

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
MINISTRY OF PUBLIC WORKS
REPUBLIC OF CHILE

THE FEASIBILITY STUDY ON
THE NEW BIOBIO BRIDGE IN
THE REPUBLIC OF CHILE



Final Report

October 1994

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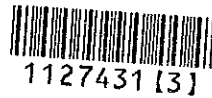


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Note

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applied in this report :

US\$ 1.00 = Ch\$ 431 = Yen 105

Ch\$ 1.0 = Yen 0.243

(As of December 1993)

Ch\$: Chilean Peso

Preface

In response to a request from the Government of the Republic of Chile, the Government of Japan decided to conduct a feasibility study on the New Biobio Bridge and entrusted the study to the Japan International Cooperation Agency(JICA).

JICA sent a study team to Chile two times between October 1993 and July 1994. The study team was headed by Mr Junji Yasui and composed of members of Chodai Co.,Ltd and Nippon Koei Co.,Ltd.

The team held discussions with the officials concerned of the Government of Chile, and conducted field surveys at the study area. After the team returned to Japan, further studies were made and the present report was prepared.

I hope that this report will contribute to the promotion of the project and to the enhancement of friendly relations between our two countries.

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

October 1994



Kimio Fujita
President
Japan International Cooperation Agency

Mr. Kimio Fujita
President
Japan International Cooperation Agency

Dear Mr. Fujita

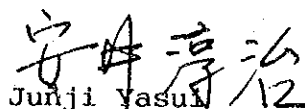
We are please to submit to you the Final Report for the Feasibility Study on the New Biobio Bridge in the Republic of Chile. The report contains the advice and recommendations of the authorities concerned of the Government of Japan and your Agency. Also included are comments by the Ministry of Public Works and authorities concerned of the Republic of Chile. The report consists of an Executive Summary, a Main Report and Drawings.

The study include a site survey for the traffic demand over the Biobio river and the investigation of existing bridges crossing Biobio river in Concepcion. Base on the site survey, an optimal route for the new bridge is selected.

From the feasibility study, the upgrading of the existing Biobio bridge is not recommended and construction of new Biobio bridge on the selected route is judged to be highly feasible, and the project should be commenced as soon as possible.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs, the Japan Public Highway Corporation and the Musashi Institute of Technology. We also wish to express our deep gratitude to the Ministry of Public Works and the Government agencies concerned in the Republic of Chile for the close cooperation and assistance extended to us during our study. We hope this report will contribute to the development of the Republic of Chile.

Sincerely yours


Junji Yasui

Team Leader
The Feasibility Study on the New
Biobio Bridge

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CHAPTER 1 BACKGROUND AND OBJECTIVES OF THE STUDY

1.1 Background

Improvement of road transportation networks connecting production centers with shipping points or consumption centers, is currently in progress in the Republic of Chile. Development of the regional economy and promotion of exports heavily rely on road transport networks.

The bridges located along these roads are however becoming obsolete. The effects of earthquakes, river bed scour caused by the rapid flow of rivers from steep mountain slopes, the increase in transportation volume, as well as overloading, contribute to the deterioration of bridges, and create an acute need for bridge construction and maintenance.

Concepcion is one of the most important commercial and industrial areas in Chile. It is directly connected with the capital city of Santiago. Concepcion is divided into south and north by the Biobio River. The flow of traffic in the north-south direction is dependent on two bridges, the Juan Pablo II Bridge constructed in 1960, and the Biobio Antiquo Bridge constructed in the thirties.

A bridge, referred to as the Biobio Antiquo Bridge has been in existence since the thirties. This bridge has suffered serious deterioration over the years, and has undergone repairs, and maintenance. Due to the deficiencies, the MOP restricted the maximum load on the bridge to 8 tons. In the report "The Study on the Rehabilitation and Conservation Program of Bridges in The Republic of Chile" prepared by Japan International Cooperation Agency (JICA) in March 1993, this bridge was a candidate for a thorough evaluation as to its load carrying capacity, and has potential need for a replacement.

In response to the request from the Government of Chile, the Government of Japan decided to implement the Feasibility Study of the New Biobio Bridge, in accordance with the Agreement on Technical Cooperation between the Government of Chile and the Government of Japan signed on July 28, 1978.

Accordingly, the JICA, the official agency responsible for the implementation of the technical cooperation programs of the Government of Japan, was tasked to undertake the Study, in close cooperation with the authorities concerned of the Government of Chile.

Refer to Figure 1-1 for Map of the Study Area

1.2 Objectives of the Study

Objective of the study is to determine the feasibility of constructing a New Biobio Bridge. The study includes examination of the existing two bridges and analysis of the traffic volume on each bridge. The study include the selection of the best alternative route for the new bridge.

Region VIII is divided south and north by the Biobio river. Because there are few bridges across the river, the whole area of Region VIII will be influenced by construction of a new bridge. The study area is all of Region VIII . The Study includes the following items:

- Investigation of socio-economic frame of the study area.
- Study of current situations of traffic and forecast of transportation demand.
- Detailed investigation of existing bridges.
- Study of natural conditions.
- Environmental impact assesment.
- Selection of optimum bridge construction location and road improvement plan.
- Preliminary design, estimation of construction cost and economic evaluation for the optimum alternative plan, and implementation program.

Technology transfer related to design and planning of bridges will be done for the benefit of the counterparts of the Republic of Chile through the implementation of the study.

Refer to Figure 1-2 for the location of the New Biobio Bridge.

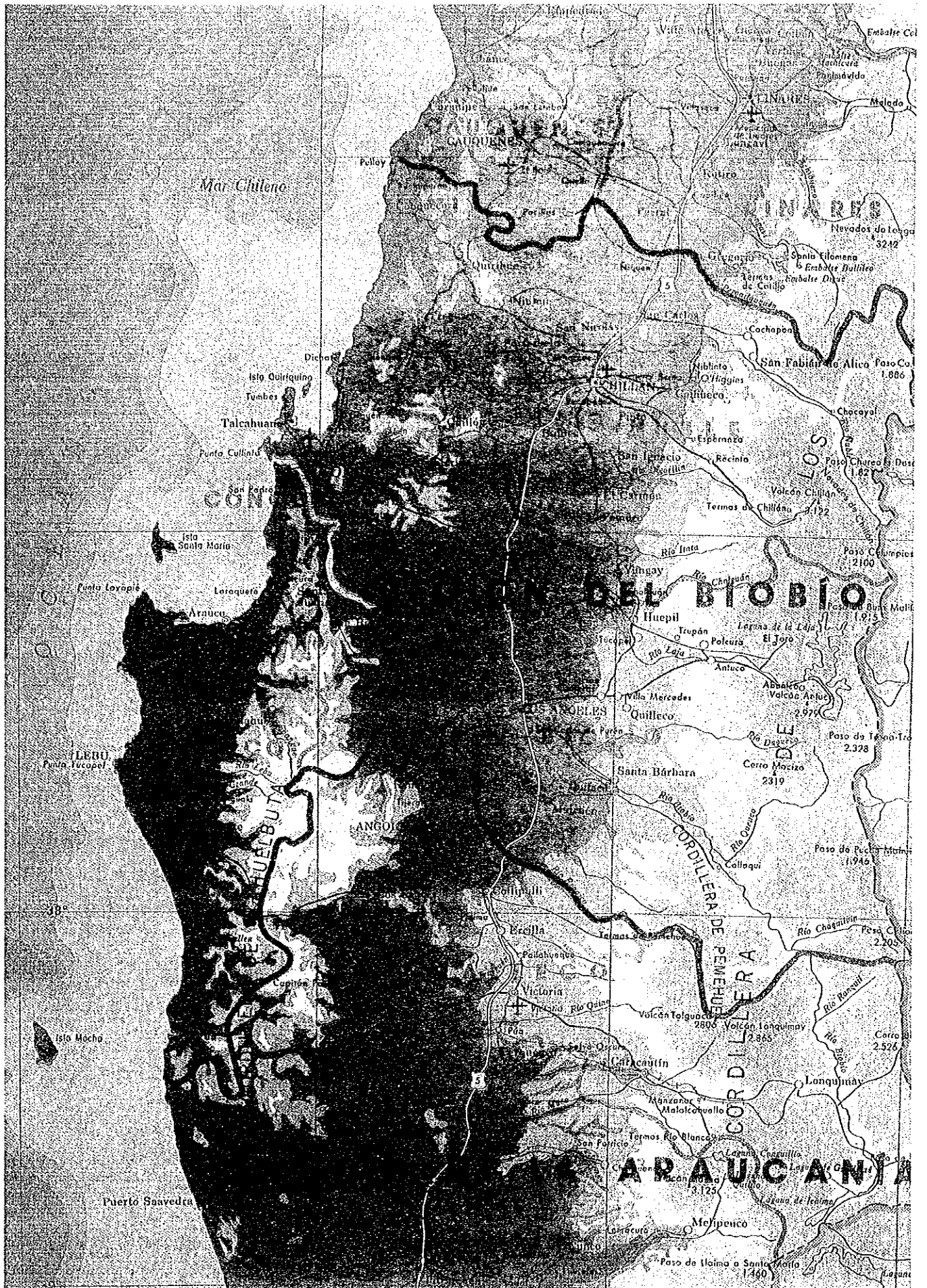


Fig. 1-1 Map of the Study Area (Biobio Province)

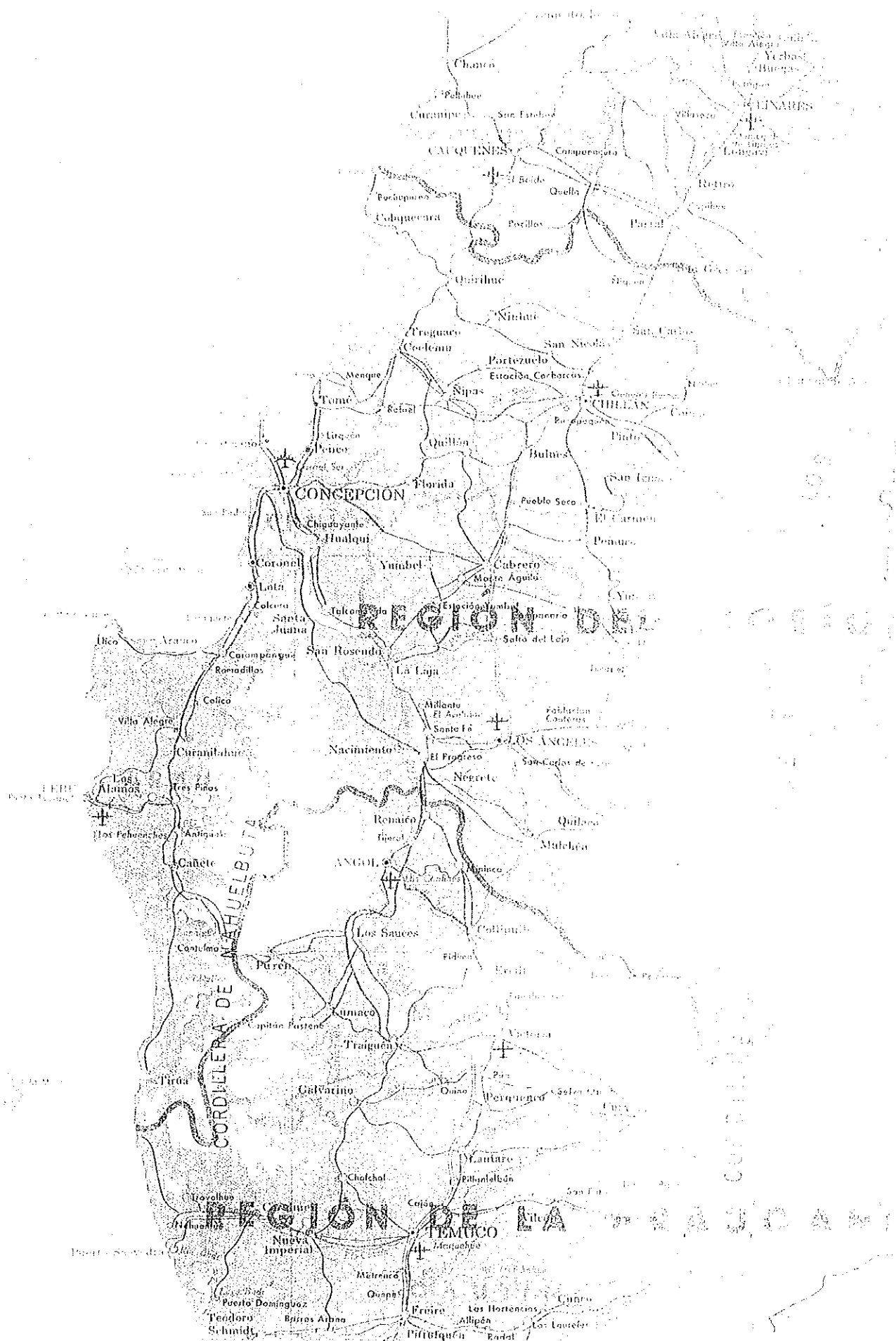


Fig. 1-1 Map of the Study Area (Biobío Province)



Fig. 1-2 Location of New Biobio Bridge

CHAPTER 2 SOCIO-ECONOMIC SITUATION OF THE STUDY AREA

2.1 Urban Structure and Socio-economic Conditions

2.1.1 Administrative Division and Concepcion Area

The Study Area (Concepcion Province) belongs to the Region VIII and consists of 9 municipalities; Concepcion, Talcahuano, Penco, Tome, Florida, Hualqui, Santa Juana, Lota and Coronel. The Metropolitan Concepcion, as used in the statistics of the INE (Instituto Nacional de Estadistica), encompasses seven (7) urbanized coastal municipalities, excluding Florida and Santa Juana.

Urbanization is proceeding from Concepcion, to the north till Tome, to the south till Coronel and to the southeast along the Biobio River till Hualqui (see Fig. 2-1). A concept of the Greater Concepcion is sometimes used as an expression of the conurbation of Concepcion area, composed of the urban area of Concepcion, Talcahuano and Penco.

The Municipality of Concepcion covers a vast extent of land including rural areas and consists of 3 districts Concepcion, Chiguayante and San Pedro. The districts of Concepcion and Chiguayante are located on the right bank of the Biobio River while San Pedro on the left bank.

As described above, there are many "Concepcion"s varying in meaning administratively or from the view point of urban structure. Hereinafter, the name "Concepcion" is used for the Municipality of Concepcion unless mentioned otherwise.

2.1.2 Zone Division

For the purpose of traffic demand projections, it is necessary to divide the Study Area into several small zones. Since the project under the Study is a new bridge over the Biobio River within the jurisdiction of the Municipality of Concepcion, Concepcion should be divided into zones of appropriate size considering the directions of traffic flow which crosses over the River. Other municipalities can be aggregated depending on their locations.

Concepcion Province is divided into 21 zones, of which 15 zones belong to Concepcion. Penco and Tome as well as Lota and Coronel are aggregated to 1 zone.

Zone numbers and corresponding administrative units or names of districts are given in Table 2-1 and Fig. 2-2.

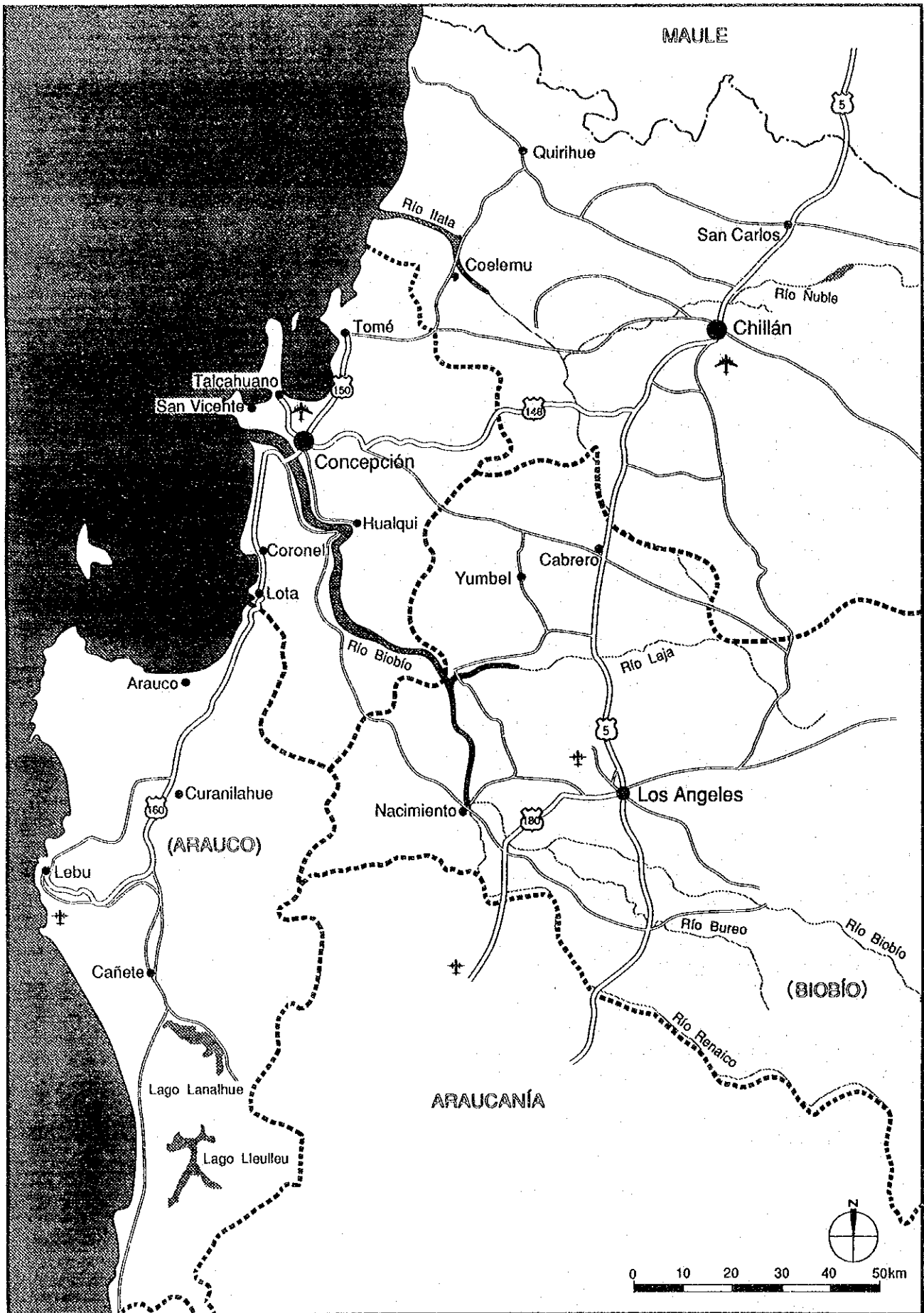


Fig. 2-1 Location and Composition of the Study Area

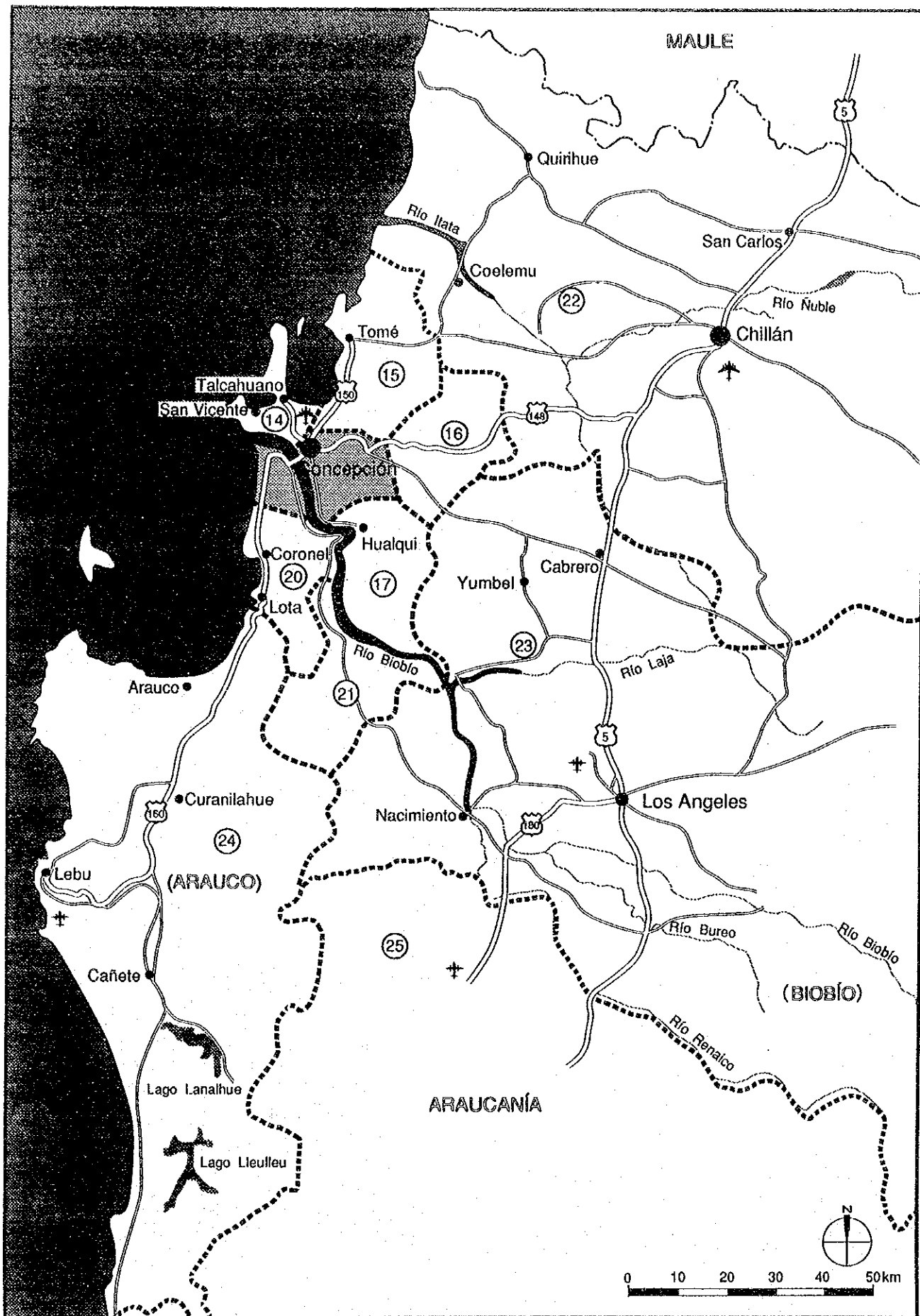


Fig. 2-2(1) Zone Division

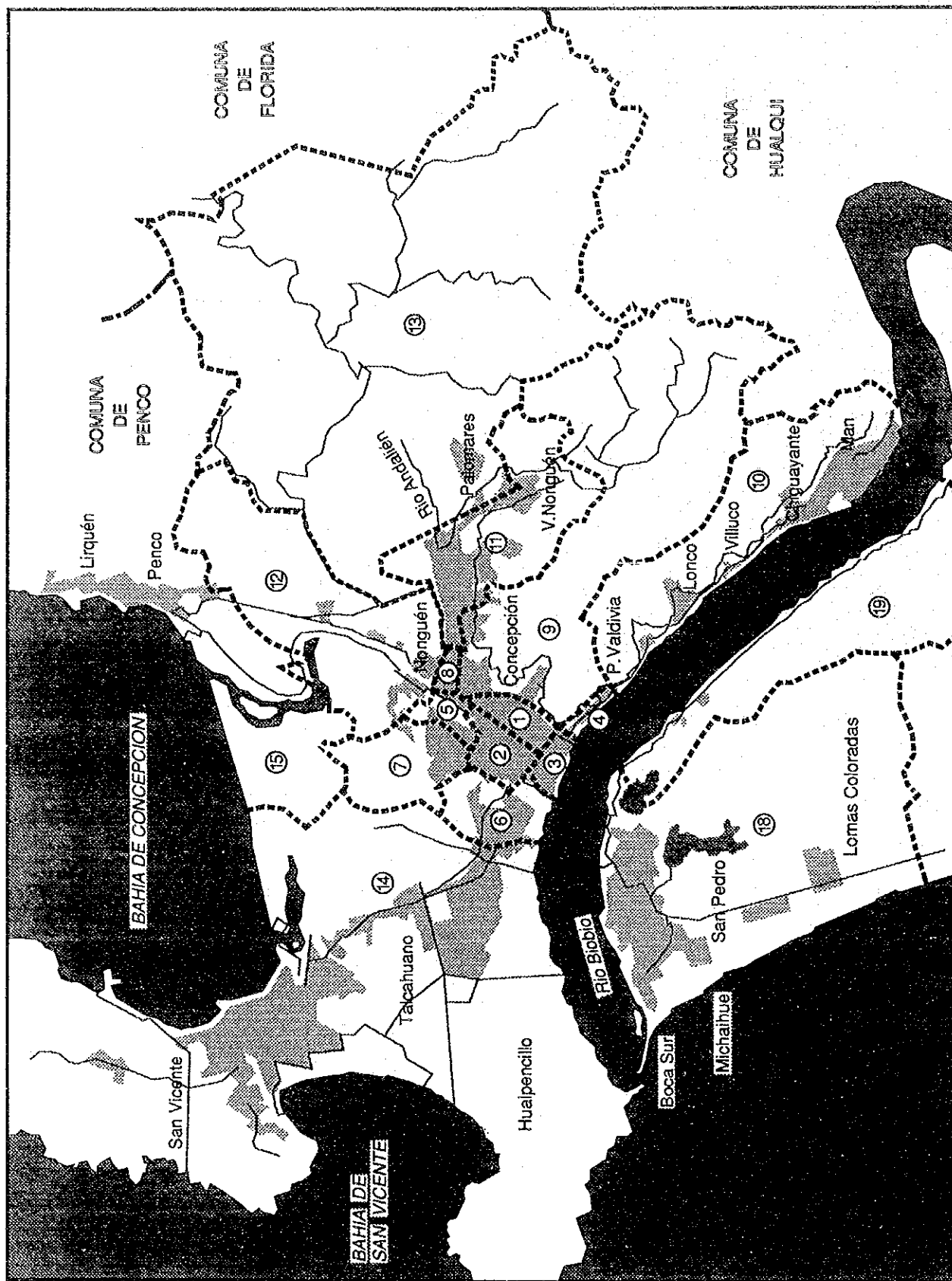


Fig. 2-2(2) Zone Division

Table 2-1 Zone Division

No. y nombre de zona	No. y nombre de distrito censal, nombre de comuna, provincia o sector
1 Centro Sur	1-Intendencia, 2-Liceo de Hombres, 3-La Carcel, 4-Plaza Espana, 21-Hospital, 22- Plaza Peru
2 Centro Norte	6-Cerro Amarillo, 7-PlazaCruz, 11-Manuel Rodriguez,
3 Costanera	12-Escuela Argentina,13-General Cruz,14-Estacion Tucapel,
4 Pedro de Valdivia	20-Plaza Condell
5 Chillancito	5-Estacion Central, 33-Bilbao
6 Lorenzo Arenas	32-Pedro de Valdivia
7 Barrio Norte	17-La Polvola, 18-Andalien 19-Poblacion Baquedano
8 Puchacay	8-Cementerio,9-Laguna Redonda, 10-Pajonal
9 Observatorio/ Agua Potable	15-Lo Mendez, 16-La Toma
10 Chiguayante	23-Puchacay
11 Larenas	24-Observatorio, 26-Agua Potable
12 Palomares	27-La Leonera, 28-Chiguayante, 29-Fabrica, 30-Matadero,
13 Rancho Grande/ Chaimavida/Las Ulloas	31-Lonco
14 Talcahuano	25-Larenas
15 Penco/Tomé	34-Palomares
16 Florida	35-Rancho Grande, 36-Chaimavida, 37-Las Ulloas
17 Hualqui	Comuna de Talcahuano
18 San Pedro	Comuna de Penco, Comuna de Tomé
19 Pinares	Comuna de Florida
20 Lota/Coronel	Comuna de Hualqui
21 Santa Juana	San Pedro, Condalaria, Spring Hill, Boca Sur, Michaihue, Loma de Coranel
22 Nuble	Pinares
23 Biobio	Comuna de Lota, Comuna de Coronel
24 Arauco	Comuna de Santa Juana
	Provincia de Nuble
	Provincia de Biobío
	Provincia de Arauca

2.1.3 Concepcion Province in the Region VIII

Concepcion Province is located in the center of the Region VIII, and although it covers only 9.3 % (3,444.5 km²) of the total area of the Region (36,929.3 km²), nearly 50 % of the Region's population is concentrated within the Province (see Table 2-2).

As shown in Table 2-3, urban population of the Region is estimated at 1,386.7 thousand, of which 830.1 thousand (60 % of the total) live in Concepcion Province. The percentage of urban population in Concepcion Province is 95.4 %, very high ratio compared with other Provinces.

The Municipality of Concepcion is the capital city of the Region VIII. Therefore, administrative organizations of the regional level in the public sector and many branch functions of private sector are located in the city.

Industrial activities, especially an industrial complex in the Municipality of Talcahuano, a coal mining zone in the Municipalities of Coronel and Lota and several numbers of large-scale factories in the Capital city also characterize the importance of Concepcion Province in economic field in Region VIII.

Table 2-2 Area, mid-year Population and Population Density by Province in Region VIII, 1993

Provincia	Superficie(1) (km ²)	Poblacion(2) (Miles de personas)	Densidad poblacional (psns/km ²)
Concepción	3.444,5	870,1	252,6
Ñuble	13.058,7	430,6	33,0
Biobío	15.005,5	333,5	22,2
Arauco	5.420,6	154,6	28,5
Region VIII	36.929,3	1.788,8	48,4

Source: (1) INE

(2) Estimated by Study Team based on 1992 Census data and data of INE.

Table 2-3 Urban and Rural Population by Province in the Region VIII, 1993

Provincia	Poblacion(Miles de personas)			Porcentaje urbana
	Urbano	Rural	Total	
Concepción	830,1	40,0	870,1	95,4
Ñuble	245,9	184,7	430,6	57,1
Biobío	206,7	126,8	333,5	62,0
Arauco	104,0	50,6	154,6	67,3
VIII Rgn	1.386,7	402,1	1.788,8	77,5

Source: Estimated by Study Team based on 1992 Census data.

Table 2-4 shows the distribution of economic establishments in Region VIII. The number of establishments in Concepcion Province is a little more than 50 % of the total for the Region, but the economic activity, in real sense, shows that Concepcion Province accounts for nearly two thirds of the Region's as described in Chapter 4.

The existence of ports, especially the port of San Vicente, makes Concepcion Province the entrance and exit of the Region to the international market. Timber, other wood products, fishmeal and so on are exported through the port of San Vicente. To activate the sluggish coal mining zone an improvement project of the port of Coronel started recently.

Concepcion Province is not only the core of economic activity but also the cultural/academic center of the Region, as there are several universities such as the University of Concepcion which gather students from all over the country.

Table 2-4 Number of Establishments by Economic Activity by Province, Region VIII, 1991

Provincia	Comercio	Servicio	Industria	Otros	Total	%
Concepción	12.059	10.117	1.521	822	24.519	51,8
Nuble	4.511	4.224	607	614	9.956	21,0
Biobío	3.581	3.585	454	344	7.964	16,8
Arauco	2.280	2.180	224	241	4.925	10,4
Región VIII	22.431	20.106	2.806	2.021	47.364	100,0

Source: 1991 Pre-census, INE

2.1.4 Urban Areas of Concepcion Province

In Concepcion Province, urban areas extend along the Pacific coast. Table 2-5 shows urban and rural populations of 9 municipalities which compose the Province.

Almost all population of Concepcion, Talcahuano, Penco, Lota and Coronel is urban, whereas in Florida and Santa Juana rural population is the majority. Hualqui is at present on the way to become a suburban city of Concepcion.

Talcahuano which is adjacent and to the north of Concepcion, and rivals Concepcion in size has two characteristics; one is being a residential area for commuters to Concepcion, the other is being an important industrial/port city contributing not only to the Region VIII but also to Chile as a whole.

Concepcion, Talcahuano and Penco form a conurbation called Greater Concepcion with a population of 634.4 thousand.

Population densities by zone in Concepcion are shown in Table 2-6. The highest zone is Zone 2 followed by Zone 1. These two zones constitute so-called Centro de Concepcion. Zones 3 and 4 are located along the Biobio River and half of their surface areas

is covered by water. Therefore, their densities are almost at the same level as Zones 1 and 2.

Table 2-5 Urban and Rural Population by Municipality in Concepcion Province, 1993

Comuna	Poblacion (Miles de personas)			Porcentaje urbana
	Urbano	Rural	Total	
Concepcion	338,3	4,4	342,7	98,7
Talcahuano	255,3	2,7	258,0	99,0
Penco	40,8	0,8	41,6	98,1
Tome	42,8	7,9	50,7	84,4
Florida	3,1	7,3	10,4	29,8
Hualqui	10,4	6,2	16,6	62,7
Santa Juana	5,5	6,8	12,3	44,7
Lota	51,7	0,1	51,8	99,8
Coronel	82,2	3,8	86,0	95,6
Total	830,1	40,0	870,1	95,4

Source: Estimated by Study Team based on 1992 Census data.

Zone 7 (Barrio Norte) is a typical residential area with a density of about 50 persons per hectare. Some parts of the Zone are already fully developed but there are still spaces for urbanization.

In Zones 9 to 19, developments are proceeding but the densities are still low even if excluding undevelopable areas of water and mountains.

2.1.5 Concentration of Establishments and Employment to Concepcion

According to the 1991 Pre-census, there are 24,519 establishments in Concepcion Province. As shown in Table 2-7, about half of them are concentrated in Concepcion. Within Concepcion there are many establishments in Zones 1, 2 and 6. In the case of Zone 6, it is because a big public market is located in the zone and each stall is counted as one establishment.

Zone 1 is the central business district and commercial center of the Region VIII, therefore many commercial and service establishments are present in the form of office buildings or shopping arcades.

Zone 2 which is located adjacent but to the north of Zone 1 has a mixture of industrial, commercial and residential land use. There are neither office buildings nor shopping arcades, only medium to small-scale factories, body shops and independent commercial stores.

Table 2-6 Area, Population(mid-year) and Population Density by Zone in Concepcion Province,1993

Número y Nombre de Zona	Superficie(1)(ha)	Población(2)	Densidad de Población (psn/ha)
1 Centro Sur	183,9 240,3	20.000	108,8
2 Centro Norte	230,4	29.500	122,8
3 Costanera	185,9	12.500	54,3
4 Pedro de Valdivia	230,4	7.800	42,0
5 Chillancito	547,2	21.100	91,6
6 Lorenzo Arenas	851,2	30.200	55,2
7 Barrio Norte	130,7	41.400	48,6
8 Puchacay	5.080,0	1.600	12,2
9 Observ./A.Potable	3.720,0	25.000	4,9
10 Chiguayante	1.710,0	58.000	15,6
11 Larenas	2.870,0	14.000	8,2
12 Palomares	12.810,0	4.700	1,6
13 R.Gde/Chai./Ulloas	7.250,0	3.200	0,2
18 San Pedro	4.030,0	71.400	9,8
19 Pinares		2.300	0,6
Comuna de Concepción	40.070,0	342.700	8,6
14 Talcahuano	14.820,0 59.870,0	258.000	17,4
15 Penco/Tome	61.320,0	92.300	1,5
16 Florida	53.460,0	10.400	0,2
17 Hualqui	41.470,0	16.600	0,3
20 Lota/Coronel	73.440,0	137.800	3,3
21 Santa Juana		12.300	0,2
Provincia de Concepción	344.450,0	870.100	2,5

Source: (1) Calculated by Study Team for Concepcion City and INE data for other cities.

(2) Estimated by Study Team based on 1992 Census data and INE data.

Table 2-7 Number of Establishments by Economic Activity by Zone, Concepcion Province, 1991

Número de Zona	Comercio	Servucio	Industria	Otros	Total	%
1	2.003	2.505	140	119	4.767	19,4
2	999	683	223	62	1.967	8,0
3	91	79	22	4	196	0,8
4	65	42	16	1	124	0,5
5	198	161	45	16	420	1,7
6	1.482	232	62	23	1.799	7,3
7	384	316	106	24	830	3,4
8	11	15	1	1	28	0,1
9	121	245	11	5	382	1,6
10	495	337	66	11	909	3,7
11	97	118	18	16	249	1,0
12	8	17	1	0	26	0,1
13	25	23	4	1	53	0,2
18	389	314	54	23	780	3,2
19	1	8	0	0	9	0,0
Concepción	6.369	5.095	769	306	12.539	51,1
14	2.097	1.713	372	197	4.379	17,9
15	1.259	1.044	129	99	2.531	10,3
16	78	146	13	8	245	1,0
17	216	193	22	12	443	1,8
20	1.919	1.763	196	179	4.057	16,5
21	121	163	20	21	325	1,3
Provincia	12.059	10.117	1.521	822	24.519	100,0

Source: 1991 Pre-census, INE

Table 2-8 shows an estimated employment distribution (number of employed persons on working place basis) in Concepcion Province. A considerable number of employed persons work at other places than the establishments mentioned above, such as farmers in rural areas, employees in the public sector and persons engaged in household service, concentration to Concepcion is a little lesser in degree than in the case of establishments.

In Concepcion, Zones 1, 2, 9 and 18 are significant in employment accumulation scale. Zones 1 and 2 together represent an employment center in the Province attracting many commuters from other zones within Concepcion and adjacent municipalities.

Zone 9 includes the University of Concepcion and some public organizations. Because the size of the zone is large, there are a considerable number of employed persons who live and work within Zone 9.

Zone 18 includes some industrial factories. Two of these factories are large-scale factories which together employ about 600 workers. Villa San Pedro is an old town in this zone, and of recent, residential developments are proceeding there. While the population is 71,400 in 1993, employed persons on living place basis count more than 22,000, about half of whom work within Zone 18.

2.1.6 Household Income

There is no published official data about household income. Fortunately through the courtesy of SECTRA, who carried out a transport survey in 1989, the Study Team obtained information about the rankings of households by monthly income. The survey area was limited to the urban areas of Metropolitan Concepcion, which are composed of Concepcion, Talcahuano, Penco, Tome, Hualqui, Lota and Coronel.

Making use of the data, average monthly household incomes are estimated as of 1993 at 1989 prices for each zone in the urban areas of Metropolitan Concepcion. Table 2-9 shows the results.

According to the table, the average monthly household income in the urban areas of Metropolitan Concepcion is 52,800 Pesos at 1989 prices.

The highest average monthly household income is 173,200 Pesos in Zone 19, where a residential development intended for high income residents is proceeding. Though not shown in the table, there are 3 very high income residential areas, such as a part of Chiguayante (Zone 10) along the Avenida Pedro de Valdivia (average 311,100 Pesos), a new residential area within Barrio Norte (Zone 7) developed along the route to the airport (average 289,200 Pesos) and a part of Zone 9 along the Avenida Pedro de Valdivia (average 288,100 Pesos). All the amounts are at 1989 prices.

Table 2-8 Employment by Zone in Concepcion Province, 1993

No. y nombre de zona	Numero de personas trabajando en la zona	Porcentaje
1 Centro Sur	37.400	13,0
2 Centro Norte	25.840	9,0
3 Costanera	3.040	1,1
4 Pedro de Valdivia	1.000	0,3
5 Chillancito	2.690	0,9
6 Lorenzo Arenas	9.650	3,4
7 Barrio Norte	8.840	3,1
8 Puchacay	2.080	0,7
9 Observ./A.Potable	14.910	5,2
10 Chiguayante	9.740	3,4
11 Larenas	3.510	1,2
12 Palomares	1.180	0,4
13 R.Gde/Chaim./Ulloas	1.170	0,4
18 San Pedro	13.250	4,6
19 Pinares	150	0,1
Comuna de Concepción	134.450	46,8
14 Talcahuano	87.640	30,5
15 Penco/Tome	19.080	6,6
16 Florida	3.550	1,2
17 Hualqui	4.900	1,7
20 Lota/Coronel	33.690	11,7
21 Santa Juana	4.190	1,5
Provincia de Concepción	287.500	100,0

Table 2-9, shows Zone 1 to be the second highest income area. There is a high income residential area next to the commercial area in this zone and shop owners with high incomes live in this residential area and the commercial area as well.

2.1.7 Vehicle Ownership

Table 2-10 shows the changes in number of registered vehicles (excluding ambulances, motorcycles, taxis, buses, tractors for agricultural use and other types of vehicles with engine) for the most recent five years, in the Region VIII, Concepcion Province and the Municipality of Concepcion.

In Concepcion Province there are 63,800 units of passenger cars, pickups and trucks in 1993, representing 57 % of the Region's total. The Municipality of Concepcion issued permits for 37,467 vehicles in 1993, which represents 59 % of the total vehicles in the Province.

The number of vehicles seems to be on a rising trend, although it is difficult to explain why the number increased sharply in 1990 and decreased in 1991.

In the Municipality of Concepcion, passenger cars represent 66 % of all vehicle registrations, while in Concepcion Province the percentage is 63 % and in the Region VIII 56 %, showing a tendency that the area is broadening and covering rural areas, with more pickups and trucks in use.

Comparing the per capita number of vehicles with Chile as a whole, which is 0.086 vehicles per person in 1992, it is 0.061 in Region VIII, 0.071 in Concepcion Province and 0.103 in Concepcion.

Table 2-11, shows the estimated household ownership rates in 1993 for the urban areas of Metropolitan Concepcion.

The average number of vehicles per household in the urban areas of Metropolitan Concepcion is 0.239, but considerably higher in the Municipality of Concepcion, 0.335.

As described in 2.1.6 about household incomes, zones with high average household income display high ownership rates. Upper income class residential areas, such as Zone 19 and other areas described in 2.1.6 show very high rates of more than 1.00.

Table 2-9 Average Monthly Household Income by Zone,
Urban Area of Metropolitan Concepcion, 1993

No.y Nombre de Zona	Promedio de ingreso mensual de hogares (pesos de 1989)	Diferencia
1 Centro Sur	158.800	3,01
2 Centro Norte	76.600	1,45
3 Costanera	41.800	0,79
4 Pedro de Valdivia	37.700	0,71
5 Chillancito	47.000	0,89
6 Lorenzo Arenas	56.400	1,07
7 Barrio Norte	46.900	0,89
8 Puchacay	109.600	2,08
9 Observatorio/Agua Potable	90.000	1,70
10 Chiguayante	47.900	0,91
11 Larenas	31.100	0,59
18 San Pedro	56.200	1,06
19 Pinares	173.200	3,28
Comuna de Concepción	64.800	1,23
14 Talcahuano	52.400	0,99
15 Penco/Tome	37.400	0,71
17 Hualqui	37.800	0,72
20 Lota/Coronel	33.700	0,64
A.U.Concepción Metropolitano	52.800	1,00

Source: Estimated by Study Team based on SECTRA data.

Table 2-10 Number of Vehicles Permitted to Use

	1989	1990	1991	1992	1993
VIII Región					
Automóvil (1)	48.345	63.190	57.654	61.088	63.400
Camioneta (2)	26.260	31.697	31.248	34.556	36.600
Camión (3)	10.701	11.154	11.657	12.509	12.700
Total	85.306	106.041	100.559	108.153	112.700
Pro.de Concepción					
Automóvil	28.537	40.709	35.411	38.370	40.200
Camioneta	11.668	16.079	14.916	16.833	18.200
Camión	4.587	4.907	5.018	5.324	5.400
Total	44.792	61.695	55.345	60.527	63.800
Com.de Concepción					
Automóvil	15.265	26.612	21.362	23.093	24.710
Camioneta	6.082	9.951	8.524	9.566	10.544
Camión	1.855	2.056	2.090	2.174	2.213
Total	23.202	38.619	31.976	34.833	37.467

Note: (1) Include station wagon and jeep.

(2) Include van.

(3) Include tractor.

Source: 1989-1992; INE

1993; Data from Municipal office for Concepcion City. For Region VIII and Concepcion Province, estimated by Study Team.

Table 2-11 Car Ownership by Household in the Metropolitan Concepcion

No. y nombre de zona	No. de vehiculos por hogar
1 Centro Sur	0,813
2 Centro Norte	0,418
3 Costanera	0,215
4 Pedro de Valdivia	0,108
5 Chillancito	0,203
6 Lorenzo Arenas	0,263
7 Barrio Norte	0,227
8 Puchacay	0,550
9 Obser. y Agua p.	0,490
10 Chiguayante	0,203
11 Larenas	0,239
18 San Pedro	0,299
19 Pinares	1,243
Comuna de Concepción	0,215
14 Talcahuano	0,215
15 Penco y Tome	0,143
17 Hualqui	0,108
20 Lota y Coronel	0,084
A.U. de Concep. Metro.	0,239

Source: Estimated by Study Team based on SECTRA data.

2.2 Development Trend of Concepcion Area

2.2.1 Population Increase

Estimated population increase trend by zone is shown in Table 2-12.

Population of Concepcion Province is increasing at an annual rate of 1.62 %. As the capital city, Concepcion is growing at a higher rate of 1.96 %.

Two (2) zones of "Centro" show population decrease, specifically where old houses are being gradually demolished and new commercial buildings are replacing them. On the other hand, suburban areas such as zones 8, 9, 11, 12, 18 and 19 are showing a rapid growth of population.

2.2.2 Development Plan and Projects

For the basic land use for Concepcion there are two land use regulation plans. One is "Plan Regulador Metropolitano de Concepcion", which is an inter-municipal plan for the urban areas of Concepcion, Talcahuano, Penco and Hualqui. The other is "Plan Regulador de la Comuna de Concepcion" for the Municipality of Concepcion. The inter-municipal plan covers general land use, whereas the municipal plan intends to control land use through more detailed quantitative regulations for each use. See Fig.2-3.

These plans were prepared and enforced at the beginning of the 80s and are still in force today. The authorities (the Municipality of Concepcion, and the Ministry of Housing and Urban Development) are working to make a new plan. The Mayor of

Concepcion stated that the new regulation plan will be made public during 1994.

Urbanization are progressing almost along the regulation plan, but in some sections, especially at the north bank of the Biobio River, squatters have created high density and unsanitary residential areas.

There are not so many development projects, which will have a great impact on the urban structure of Concepcion. Excluding transport related projects (which are described elsewhere in this report), the following should be taken into consideration:

1. A redevelopment project for the long belt zone along the north bank of the Biobio River,
2. Rebuilding of the Central Public Market
3. A shopping mall development at the clover leaf interchange of J.Alessandri Avenue with Autopista a Talcahuano.
4. Real estate development projects near Laguna Grande and Laguna Chica in San Pedro.
5. An industrial zone developed along the road to Cabrero

Table 2-12 Population Increase by Zone, 1982-1993

No. y Nombre de Zona	Población		Tasa anual de Crecimiento (%)
	1982	1993	
1 Centro Sur	24.100	20.000	-1,68
2 Centro Norte	32.200	29.500	-0,79
3 Costanera	10.500	12.500	1,60
4 Pedro de Valdivia	6.400	7.800	1,81
5 Chillancito	19.300	21.100	0,81
6 Lorenzo Arenas	27.500	30.200	0,86
7 Barrio Norte	32.900	41.400	2,11
8 Puchacay	600	1.600	9,33
9 Obser. y Agua p.	17.800	25.000	3,14
10 Chiguayante	48.100	58.000	1,72
11 Larenas	6.300	14.000	7,53
12 Palomares	2.600	4.700	5,53
13 R.Gde, Chai. y Ull.	6.500	3.200	-6,24
18 San Pedro	41.800	71.400	4,99
19 Pinares	200	2.300	24,86
Comuna de Concepción	276.800	342.700	1,96
14 Talcahuano	211.100	258.000	1,84
15 Penco y Tome	82.600	92.300	1,01
16 Florida	10.700	10.400	-0,26
17 Hualqui	15.400	16.600	0,68
20 Lota y Coronel	121.400	137.800	1,16
21 Santa Juana	11.500	12.300	0,61
Prov. de Concepción	729.500	870.100	1,62

Source: Estimated by Study Team base on INE data.

The redevelopment of the north bank of the River is gradually being realized. A committee composed of regional offices of related Ministries, the Regional Government and the Municipality of Concepcion started to work for making an implementation plan focused on sections 3 and 4 (the place where the planned new bridge of this Study will be constructed). The plan includes an improvement of residential area with infrastructures and a formation of new governmental and commercial center. See Fig. 2-4.

The rebuilding of the Central Public Market is now at the stage of negotiations between the Municipality and stall users.

The shopping mall is called Plaza del Trebol with a total floor area of 40,000 m² in two levels, developed on a vast site of 150,000 m². There would be two department stores, 120 specialty shops of national and international brands, a food court composed of 16 first-class restaurants and a super market. The parking capacity for visitors is 4,000 vehicles. The number of persons employed permanently would be 2,000 persons. The number of visitors is estimated at 1,000,000 persons per month. The inauguration is scheduled to be in April of 1995.

The development projects in San Pedro are seven middle to high-class residential areas planned around Laguna Grande and Laguna Chica. A part of the first project named Parque del Lago which is located along the road to Santa Juana is already completed and 77 lots are sold out. The other 200 lots will be supplied in three years. The lot size ranges from 900 m² to 3,000 m². The other six projects will start after 1995 and the total number of planned housing units is 6,820 units (corresponding to a population increase of 30,000 persons).

The industrial zone is at present partially occupied, but is expected eventually to be fully used, since the location is good and there are not so many other places where industries can locate.

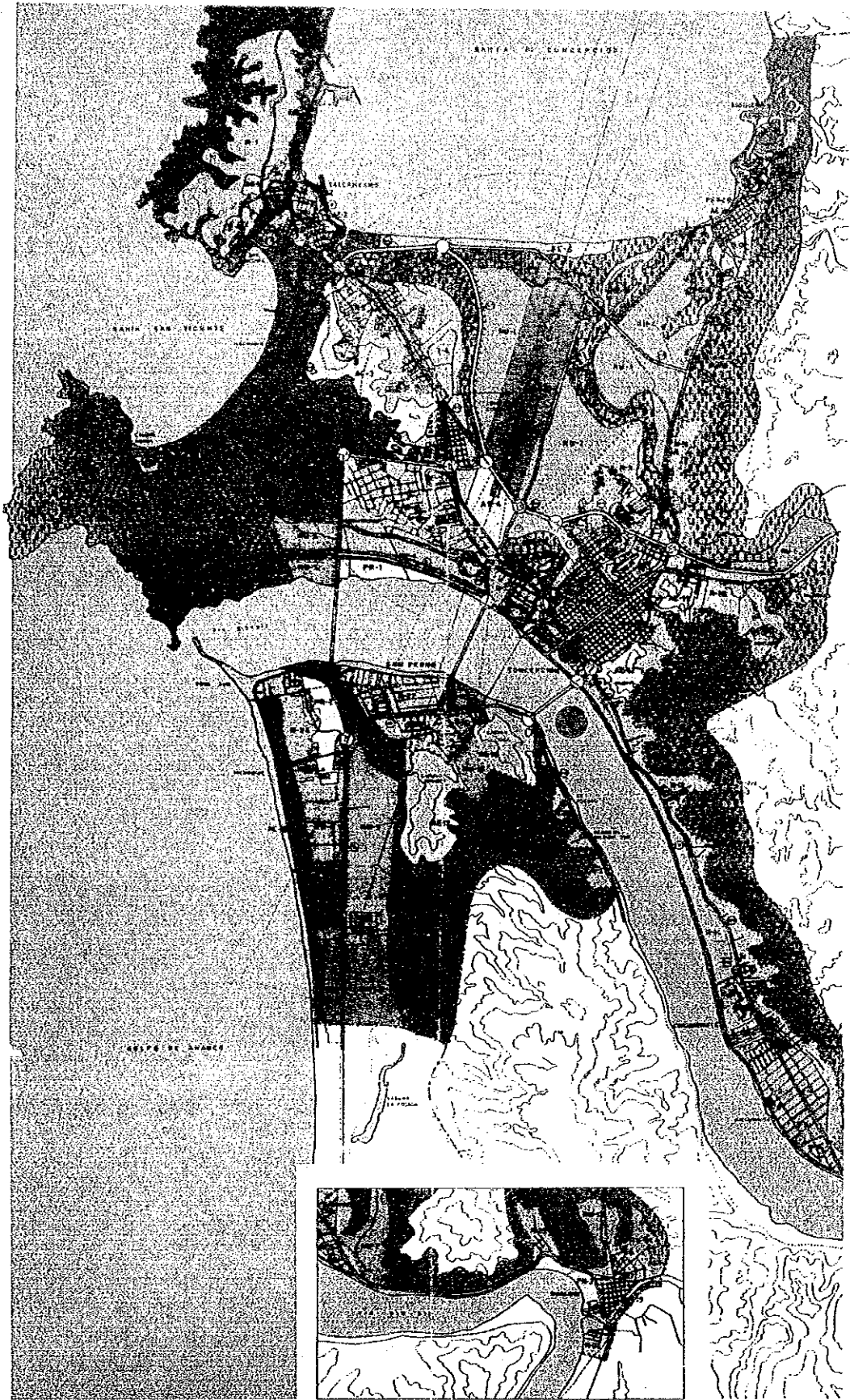


Fig. 2-3 Regulation Plan for Metropolitan Concepcion

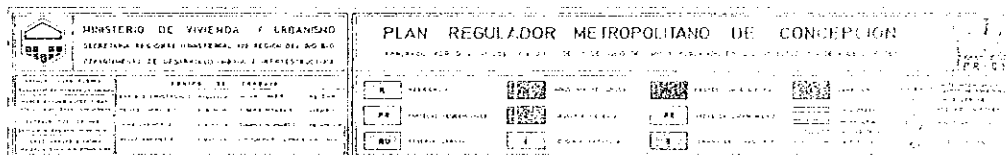
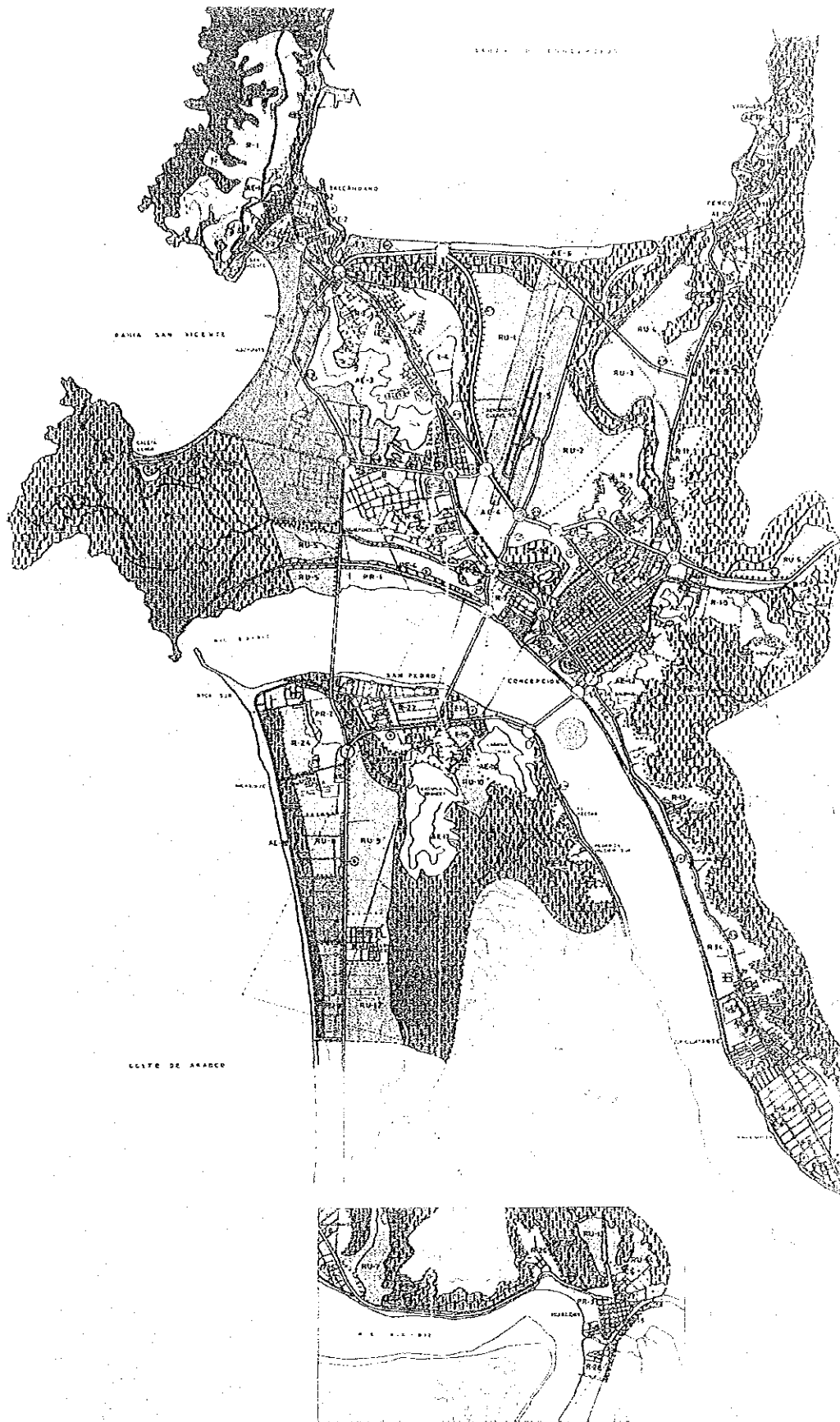
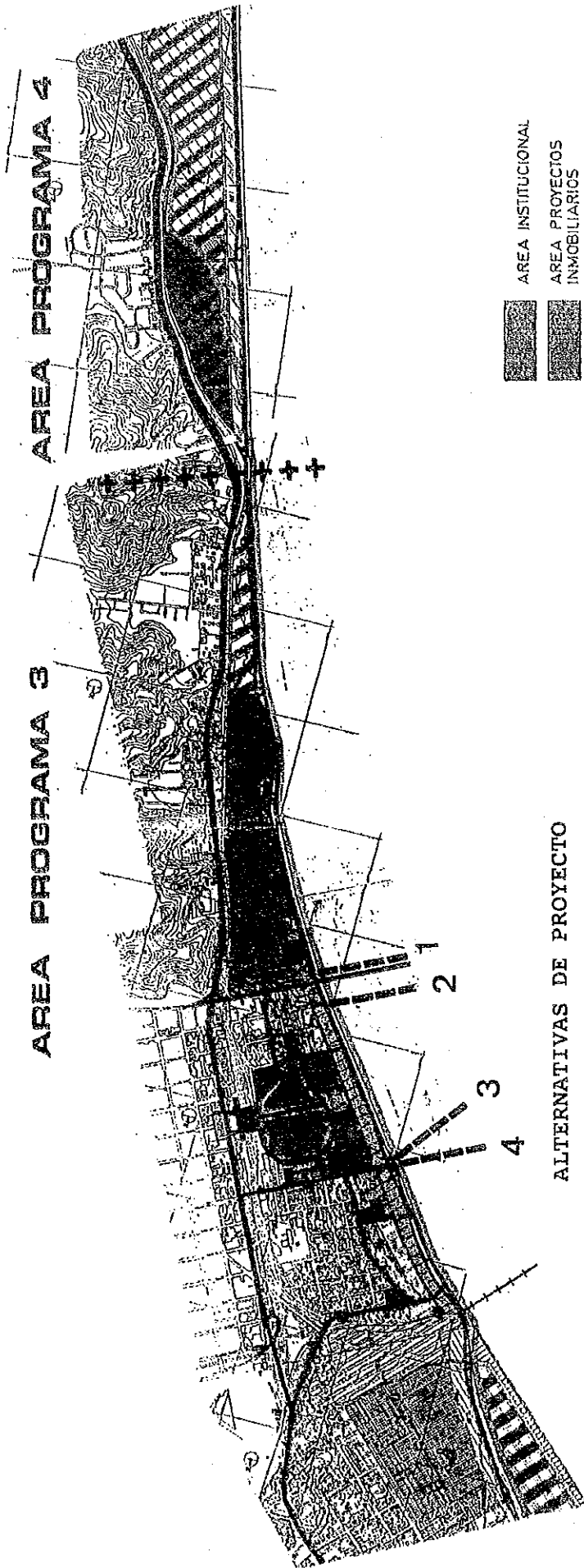


Fig. 2-3 Regulation Plan for Metropolitan Concepcion



AREA INSTITUCIONAL
 AREA PROYECTOS INMOBILIARIOS

ALTERNATIVAS DE PROYECTO

PROGRAMA GESTION URBANA 1993

COMISION COORDINADORA DEL PROYECTO DE RECUPERACION DE LA RIBERA NORTE DEL RIO BIO BIO CONCEPCION

	PROYECTO DE SANEAMIENTO URBANO CON COOPERACION EXTERNA		AREA OCUPADA BENEFICIADA POR PROGRAMA DE MACROINFRAESTRUCTURA		AREA DE INTERES PARA EJECUTAR RELLENOS		VIALIDAD ESTRUCTURANTE
	AREA FUTURO PARQUE COSTANERA		AREA DESOCUPADA BENEFICIADA POR PROGRAMA DE MACROINFRAESTRUCTURA		AREA FUTURO PARQUE EN SECTOR RECUPERADO AL RIO		COLECTORES
	AREAS DE EQUIPAMIENTO		AREA RECUPERADA AL RIO DE PROPIEDAD FISCAL		LIMITE AREA PROGRAMA		PLANTA ELEVADORA
							ALTERNATIVAS FUTURO PUENTE

Fig. 2-4 Plan for Programs 3 and 4 of the Redevelopment Project of the North Bank of the Biobio River

CHAPTER 3. ROAD NETWORK AND TRANSPORT DEMAND CHARACTERISTICS

3.1 Transportation Network

3.1.1 Interurban Road Network

The main roads connecting Concepcion city with its surrounding core cities consist of Route 148 which is a gate from the East, Route 150 linking Penco /Tome in the North, Route 154 an access to the harbor area of Talcahuano in the West and Route 160 running along the seashore connecting with Coronel/Lota in the South.

Fig.3-1 indicates the locations of the main access roads to/from Concepcion city with its daily traffic volume in 1990. Among those roads, Route 154 handled about 25,000 vehicles a day in 1990 because it functions as a trunk road linking the harbor area with Concepcion city.

3.1.2 Road Network in Concepcion City

(1) Network Patterns and Number of Lanes

The road network in Concepcion city is a grid type as illustrated in Fig.3-2. The number of lanes of main streets are shown in Fig.3-2 as well. The Los Carrera street is running through the West to East with 6 lanes from A. Prat Avenue to the Paicavi Street but has 2 lanes from the Paicavi Street to Av. Irarrazabal. A. Prat Avenue plays important roles as North - South axes in the city with 4 lanes from North section up to the Los Carrera street and 3 lanes after that. The Chacabuco street has 8 m road width but due to parking cars on both sides only 4 lanes are available.

In order to increase the capacity of streets and to keep smooth traffic flows, traffic regulations such as one-way system, prohibitions against parking on streets are adopted. The one-way system is applied mainly in the Central Business District(CBD) and in the southern part of the city where many administrative and commercial facilities are concentrated (Fig.3- 3). Parking regulations are also adopted in the same CBD area and on the trunk roads as well (Fig.3-4).

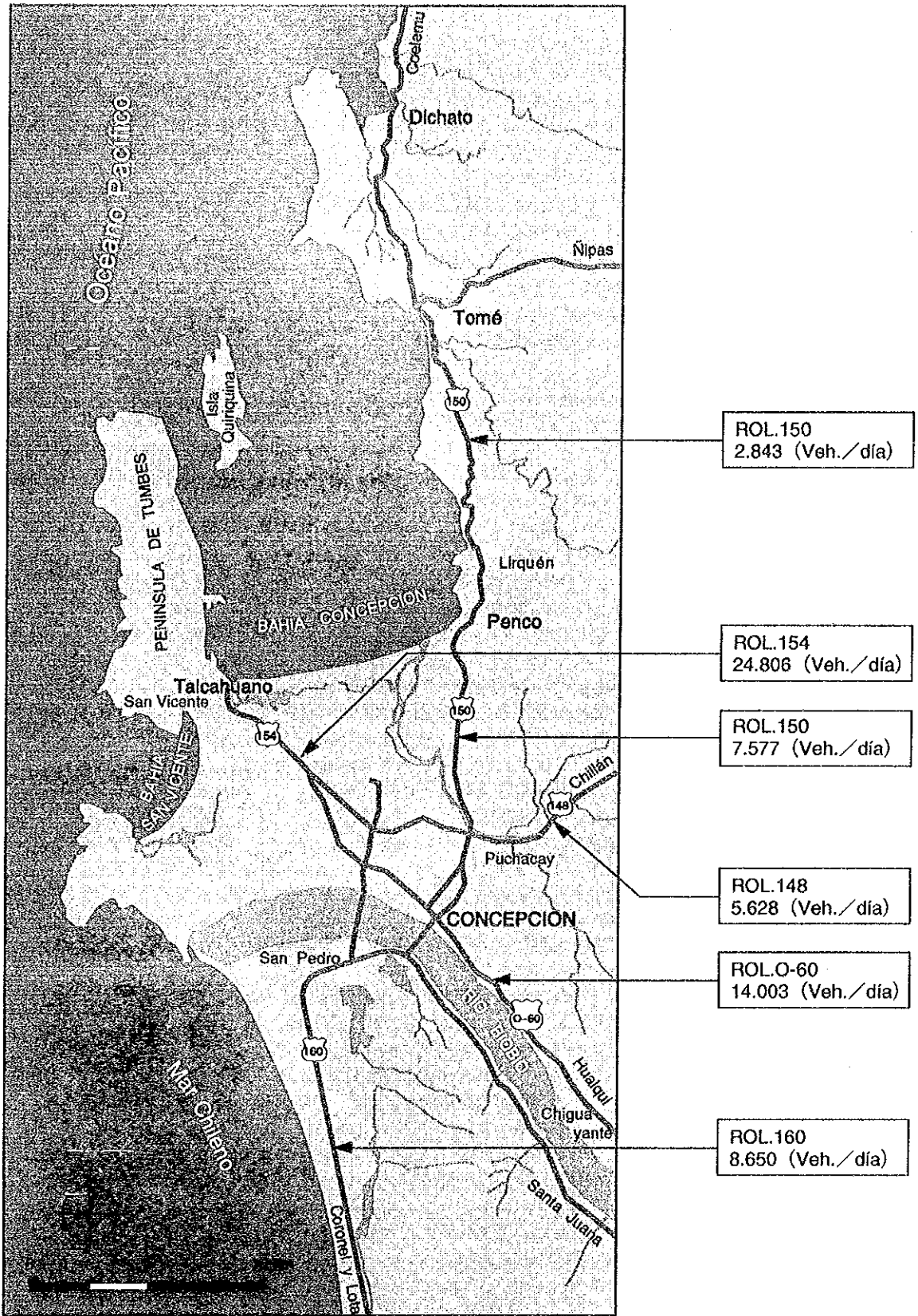


Fig. 3-1 Interurban Road Network

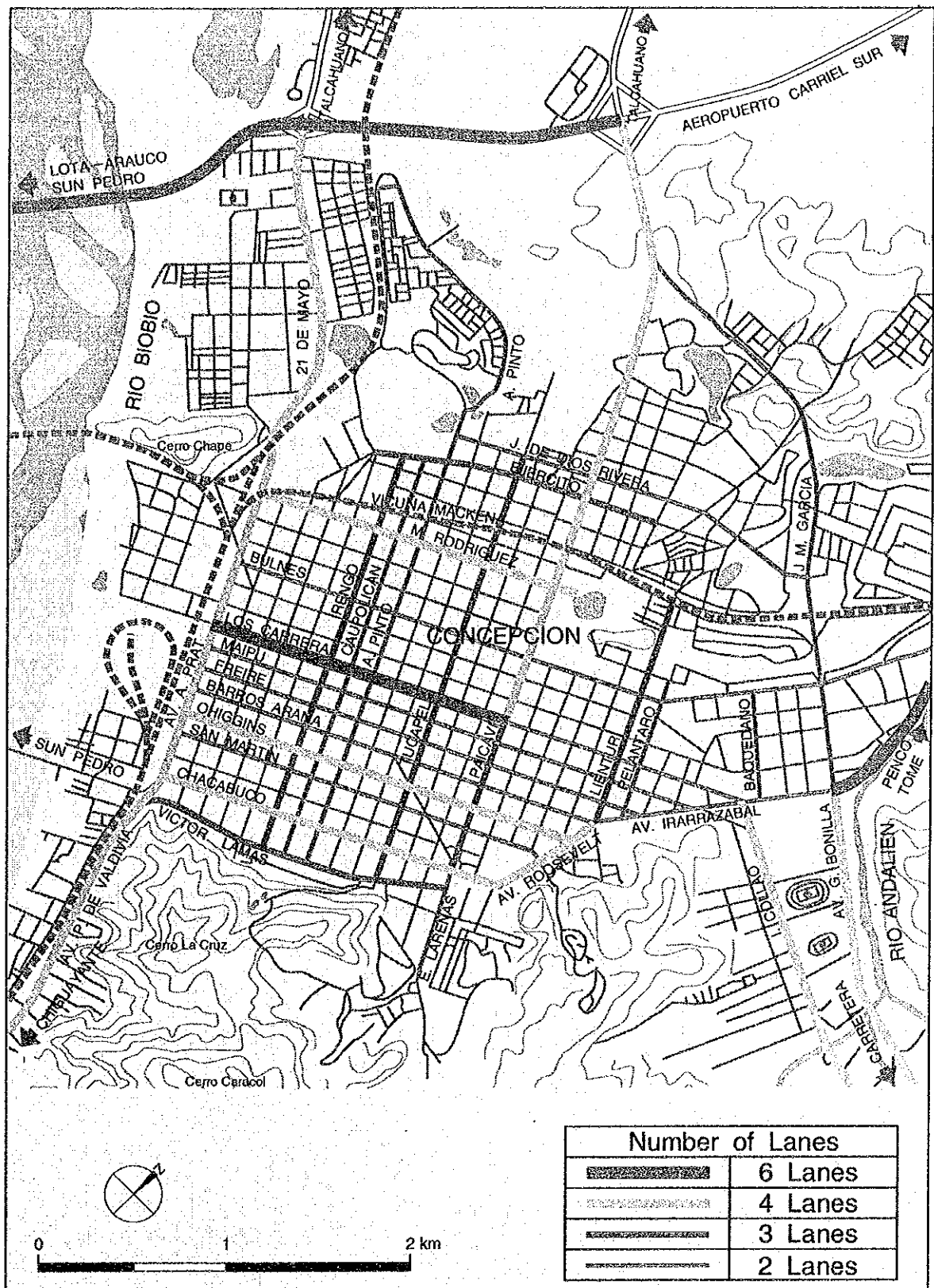


Fig. 3-2 Road Network and Number of Lanes

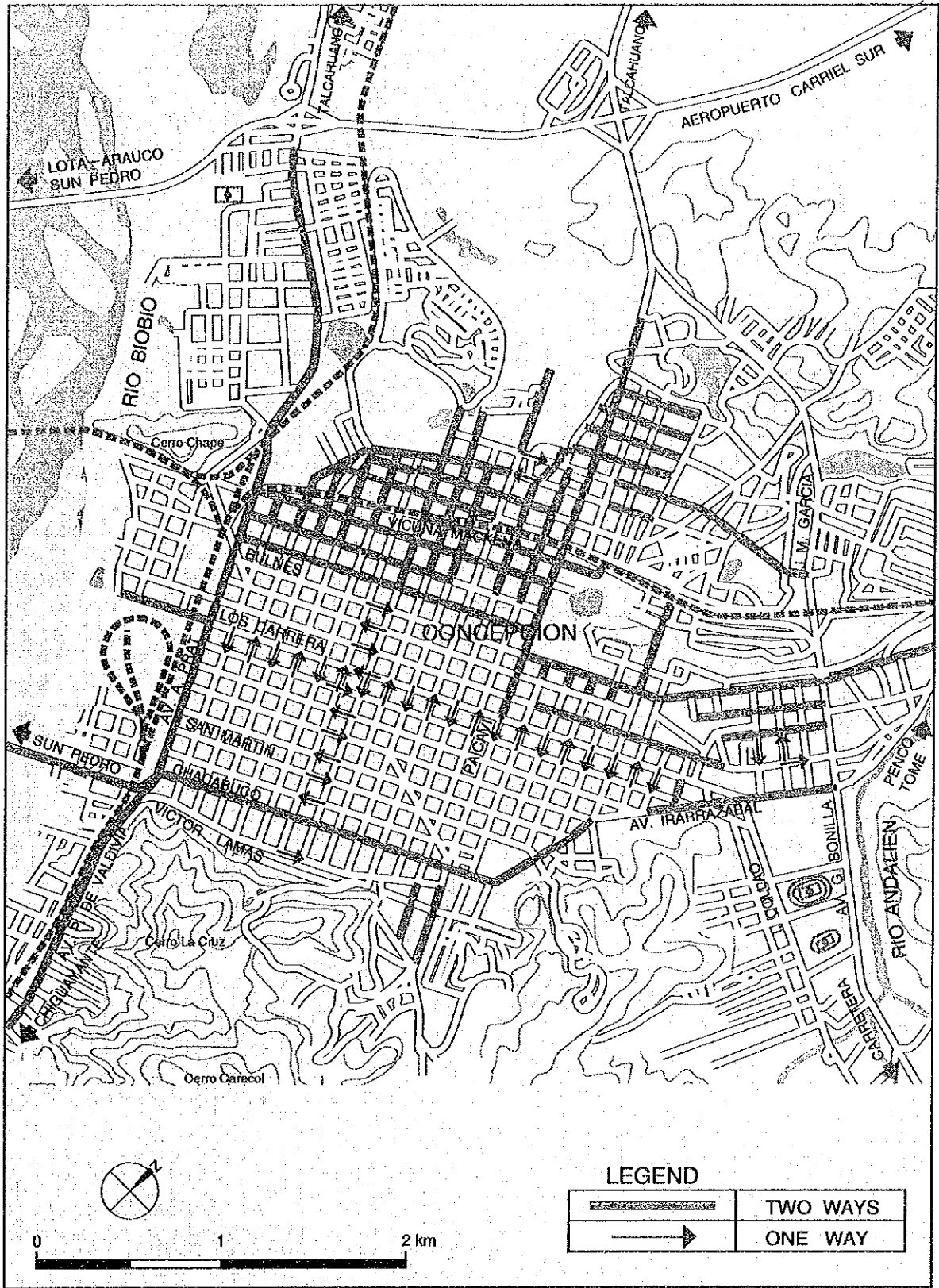


Fig. 3-3 One-Way System

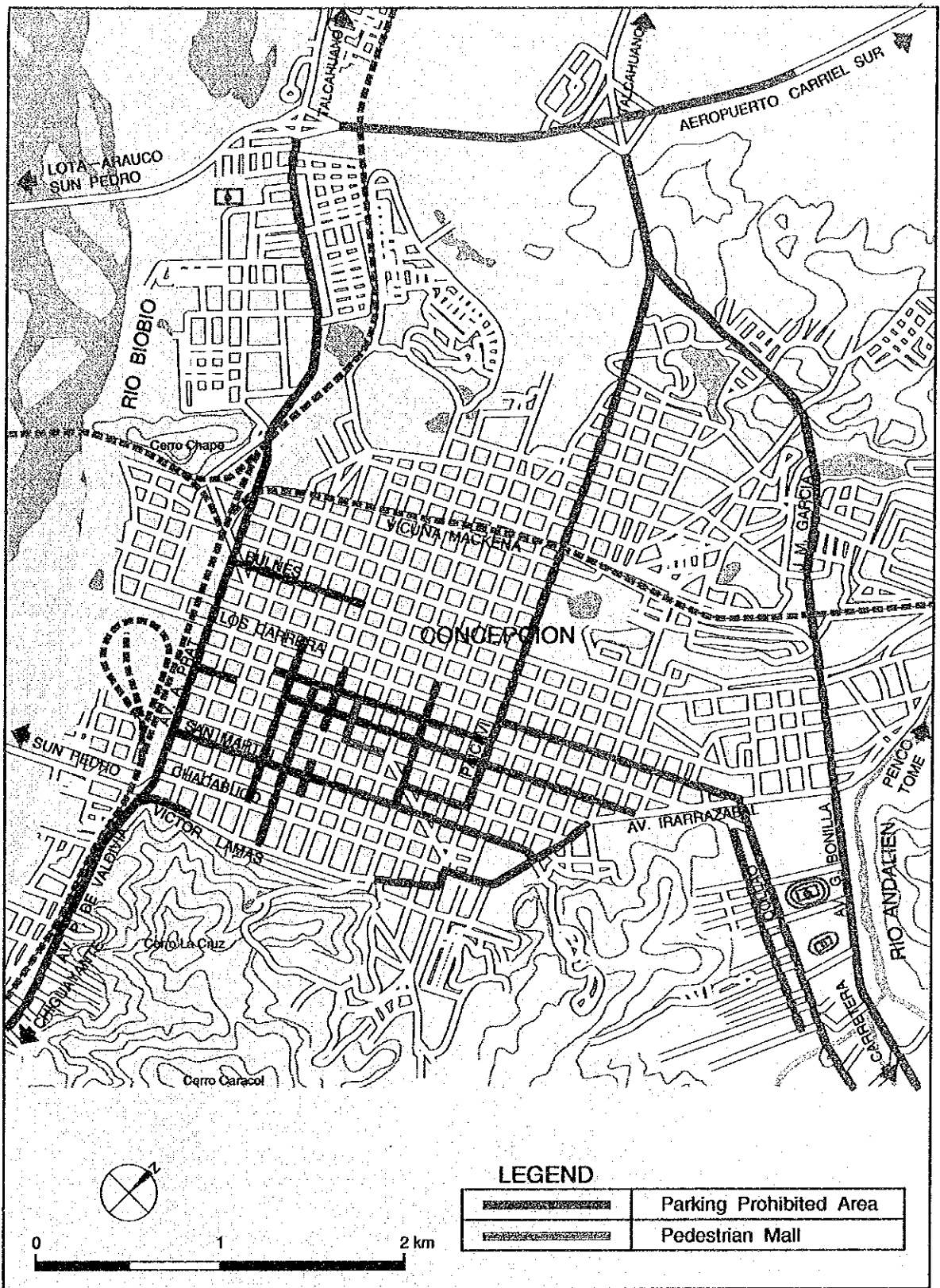


Fig. 3-4 No Parking Area and Pedestrian Mall

