevelopment of built-up areas. However, for the successful program, a combined system should be considered.

Application Directions

- (1) Although 10 project areas are established, they are considered to be one project area in the application of the replotting system. This is due to: a) In order to provide public facilities (mainly parks) a wider area has to be considered as project area so that smaller land reductions from each lot of land could result; b) Replotting of land will take place in a wide area (remote replotting) due to relocation of urban functions.
- (2) The replotting system will be applied also to those areas where the widening or realignment of streets will affect the area, and where the shape of the blocks is due to be changed.
- (3) The combined system can be applied to the area where the lots are relatively small and/or where the properties do not expect to participate in the redevelopment actions. Through the replotting system, landowners will be persuaded to change their positions. Following that, the appropriate conversion system can be adopted for three-dimensional rearrangement of the area.
- (4) Public land can facilitate the replotting of private land. In this regard, special attention has to be paid to clear the squatter area and regain public tenureship.
- (5) As to the areas where replotting system is extensively applied (areas 7, 8, 9, 10), new measures must be introduced to ensure the realization of land use idea, through the construction of suitable buildings.

Summary of Possible Renewal Measures by Project Area

Area No.	Area Features		Related Project	Possible Renewal Measures
	Present	Future		
1 (12.86 ha)	Mixture of industrial commercial and residential land use: Old buildings and smaller lots.	New business blocks around the custom house.	1. Realignment of Cra. 50. 2. Restoration of the custom house.	Combination of the replotting and Right Conversion System (Replotting for easier execution of the Right Conversion System).
2 (4.59 ha)	Larger lots for industrial warehouses and bus facilities.	Principal urban park.	1. Realignment of Cra. 50. 2. Widening of Cra. 46 and Calle 30.	Replotting to convert the land tenureship from private to public.
3 (9.79 ha)	Squatter area on public land (national).	Business, commercial and cultural complex (intense land use on the water-front).	1. Squatter-clearance.	Squatter-clearance with integration to other housing development on renewal scheme, and land subdivision with infrastructure development.
4 (6.04 ha)	Civic center	Regional center with open space and transport facilities.	1. Gran Parada	Expansion of public land by land replotting to get public land.
5 (20.36 ha)	Commercial center with historic and old buildings.	Redeveloped commercial center with restoration of old buildings.	1. Widening of Cll 30. 2. Restoration of historic buildings. 3. Gran Paradas.	Combination of the Replotting and Right Conversion System.
6 (8.11 ha)	Mixture of industrial, commercial and residential land use.	Redevelopment for appropriate mixed land use.	1. Realignments of Cll 17. 2. Relocation of some functions to GRANABASTOS.	Combination of the replotting and Right Conversion System (Replotting for easier execution of the Right Conversion System).
7 (29.94 ha)	Market and vacant lands with degraded channel.	Intensified market area with park.	1. Realignment of Cll 17.	Replotting market function into the area with land preparation, sewerage and drainage systems.
8 (33.23 ha)	Mainly market and industrial use with degraded channel.	New business district with possible introduction of public buildings.	1. Arrangement of Cra. 46. 2. Realignment of Cll. 17. 3. Relocation of some market function to GRANABASTOS.	Replotting to convert land use from market to business with infrastructure development.
9 (23.54 ha)	Mostly vacant land with some squatter areas.	Integrated industrial land use with bus terminal.	1. Riverside bypass. 2. Inter-municipal bus terminal.	Replotting to introduce industrial function with infrastructure development.
10 (31.42 ha)	Mostly vacant land with industrial land use.	New housing development.	1. Riverside bypass. 2. Arrangement of Cra. 46.	Replotting to introduce housing development.

Replotting of Land among Areas

AREA Nº	1	2	3	4	5	6	7	8	9	10	GCA	OTHER
1						●			●			●
2	●		●						●			
3	●			●								
4					●		●					
5							●	●				
6							●		●			●
7									●	●	●	●
8							●		●	●	●	●
9									●	●	●	●
10									●			●
OTHER	●		●					●				●

Note: (1) Black dots show the possibility of land replotting from the areas in the left-most column to the areas in the top row.
(2) GCA: Gran Centro de Abastos.

22. IDENTIFIED PROJECTS

Road Projects

The road projects will include the construction of 14 new road sections (total length of 67.0 km) and the improvement of 25 sections (79.7 km). Important new road projects are the Bypass along the Magdalena River connecting Zona Franca, Barranquillita and La Loma 1 area, and several major arterial projects to support the development of the north and south subcenters. All important improvement projects are included, in the project groups for upgrading the Circunvalar, Inner Circunvalar, two north-south corridors (Calle 30 and Ave. La Arenosa - Soledad Corridor) and two eastwest corridors (Centro-North Subcenter Corridor and Zona Franca - Juan Mina Corridor).

Drainage Projects

The drainage projects are proposed only from the viewpoint of solving traffic hindrance caused by flood in the trunk road network. Therefore, a project not listed here is not necessarily unimportant or not urgent. There are three large-scale buffer reservoir construction projects to protect Centro area from heavy rain water. Other six projects are to solve local problems at critical points and sections.

Public Transportation Projects

To facilitate urban bus service, it is recommended that an urgent project of bus bays and Gran Parada (off-street big bus stop) development projects be implemented in order to help traffic to flow smoothly and to improve service to passengers. To improve the service quality and financial conditions of the urban bus operators, the bus inspection center project is proposed as a long-term project. In addition, two bus terminals for long distance buses (intermunicipal and interdepartmental) are proposed in order to upgrade passenger's convenience, to support urban development and to provide parking spaces.

Although the present introduction of rail transit system into the Barranquilla Metropolitan Area is financially and economically premature, the rail transit projects are listed because their introduction in the future will require much preparatory work even now, as urban development and transportation facility development will be carried out.

Traffic Control Projects

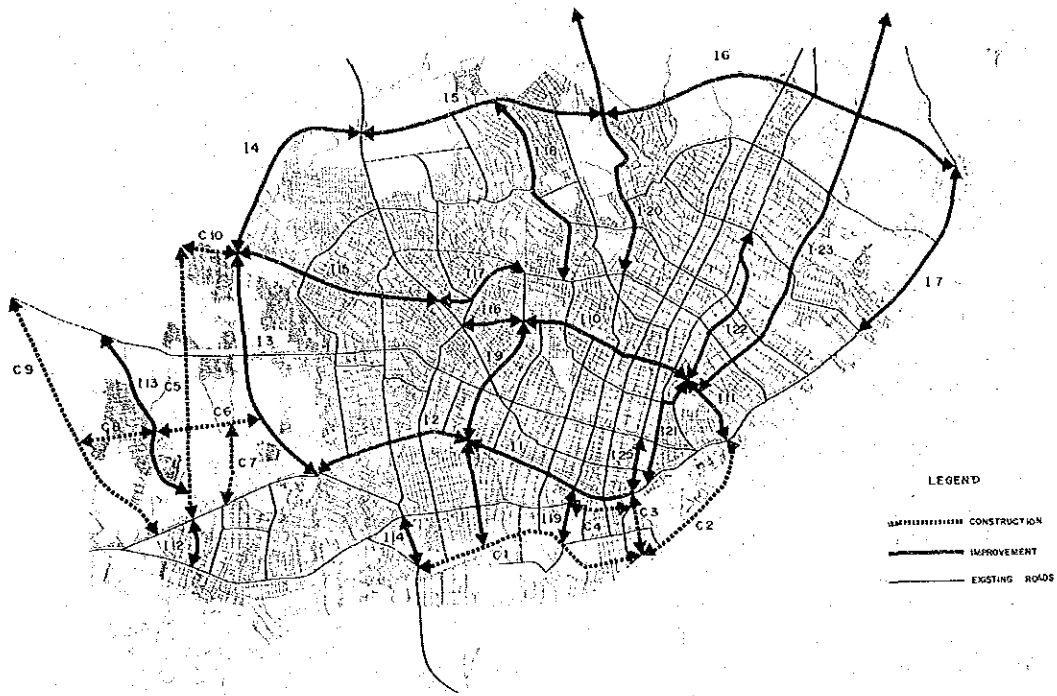
The urgent project for the 1980s includes installation of traffic signals, traffic safety devices, and parking facility development. A long term guide is also shown on signal installation, traffic control and parking plan.

Central District Renewal Project

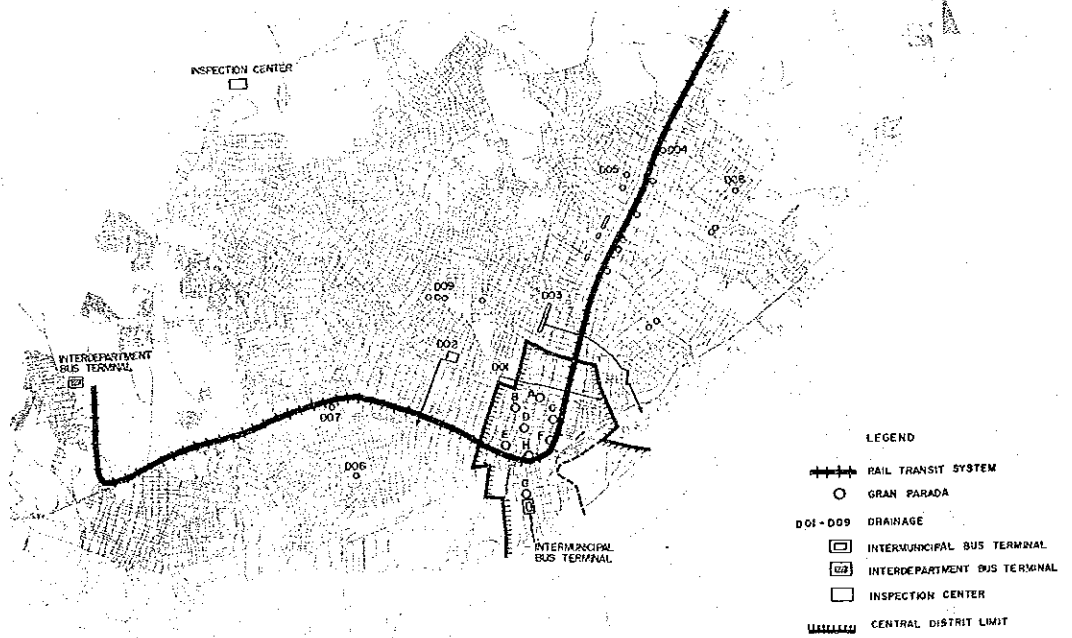
This project is a large-scale and comprehensive project comprising many project components such as street construction/improvement, canal reform, land reclamation, drainage facility construction, construction of public service facilities such as bus terminals, market and parks as well as urban development projects by private sector, most of which are inter-related and need to be well-coordinated.

Project Package

Prior to scheduling, the inter-relationship (competitive, exclusive, supplementary or inter-dependent relation) among the abovementioned functionally interrelated projects are combined into project packages for the convenience of project scheduling and evaluation.



Project Location Maps (Road Project)



Project Location Maps (Other Projects)

23. COST AND SCHEDULE

Road Projects

The total cost to realize road masterplan is estimated at 28265 million pesos at 1984 prices. Of this, 13567 million pesos or 48% will be for new road construction projects and 52% for existing road improvement projects. Foreign currency portion will be 114 million US Dollars or 45% of the total.

The basic investment scheduling is: a) Because a sudden expansion of road investment budget is difficult to expect, the investment schedule should be arranged so that funds for investment are increased gradually to keep pace with economic growth. b) The schedule must maintain a balance and harmony with other sector projects such as bus terminals and Gran Abastos (public wholesale market). c) Land acquisition and compensation for the widening projects of the existing streets in highly urbanized area will take a long time, so that the construction periods of those projects should be stretched over a long period.

Priority projects are; i) Projects to mitigate traffic congestion in Centro, ii) Projects to support and accelerate the Barranquillita development and iii) Projects to improve the Centro-south subcenter corridor. As the result, the final schedule allocates 16.5% of the total investment amount to the period of 1986 – 1990, 26.2% to 1991 – 95 and 57.3% to 1996 – 2000.

Drainage Projects

Three buffer reservoir projects will cost 4300 million pesos. Such large-scale projects as these would require a feasibility study before implementation, including careful comparative analysis with other alternative solutions from economic and technical points of view. The costs of other projects covers only facilities such as side drains and culverts on and around the related streets.

The three reservoir projects should be scheduled in the early stages, being the projects to be undertaken as measures for prevention of economic stagnation of Centro area and for vitalizing the area sufficiently to realize its renewal.

These projects will take four to six years to construct. Other projects are scheduled in accordance with the timing of the related road projects.

Public Transportation Projects

The total investment amount for all projects excluding the rail transit projects is estimated at 2226 million pesos, of which 1540 million pesos of 70% pertain to eight Gran Parada projects. As the land acquisition for the Gran Parada projects will need a long time, some of them will be carried over to the next century. The interdepartmental bus terminal is scheduled for opening in 1990, and it is expected to be one of the urban core facilities in the south sub-center. However, some supplementary facilities such as commercial space will be developed during the second stage in the mid-1990s. The intermunicipal bus terminal will be developed also in the middle of the last decade keeping pace with the urban development of Barranquillita.

Construction of 21 km rail transit will require sizable amounts of money, exceeding 37 billion pesos. The foreign currency portion would be 57% of the total. Based on the result of economic and financial analysis, the realization of the entire line in this century seems to be difficult, however, the route 1 (10.4 km from Centro to Soledad at a cost of 19.9 billion pesos) appears "conditionally" feasible.

Other Projects

In this study, the traffic control projects are not scheduled because of their symptomatic treatment nature. The Central District renewal project will be continuously carried out from present until or beyond the year 2000.

Road Investment Schedule

(million pesos)

No.	Code	Project Name	Investment Amount	Economic Cost	85	90	95	2000
1	C01	Bypass I	2,174.2	1,919.3				
2	C02	Bypass II	1,686.3	1,480.1				
3	C03	Cra. 46	313.3	270.4				
4	C04	Calle 17	491.1	436.5				
5	C05	Vfa Caracolf I	619.3	556.4				
6	C06	Transversal I	133.	155.3				
7	C07	Ave. Las Moras	133.7	120.1				
8	C08	Transversal II	113.9	97.2				
9	C09	Vfa Central de Abastos	409.8	352.2				
10	C10	Calle 450 Ext.	104.2	90.5				
11	C11	Calle 45 Ext.	1,633.8	1,404.2				
12	C12	Carretera Metropolitana	3,785.9	3,272.8				
13	C13	Anillo Rural	1,354.6	1,195.4				
14	C14	Transversal Rural	608.4	523.0				
15	I01	Calle 30 I	1,376.6	1,327.1				
16	I02	Calle 30 II	301.1	264.9				
17	I03	Circunvalar I	676.9	592.0				
18	I04	Circunvalar II	404.9	401.6				
19	I05	Circunvalar III	660.9	584.3				
20	I06	Circunvalar IV	1,099.8	971.5				
21	I07	Vfa 40	404.5	353.7				
22	I08	Cra. 22 I	409.4	376.7				
23	I09	Cra. 22 II	432.5	394.9				
24	I10	Ave. La Arenosa I	1,024.4	964.7				
25	I11	Ave. La Arenosa II	343.6	319.7				
26	I12	Vfa Caracolf	150.9	139.3				
27	I13	Vfa Soledad 2000	317.5	286.6				
28	I14	Acceso Pte. Pumarejo	136.9	119.5				
29	I15	Calle 45D I	1,262.6	1,182.1				
30	I16	Ave. La Arenosa III	874.2	850.5				
31	I17	Calle 45D II	504.9	424.8				
32	I18	Cra. 26-Calle 760	306.8	266.9				
33	I19	Cra. 38	190.5	167.7				
34	I20	Cra. 38 Occidente	1,027.9	879.0				
35	I21	Cra. 50-Cra. 54	1,294.2	1,239.5				
36	I22	Cra. 54-Cra. 51B	229.2	197.8				
37	I23	Cra. 60-Cra. 64	731.6	636.8				
38	I24	Carretera Oriental	258.1	220.7				
39	I25	Cra. 46 Abajo	184.9	169.7				
Total			28,264.9	25,205.4				

Drainage Projects Investment Schedule

(million pesos)

No.	Code	Project Name	Investment Amount	Economic Cost	85	90	95	2000
40	D01	Parque Universal Reservoir	1,703.8	1,524.5				
41	D02	Talle E.M.P Reservoir	1,041.4	932.2				
42	D03	Cra. 41 Reservoir	1,543.6	1,381.4				
43	D04	Cra. 46	132.0	118.4				
44	D05	Cra. 48	166.6	141.9				
45	D06	Calle 17	19.8	17.9				
46	D07	Calle 30	24.6	22.4				
47	D08	Cra. 60-Cra. 64	108.5	98.9				
48	D09	Av. La Arenosa	41.6	38.1				
Total			4,766.7	4,271.1				

Public Transportation Projects Investment Schedule

(million pesos)

No.	Code	Project Name	Investment Amount	Economic Cost	85	90	95	2000
49	P01	Urgent Projects	43.5	39.0				
50	P02	Gran Paradas	1,539.2	1,485.5				
51	P03	I. Municipal Bus Terminal	221.9	241.0				
52	P04	I. Departmental Bus Terminal 1	236.1	211.3				
53	P05	I. Departmental Bus Terminal 2	89.5	79.1				
54	P06	Inspection Center	95.3	84.9				
55	P07	Rail Transit System 1	(19,912.0)	(17,924.4)				(Conditional)
56	P08	Rail Transit System 2	(17,467.0)	(15,722.7)				(After 2000)
Total			2,225.5	2,140.8				

24. EVALUATION OF ROAD PROJECTS

Evaluation Method

The economic benefit of road projects is measured in terms of savings in the amount of vehicle operating cost (VOC) and of travel time cost (TTC). The benefit of the road masterplan as a whole is expressed by the difference between the aggregate VOC and TTC when the masterplan is completely carried out according to the schedule and those when the present road network is left as it is without any additional investment (do nothing case). The economic benefit of each road project group is expressed as the increment of VOC over TTC resulting from the exclusion of the project group from the masterplan.

Vehicle Operating Cost and Travel Time Cost

The components of VOC are classified into those which are proportional to the distance driven (running cost) and those which are proportional to running time (vehicle time cost). Unit cost for these were studied in Barranquilla. The result shows, for example, that for a passenger car the running cost is 7.72 pesos and the time cost is 43.32 pesos in 1984.

The present labour productivity in Atlantico is estimated to be 169 pesos per hour. The same amount was adopted to value the travel time of commuting trips and business trips. However, small fractions of saved time less than five minutes have been considered negligible.

Evaluation of Road Masterplan

The total investment amount of 28265 million pesos at market price is equivalent to 25205 million pesos at economic price. The residual values of the constructed and improved facilities with this investment will be 14715 million pesos at the end of the year 2000. Therefore, the depreciated amount in this century is 10490 million pesos, which is regarded as cost in the course of economic evaluation. On the other hand, benefit in 2000 will reach to about 1200 million pesos and accumulated benefit until 2000 to 58111 million pesos, of which 74% will come from VOC saving and 26% from TTC saving.

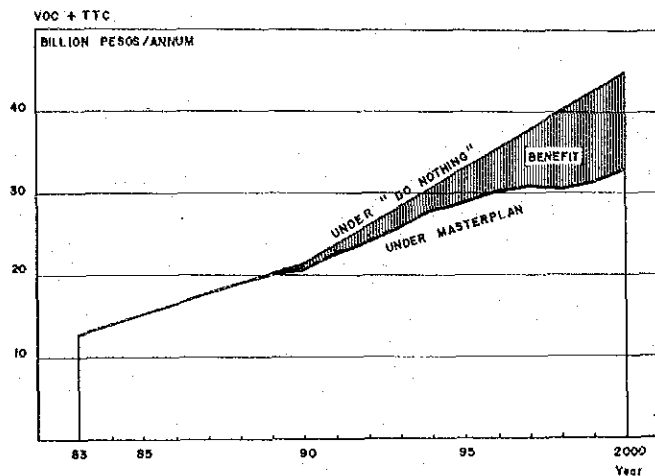
Discounting the cost and benefit stream at the rate of 12%, the net present value amounts to 8138 million pesos and B/C ratio is 2.9 which proves economic soundness of the masterplan. The masterplan will become economically unfavorable when the construction cost unexpectedly rises by 2.9 times which seems unrealistic.

The internal rate of return (IRR) of 39.7% is also high, but this indicator is not necessarily suitable to the evaluation of such a project since the works under this masterplan involve expenses which are continuously being incurred simultaneously with benefits throughout the entire period of analysis.

Evaluation of Project Group

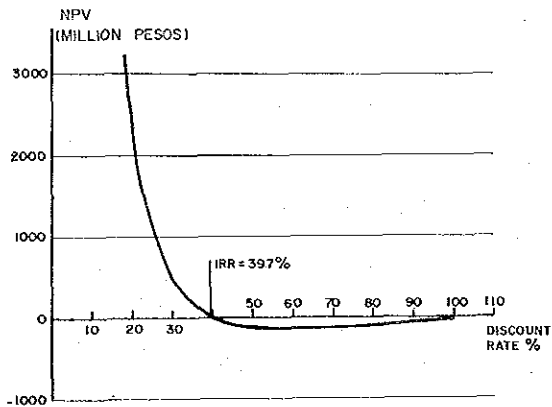
Whole new road construction projects and whole road improvement projects show more or less the same extent of favorable feasibility. Separated into the periods of investment, the project group implemented prior to 1996 shows a higher investment efficiency than the later group. This fact proves the soundness of the masterplan schedule.

Projects with a geographical proximity and functionally related with each other are grouped together for evaluation, and all such groups have proven feasible. Particularly favorable are Centro-South Subcenter Corridor package and Circunvalar package. Relatively low investment efficiencies are shown by Inner Circunvalar package and Juan Mina Corridor package which need high land acquisition and compensation costs.



Benefit of Road Masterplan

Year	Benefit (Million pesos)
1988	43.0
1989	60.0
1990	753.0
1991	1,568.0
1992	2,053.0
1993	2,619.0
1994	3,154.0
1995	4,165.0
1996	5,201.0
1997	6,737.0
1998	9,494.0
1999	11,141.0
2000	11,999.0



Net Present Value and Internal Rate of Return

Evaluation of Road Master Plan

B/C	2.89	---
N.P.V.	8,137.0	(Million)
I.R.R.	39.7	(%)

Evaluation of Road Projects

No.	Project Package	Construction Period	Construction Cost		Indicators Evaluation		
			Financial	Economic	B/C	NPV	IRR(%)
0.	Master Plan as a whole	1987-2002	28,265.9	25,204.4	2.89	8,137.0	39.1
	Sensitivity I (20 up of Cost)	1987-2002	33,917.9	30,246.5	2.40	7,274.0	33.8
	Sensitivity II (20 down of traffic)	1987-2002	28,264.9	25,205.4	2.51	7,529.0	35.2
1.	New road projects	1987-1998	6,223.5	5,478.0	3.58	5,017.9	45.1
2.	Road improvement projects	1987-2000	14,400.1	13,111.3	3.46	6,861.2	54.7
3.	Projects during 1987-1995	1987-1995	8,875.5	8,044.8	4.41	10,601.8	52.3
4.	Projects during 1996-2000	1996-2000	11,748.1	10,544.5	2.06	1,192.9	23.9
5.	Centro development roads	1987-1997	8,154.1	7,394.7	2.78	4,600.8	36.1
6.	Inner Circunvalar	1996-2000	3,084.1	2,906.5	1.57	345.2	21.8
7.	Circunvalar	1993-2000	3,300.4	2,903.1	4.82	1,050.9	74.6
8.	Centro-South subcenter	1987-1995	6,260.6	5,541.4	6.35	11,383.9	63.7
9.	Arenosa-West Soledad Corridor	1991-2000	4,113.9	3,832.3	1.78	545.6	28.8
10.	Centro-North Subcenter Corridor	1994-2000	2,439.9	2,243.8	2.74	1,155.6	37.1
11.	Juan Mina Corridor	1991-2000	2,176.6	1,917.5	1.53	59.7	20.5
12.	Centro & Adjacent area roads	1987-2000	11,238.6	10,301.2	3.44	7,796.5	46.9

Source: Study Team

25. FINANCIAL EVALUATION

Interdepartmental Bus Terminal

The bus terminal will have several kinds of revenues, tolls on bus passengers, tolls on buses, rental of commercial facilities, fees for advertisements, baggage storage charges, and so forth. The total revenue in the first year of operation (1990) will amount to 299 million pesos at 1984 prices, while the same year's current expenditure will be only 32 million pesos. After 17 years, the accumulated balance will reach 1673 million pesos, far exceeding the investment amount of 326 million pesos, indicating high profitability from this project. The IRR is estimated at 26.7%, B/C ratio at 2.27.

Under the annual inflation rate of 20%, this project is viable even with a loan exceeding a 30% interest rate. It can also continue to sustain the profit sufficiently to cover the second stage investment. With a favourably conditioned loan of 24% interest rate, the project can accumulate a balance over 13,000 million pesos (1330 million pesos at 1984 prices).

Intermunicipal Bus Terminal

The first year revenue in 1996 is anticipated to be 54 million pesos, against a current expenditure of 16 million pesos, resulting in a net income of 38 million pesos (at 1984 prices). As long as the toll system based on the bus tariff is adopted, the intermunicipal bus terminal will accrue a smaller revenue than that of the interdepartmental bus terminal. Its IRR of 11.6% and B/C ratio of 0.97 are in the marginally feasible range. However, if the interest rate is 24%, and with a high inflation rate of 20%, corresponding to a real term interest rate of only 3.3%, the project can change its accumulated balance from deficit to surplus within nine years (by 2004). The maximum fund requirement will come in the sixth year after opening and is estimated at 515 million pesos (83 million pesos at 1984 prices). This project cannot be viable unless the inflation continues at the rate of more than 13% per annum.

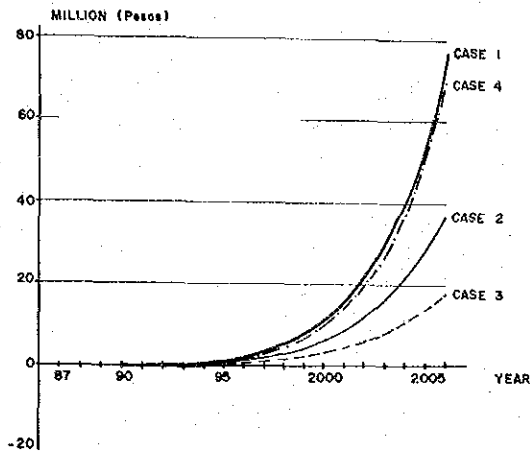
Since there is a significant difference between the profitabilities of the interdepartmental and intermunicipal bus terminals, it is worth to consider the possibility of managing both terminals by one entity in order to make their services at equivalent levels. In this case, IRR will be 23.6 and B/C ratio 1.96.

Rail Transit

The rail transit planned in the alternative network would cost 37400 million pesos at 1984 prices for the total length of 21.3 km. On the other hand, the revenue in 2000 is estimated at 1940 million pesos assuming the same level of tariff as the current bus fare. Deducting current expenditure of 940 million pesos from revenue, net income in 2000 will amount to only 1000 million pesos. Even before making detailed financial analysis, the difficulties associated with the project are very evident.

Route 1 (Centro-Soledad) with relatively large demand can accrue a net income of 740 million pesos in 2000, resulting in IRR of 4.4%. The project can be made more profitable by raising tariff, in which case the IRR of the project can exceed 12%, but only when the tariff is set at over 35 pesos per ride.

Even under more realistic tariff of 20 pesos per ride, Route 1 would be viable, although not highly profitable, cancelling the accumulated deficit in 16th year following commencement of service. This fact suggests the possibility of introducing rail transit Route 1 by the end of this century.



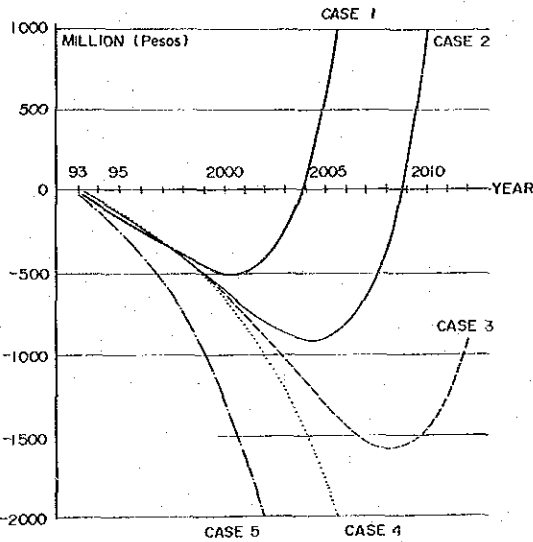
Trend of Balance Carried Forward of Interdepartmental Bus Terminal

Legend

Case	Inflation	Interest
1	20	24
2	15	24
3	10	24
4	20	30

Major Indicators of Case 1 (million pesos)

1. Investment Phase I (87-89)	236.1
2. Investment Phase II (94-96)	89.5
3. Year of clearing deficit	1,991
4. Balance in 2000	11,041.8
5. Financial IRR (%)	26.7



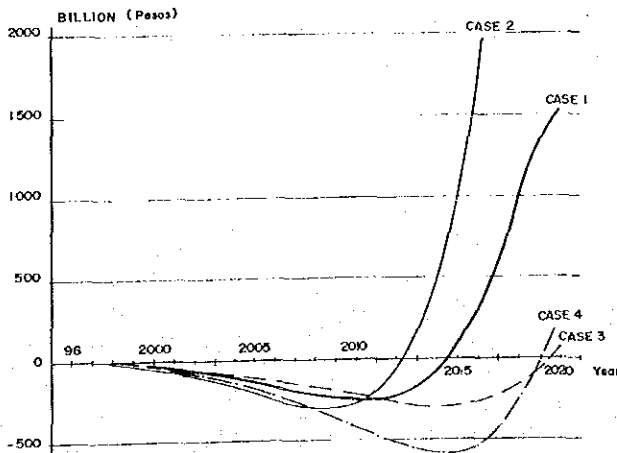
Trend of Balance Carried Forward of Inter-Municipal Bus Terminal

Legend

Case	Inflation	Interest
1	20	24
2	15	24
3	13	24
4	10	24
5	20	30

Major Indicators of case 1 (million pesos)

1. Investment (93-95)	221.9
2. Maximum deficit (in 2000)	515.3
3. Year of clearing deficit	2,004
4. Balance in 2010	9,179.6
5. Financial IRR (%)	11.6



Trend of Balance Carried Forward of Rail Transit (Centro-Soledad)

Legend

Case	Fare (\$/Ride)	Inflation Rate (%)	
		Foreign	Local
1	20	6	20
2	20	6	25
3	20	6	15
4	16	5	20

Major Indicators of Case 1 (million pesos)

1. Investment (92-99)	19,912.0
2. Maximum deficit in 2010	255,270.0
3. Year of clearing deficit	2,015
4. Balance in 2020	2,252,972.0
5. Financial IRR (%)	4.4

26. CONCLUSIONS AND RECOMMENDATIONS

Through the masterplan study, a variety of development plans in terms of land use, transport network, public transport, urban renewal were proposed. These plans should be thoroughly scrutinized and promptly authorized to define a development guideline of the Metropolitan Region.

It is also important to implement as soon as possible the proposed short term plans composed of traffic management plan, bus facilities development plan and a countermeasure plan for Arroyo.

As a whole, the concentration of various problems in the Central District have been identified. From the standpoint of transport, major traffic congestion and problems in the traffic management are common place in the District. Furthermore the public transport system is seriously in confusion in terms of the volume of buses and their routes.

These problems are closely related to the existing urban activities and environment in the District. Major urban activities, commercial and business show a tendency to flee from the District, moreover, the spatial configuration of the function are in disorder along with contamination of channels. In conclusion, the Central District has not been able to keep pace with the rapid urbanization process of the Metropolitan Region, and every aspect of urban problems is manifested in the District.

The future metropolitan development requires the Central District to be the primary regional center to undergo extensive urban renewal. This is because, from the viewpoint of reasonable regional development, more efficient regional core has to be established with appropriate creation of sub-centers.

Thus, the urban renewal in the Central District has to be a consolidated action to realize:

- 1) Revitalization of major urban activities.
- 2) Development of rational transport systems.
- 3) Improvement of physical environment.

Restructuring of the District including Barranquillita is proposed with the development of a road system, introduction of bus circulation system, measure against Arroyo, creation of open space, and other infrastructure development.

Integrating all these together, the renewal scheme in the Central District is a most significant action for the future development of the region.

To actualize the masterplan including the above renewal scheme, the following actions are recommended:

1. Establishment of New Planning Organization

All the planning aspects concerning urban development in Barranquilla are ranked behind those of other large cities in Colombia. This may be attributed to the shortcomings of the organization in charge of urban planning with close coordination with various institutions. It is our understanding that the establishment of a more effective planning office has been already proposed.

In this regard, it is recommended that this office will carry out, among others, the following functions:

(1) Planning Studies

Based on and in connection with this masterplan study, the office is expected to undertake: (a) preparations for guidelines and control system on urban development, (b) continuous studies on the various development plans in terms of more detailed analysis, preparations for their realization and so on. Special attention has to be paid to the urban renewal plan for the Central District, the introduction of a rail transit system and the Arroyo countermeasures.

(2) Information Development

For realistic planning and studies, data and maps on demography, economy, transport and land use have to be collected and compiled. In addition to ad-hoc surveys, a data collection/management system should be established permanently for their periodic up-dating.

(3) Monitoring and Review of Masterplan

A long-term masterplan must also be flexible, and needs to be revised on occasion, monitoring the current urban growth situation and the adaptability of the masterplan. In this context, the masterplan has to be reviewed at least in the early 1990s. At that time, the introduction of a rail transit would be presumably an important and realistic planning objective, especially if road development projects have been delayed for some reasons.

(4) Planning Coordination

Various problems and programs have been made and implemented without comprehensive planning concepts. Examples are housing schemes expanding rapidly to suburban areas and the decision of new bus routes without coordination among bus companies. These facts have added much to the disorderly development of the city and the region.

Accordingly, the office of the New Planning Organization has to be the center for coordination of individual plans and proposals by different entities.

2. Financial Resources

In order to realize the masterplan, it is essential to establish a solid self-sustained fund as well as to utilize the vitality of the private sector and to introduce the central government fund. In this respect, the following are suggested:

- (1) To apply the current tax system more strictly: A possibility exists to increase the tax revenue, even at the present rates, by more strict application of the tax regulations.
- (2) To apply, more strongly, the benefit principle: The primary beneficiaries of the road and bus facility development are car owners as well as inhabitants along the road, consequently in principle, the car owners and inhabitants should shoulder the costs.
- (3) To reform the current tax system: In connection with item (2) above, the current tax system should be reviewed, as necessary. Specifically the present rate of taxation being the principal source of FEI (Special Investment Fund) should be studied. In

order to make road administration more flexible, it is also recommended to commingle the tax revenue for road development, currently managed by individual local authority into a metropolitan road fund, if possible.

- (4) To establish public enterprises: New public enterprises should be set up to undertake such profitable public-type business as bus terminal and Barranquillita development. Their profits should be reinvested in public works.
- (5) To introduce new development method: Further efforts should be made to decrease the burden on the public investment, while increasing the public revenue. To accomplish this, it is desirable to look for new urban development methods such as "replotting system" and "and" right conversion method".

3. Public Relations

Well informed citizens, and cooperation on tax payments and the usage of such taxes are essential in order to carry out a large-scale urban reconstruction and infrastructure development. Consequently, citizen participation in the planning process is also important. On the other hand, the contents of a plan should be broadly disseminated through the mass-media and into appropriate concerned groups. Especially in case of urban renewal, no project could be accomplished without deepening the understanding of the directly interested people as to the purposes, method and effects of the project.

4. Feasibility Study

As the major large scale projects, the following are identified through the master plan study.

- a. Urban Renewal/Development of the Central District.
- b. Road Network Development.
- c. Development of Bus Transport System
- d. Development of Rail Transit System.
- e. Development of South Subcenter Area.
- f. Development of North Subcenter Area.

As for the projects with high priority, it is recommended to undertake a feasibility study at an early stage.

Among the above, the study related to the urban renewal/development of the Central District should be most urgently carried out since the Central District has numerous problems in its land use, transport, environment, etc., while it is expected to be the most important regional core of the Caribbean coast.

This feasibility study may involve the studies on the urban renewal scheme and the supporting infrastructural development projects such as road, canal, terminals, etc.

In order to realize the urban renewal, it is necessary for the public sector to induce and involve the private sector. In this sense, the study may also include the study on the renewal/development measures which can be effectively applied to bring saving from the public investment for its implementation.

LIST OF MEMBERS FOR THE STUDY

Coordinating Committee

- (1) Dr. Guido Borrero Durán
Alcalde de Barranquilla
- (2) Dra. Maite Fadul de Landaburo
Jefe de la División de Cooperación Técnica
Internacional D.N.P.

Technical Committee

- (1) Dr. Luis Antonio Cervantes Fajardo
Secretario de Colpuertos
- (2) Dr. Adriano Movil Arias
Director del INTRA
- (3) Capitan Pinilla Reyes Pedronel
Policia Vial
- (4) Dr. Joaquín Facio Vergara
Director del Ministerio de Obras Públicas
- (5) Dr. Hector Amarís Piñeres
Director de Transporte y Tránsito
- (6) Dr. Mario Molinares Sarmineto
Corporación Financiera de Transporte
- (7) Dra. Carmen Arévalo Correa
Gerente Empresas Públicas Municipal

Colombian Counterparts

- (1) Dr. Jaime Ujueta Smith
Secretario de Obras Públicas y Planeación
Municipal de Barranquilla
- (2) Dra. Mary Garcia de Biava
Arquitecto-Asesora Ejecutiva del Proyecto
- (3) Dr. Gabriel Arévalo Quintero
Jefe de Desarrollo Urbano del Municipio
- (4) Dr. Mario Hernandez Sanchez
Arquitecto Planificador Urbano
- (5) Dr. Armando Meza Campanella
Ingeniero de Transporte y Vías
- (6) Dr. Rafael Peña de Castro
Ingeniero de Transporte
- (7) Dr. Ricardo Fabregas Escarcia
Ingeniero Civil
- (8) Dr. Oscar Narváez Martinez
Economista
- (9) Dr. Luis Mercado Rodriguez
Arquitecto
- (10) Dr. Ramón Vides Galvan
Economista

Supervisory Committee

- (1) Professor Kazuhiro Yoshikawa
Professor of Kyoto University
- (2) Mr. Tatsuhiro Ogihara
Ministry of Construction
- (3) Mr. Hirotake Omi
Ministry of Construction
- (4) Mr. Akira Uezono
Ministry of Transport
- (5) Mr. Hisaiki Takenaka
Ministry of Transport
- (6) Mr. Kazuo Yamazaki
Metropolitan Expressway Public Cooperation
- (7) Mr. Toshio Morooka
(Japan International Cooperation Agency)

Study Team

- (1) Mr. Takeo Sato
Team Leader
- (2) Mr. Toshisada Katsurada
Coordinator/Transportation Planner
- (3) Mr. Yuji Morioka
City Planner
- (4) Mr. Kanenari Ijuin
Highway Engineer
- (5) Mr. Koichi Kaneko
Public Transport Planner
- (6) Mr. Iwane Mizuno
Land Use Planner
- (7) Mr. Kimio Kaneko
Traffic Engineer
- (8) Mr. Tetsuo Wakui
Transport Economist
- (9) Mr. Iwao Nakajima
Architect
- (10) Mr. Isao Sagae
Traffic Survey Planner
- (11) Mr. Yusuke Kajimura
Traffic Survey Planner
- (12) Mr. Masayuki Ishiya
Computer Engineer

