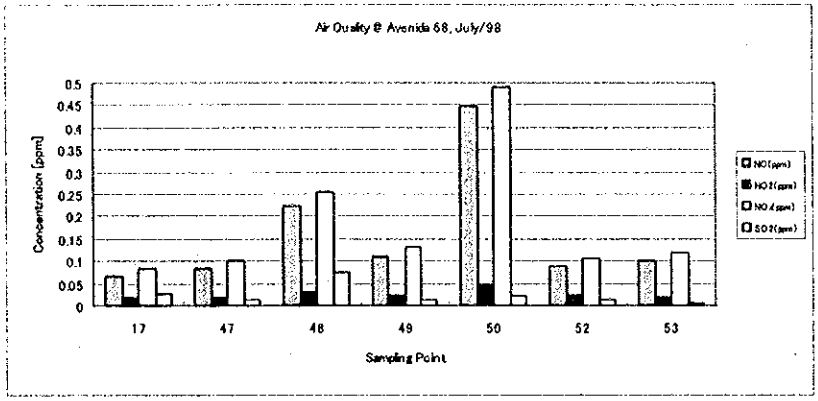


Figure 12.5-9 Field Measurement @ 68 (NOX and SO_2, July 98)

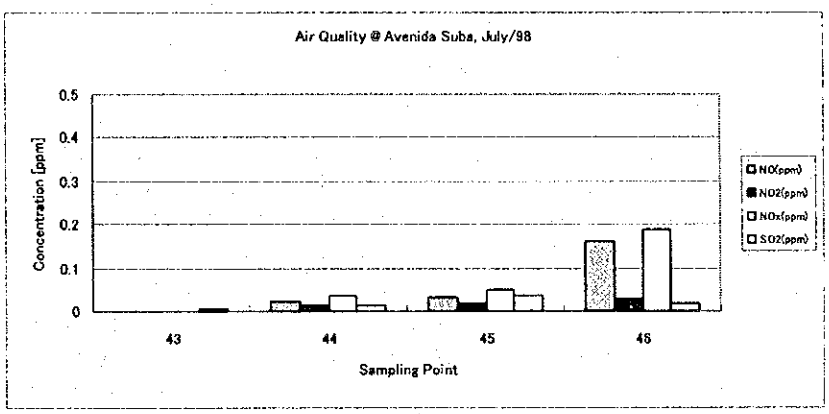


Figure 12.5-10 Result of Field Measurement @ Suba (NOX and SO_2, July 98)

12.5.3. CONCLUSIONS

Air quality measurements were carried out at 52 points distributed along major roads. Within this measurement, following five parameters such as dust (PM-10), CO, NO, NO_2 and SO_2 are of concern. Throughout the comparison with DAMA's measurement results, good agreements are recognized, and thus, it can be said the measurement carried out within this study is well organized and those result are valid. From this measurement, it was found that air quality conditions along major roads such as 7a, Caracas and Quito are worse, in particular, measured NOX and CO values exceed the city environmental standards at several points.

12.6. FIELD SURVEY: NOISE

12.6.1. STUDY DESIGN

In order to obtain the baseline data of current noise condition along major roads, the noise measurement along proposed routes was carried out by JICA Study Team. Forty-nine measuring points that are identical to those for the roadside air quality measurement, described previously were conducted. Among these, three points are used for nine hours-continuous measurement. Table 12.6-1 summarizes the outline of this noise measurement.

Table 12.6-1 Noise measurement.

Instrument: Model NL-04, RION	
Moving.	
Total number of measuring points Measuring period	49 10 min
Fixed.	
Total number of measuring points Measuring period	3 9hrs 9:00-18:10

12.6.2. Discussions

Figures 12.6-1 and 12.6-2 show the spatial variation of LA50 and LAeq measured within this study, respectively. The obtained data for each parameters are varied within ranges summarized as follows,

LA50: 65.5 – 77.8 dBA and LAeq: 68.2 – 83.4 dBA

Similar measurement tendency was recognized in results of previous Master Plan Report study (23 measurement points, JICA, 1996).

Daytime noise standards for residential and commercial areas established in Bogota are set to 65 and 70 dBA, respectively, so most of obtained data are high above those standard. Thus it can be said that the current noise condition at most of measuring points are in bad situation. Figure 12.6-3 shows the time variation of noise (9 a.m. – 6 p.m., LA50 and LAeq) at three points (#7: 7a, #12 Caracas and #26: Quito), respectively. Measured noise levels are always above 70 dBA at any time. No special daily variation pattern can be recognized. However, noise level tend to increase around evening time at Quito and Caracas whereas not at 7a. This difference might be due to the traffic control regulations imposed on each route. In current study (Master Plan Report, JICA, 1996), 12-hour noise measurement (7 a.m. – 7 p.m.) was carried out at one location (Quito between Calles 53 and 53B). In that result, no significant noise variation was observed.

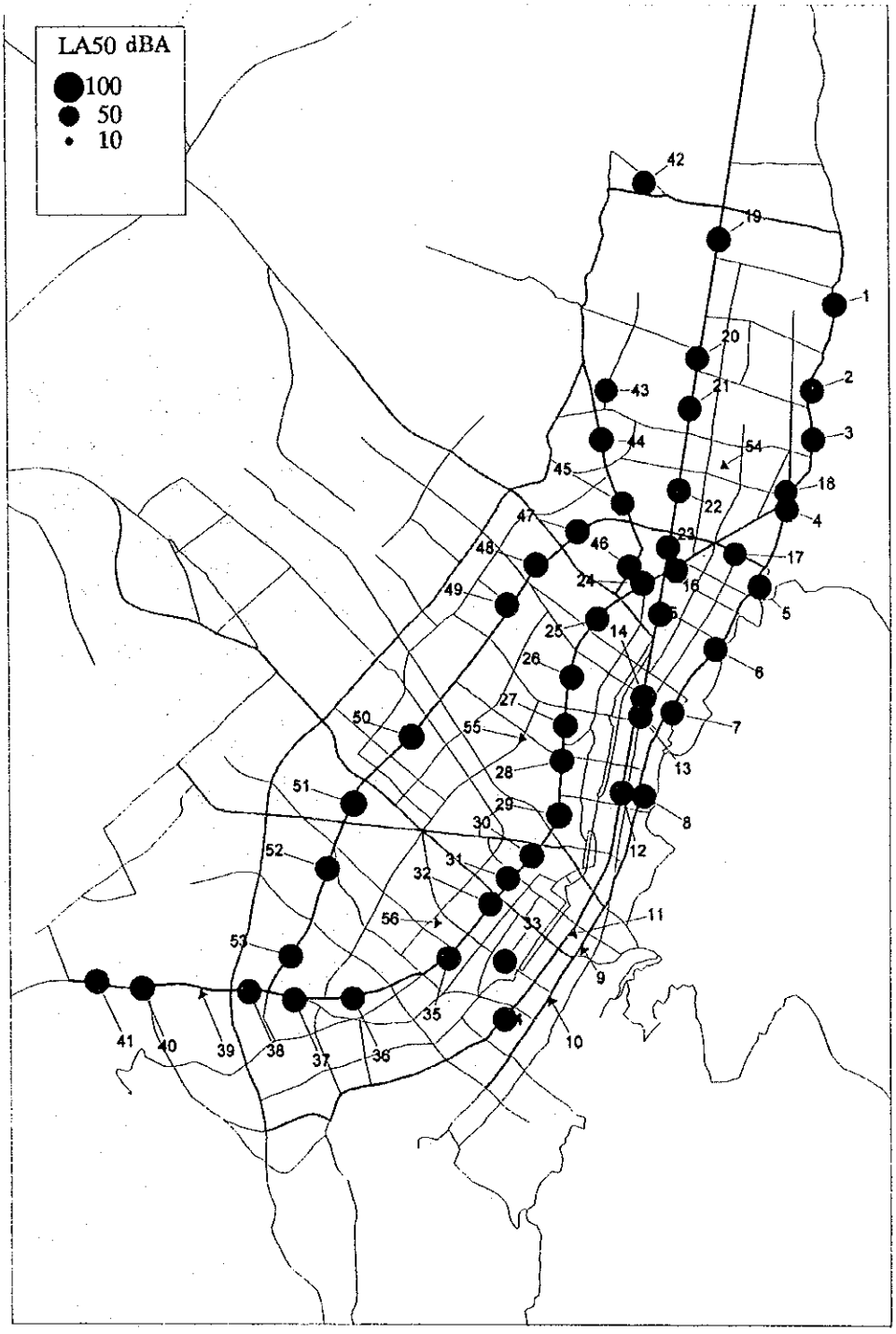


Figure 12.6-1 Noise Measurement (LA50), July 98

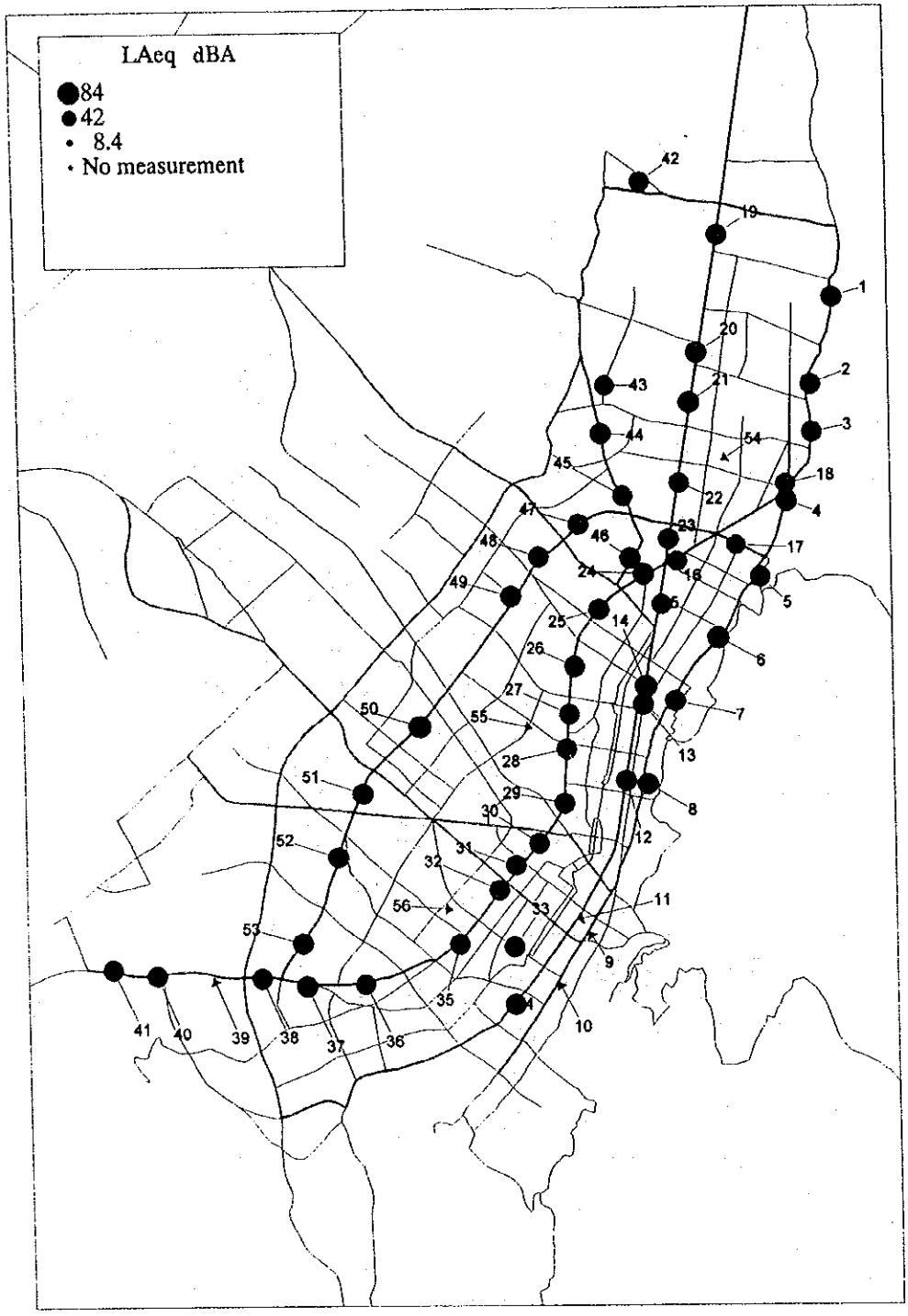


Figure 12.6-2 Noise Measurement (Laeq), July 98

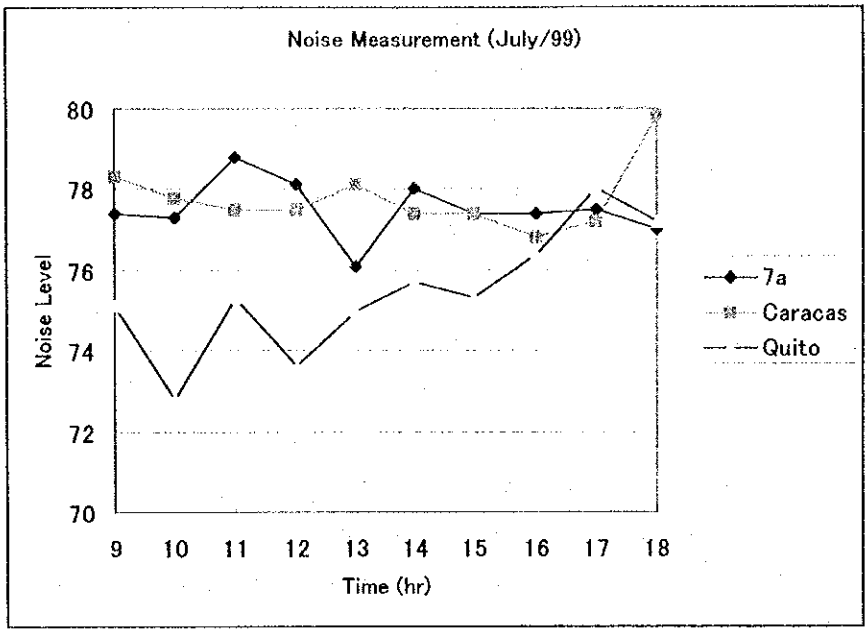


Figure 12.6-3 Continuous Noise Measurement, July 98

12.6.3. CONCLUSIONS

Preliminary noise measurement was carried out at 49 points along major roadsides, and 9-hour continuous measurements were done at three points among of them. From this study, it was found noise level along the major roadsides such as 7a, Caracas, and Quito exceed the city noise standard, and thus current noise condition along major roads are worse.

12.7. SOCIO-CULTURAL COMMUNITY SURVEY

12.7.1. INTRODUCTION

Community participation has an important role in the proper infrastructure project planning and management. It is essential to examine every aspect of the project based on the current community's needs or priorities. Socio-cultural survey has to be done in order to properly grasp the opinion about this new expressway and bus way project from communities of Bogota city. Detailed descriptions about the methodology of the interview conducted within this study will be presented later.

12.7.2. STUDY DESIGN

A socio-cultural opinion survey, carried out by the JICA Study Team in April through August 1998, recorded the opinion of 1000 residents along present route options for the expressway and the bus way. The interviews were carried out by socio-economist and ten trained technical assistants during three weeks of fieldwork including all weekends. Table 12.7-1 lists ten interview locations within this survey.

Table 12.7-1 Survey sites.

No.	Site
1	Hacienda Sta. Barbara Cra. 7
2	Centro Administrativo Distral Cra. 30 Calle 26
3	Calle 80 con Avenida 68 (Exito)
4	Av. Americas con Av. 68
5	Parque Nacional Cra. 7
6	Centro Internacional Cra. 10
7	Av. Caracas con Calle 27 Sur
8	Calle 116 con Av. Suba
9	Calle 170 con Autopista Norte (Exito)
10	Cra. 30 con Av. 1° de Mayo

This survey addressed four major study topics as follows:

a) General environmental concerns for the current traffic condition.

b) Opinions about the landmark facilities to be preserved.

c) General concerns for the new expressway project.

d) General concerns for the new bus way project.

The results will be used in the potential impact assessment in order to achieve a balanced project management plan.

12.7.3. Discussions.

(1) Background Information

The study team selected 1,000 interviewees in random sampling manner. The age of the interviewees varies from under 20 to 60. 81.6% of interviewees belong to the range of 21 to 40 years old. The gender balance is evenly taken; 524 male and 476 female, and 33% of interviewees have regular jobs. Monthly income varies from under $210,000 to over $2,100,000. Most of interviewees (89.8%) live in Estrato 1-3. Half of the people live in current residence for more than 10 years. 59.6% possess one or more cars at home, of which 48% are their own.

(2) Opinion on Environmental Pollution caused by Traffic Congestion

Most of interviewees recognize current environmental pollution problem (e.g., exhaustion gas and noise) as very serious matter. As the solutions for this problem, they primarily expect for the transport facilities improvement. The expectation for the provision of the metro service is the highest (74.1%), followed by road improvement (63.8%) and vehicle equipment renovation (53.5%). Regulational measures such as the transport demand control or the tariff schedule are not considered effective (23.8% and 2.9%, respectively).

(3) Preservation of Natural/Cultural/Historical/Archeological/Conservation facilities.

There are many conservation facilities in Bogota, and 75% of interviewees show strong concerns of some conservation facilities around their residences. The facilities of interests are parks, churches, schools, monuments, woods and so on. When asked how they feel about modernizing high rise structures in places such as la Candelaria, most of interviewees (74%) are against for those plans from the standpoint of landscape preservation, and 87% of the interviewees consider the preservation of those facilities is important. Among those facilities, they put the highest priority on the preservation of the green open space such as parks (58.5%) while other facilities such as buildings, churches

and old trees are prioritized with almost same weight (15.3%, 13.5%, and 12.7%, respectively).

Generally, interviewees are against the removal/or relocation of conservation facilities associated with the construction of transport facilities. Over 40% of the people oppose to the removal of any of the alternatives to be provided (old buildings, green space, old trees, and churches/schools). Interviewees show the strongest opposition to the green space removal (79%) and 43 % for the preservation of the old trees.

(4) Construction of Toll Urban Expressway

95% of interviewees perceive the necessity of the urban expressway even if it is a toll road. Reasonable charge per 1 ride is 1,690 peso in average. Given an assumption that a current travel takes 60 min, using an ordinal road, and that the newly built expressway significantly shortens the travel time (say, shortened by 40, 30, 20 min, respectively), interviewees are asked if they are willing to pay 3,000 pesos flat fare for the service. 82 percent of the interviewees agree to pay 3,000 pesos for the 40 min- cut while 49 percent for 30 min-cut and only 21 percent for 20 min-cut. It is clear that the more the expressway shortens the travel time, the higher they are willing to pay.

Then, the study team questioned the interviewees' impressions about the landscape, provided that all sections of expressway was elevated as in grade-separated intersections. As a resident, 55% of interviewees answer it will be very uncomfortable, showing strong concerns for the change of the atmosphere. As a driver or a pedestrian, interviewees show less concern (3% and 15%, respectively).

(5) Construction of Express Bus System

The study team set an assumption that the Express bus system would have its own track and asked interviewees how much extra-tolls they are willing to pay for the time saving of the transport, currently taking 60 min. On average, interviewees would pay $160.3 for 20 min-cut, $255.1 for 30 min-cut, and $356 for 40 min-cut, respectively.

In terms of the tariff schedule, almost half of interviewees are against to the kilometer-use payment system whereas 40% agree. 8% of interviewees are not sure about the tariff schedule.

Asked if there are any problems or concerns on current bus operation, 85% of interviewees show strong concern, and the major problems are bad driving manner (32.6%), discomfort of vehicle seats (31.4%), and very slow service (29.8%).

12.7.4. Conclusions

Most of interviewees regard current transport-related pollution as serious problems and feel the necessity of certain actions. They primarily expect the solution by constructing metro and road facilities.

Also, they are aware of importance to preserve historical/cultural facilities. Among them, preservation of the green open space such as parks is of their highest interest. Generally, people are against the removal/or relocation of conservation facilities associated with the construction activity of transport facilities. In terms of the urban expressway and express bus system, they support the construction of those facilities, but from the viewpoint of landscape preservation, their attitudes are rather negative.

Most of them tend to understand the importance of this new bus way and expressway project and they are willing to pay extra-cost for the travel-time shortening to be induced by the construction of new traffic facilities.

12.8. SCOPING AND SCREENING.

12.8.1. INTRODUCTION

The whole route plan of the expressway and bus way network to be considered within this study consist of following seven major road-component: (1) Avenida 7a, (2) Avenida Caracas, (3) Avenida Quito, (4) Avenida Suba, (5) Avenida 68, (6) Calle 170, and (7) New Circunvaral. So, the preliminary environmental examination of each major road is carried out separately, and potential environmental issues associated with each major road are summarized as follows.

12.8.2. AVENIDA 7A

The northern half of Avenida 7a is located in the foot of the Oriental Mountains, and road itself is in adjacent to default line, so there is a considerable risk of earthquake damage along this road. Also, this road is located at the mountainside, so there is a risk of local inundation when the torrential rain hit Bogota. No rare flora/or fauna is reported along this route. No illegal squatter area is found along this road. Table 12.8-1 summarizes the preliminary environmental evaluation of Avenida 7a.

12.8.3. AVENIDA CARACAS

Avenida Caracas-Autopista Norte is located in the Bogota Plain and run through the commercialized area of the city. Southern half part of this road is almost parallel and close to the Avenida 7a (i.e., close to default line), so there is a risk of earthquake damage along this road. No rare flora/or fauna is reported along this route. No illegal squatter area is found along this road. Table 12.8-2 summarizes the preliminary environmental evaluation of Avenida Caracas.

12.8.4. AVENIDA QUITO – AUTOPISTA SUR

Avenida Quito- Autopista Sur is located in the Bogota Plain and connects between Norte and Sur Zones. No rare flora/or fauna is reported along this route. No illegal squatter area is found along this road. Table 12.8-3 summarizes the preliminary environmental evaluation of Avenida Quito – Autopista Sur.

12.8.5. AVENIDA SUBA

The northern part of Avenida Suba passes on the rocky hill of Suba but most part of this avenue is located in the Bogota Plain and run through Noroccidente Zone. No rare flora/or fauna is reported along this route. No illegal squatter area is found along this road. Table 12.8-4 summarizes the preliminary environmental evaluation of Avenida Suba.

12.8.6. AVENIDA 68

Most part of Avenida 68 is located in the Bogota Plain, and connects Norte and Sur Zones running through Noroccidente and Occidente Zones. No rare flora/or fauna is reported along this route. No illegal squatter area is found along this road. Table 12.8-5 summarizes the preliminary environmental evaluation of Avenida 68.

12.8.7. CALLE 170

Calle 170 is relatively short route plan within this study and most part of this street is flat and located in the Bogota Plain. Mostly, this road runs through the residential area, so the road environment is relatively calm compared with other routes. No rare flora/or fauna is

reported along this route. No illegal squatter area is found along this road. Table 12.8-6 summarizes the preliminary environmental evaluation of Calle 170.

12.8.8. NEW CIRCUNVARAL

The New Avenida Circunvaral lies from north to south along the Oriental Mountains going from the northern foot and then halfway up to the level of 2,800 EL-m and keeping the same elevation until going down to the city center area. The halfway of the Oriental Mountains present very steep rocky slope while the foot forms less steep mountain skirt, which is made of the products of sedimentation. Due to the short run-off time, a regional flooding tends to occur when the torrential rain hit Bogota. Several illegal squatter areas are very close to this route, so more detailed study will be required for further process. The vegetation around this route is highly affected by human activities from the pre-Colombian age, so there is no natural forest left but a little secondary forests. Most of forest are planted with foreign species (e.g., eucalyptus and pines), and remainings are pastures, shrubs, and so on. No rare flora/or fauna is reported along this route. There is a preserved forest area near the military base at Avenida 7a, so-called *Sierras del Chic*. New apartment complex is built around the northern half of this route while middle and lower income class housing, private schools and universities exist. Several illegal squatter housings are found around the upper zone of this route. Table 12.8-7 summarizes the preliminary environmental evaluation of Avenida Cirucunvaral.

Table 12.8-1 Scoping (Avenida 7a).

Element		Impact	Importance
Natural Environment			
1	Soils	Potential for soil erosion during/and after the construction period.	D
2	Seismisty	Risk of earthquake damage due to the existence of fault line (Falla Piedemonte Llonero).	A
3	Vegetation	Destruction of mountainside vegetation.	D
		Destruction of roadside vegetation.	C
4	Birds	Disturbance to bird habitats during construction.	D
5	Run-off	Local flood/or inundation due to torrential rain.	B
6	River flow	Risk of water pollution to major tributaries during construction.	D
		Excessive water blockage of drainage system.	B
7	Groundwater	Groundwater quality degradation during construction.	B
		Groundwater level drawdown during construction.	B
		Drainage of discharged groundwater during construction.	B
		Disturbance to regional groundwater flow.	B
		Enhanced consolidation due to drawdown of groundwater level during/and after construction.	B
Socio-Economic			
8	Land Take	Land Take due to alignment roads.	B
		Disruption to local development plan.	B
		Demolition of roadside houses.	B
		Demolition of illegal squatter's lots.	D
9	Education	Disruption to school during/and after construction.	B
10	Road Safety	Increased risk of accidents due to increased road traffic during construction.	B
11	Archaeology/ historical and monumental	Conflict with the setting of historical/or monumental facilities.	A
12	Landscape	Visual conflict with surrounding community.	A
		Cutting of hill or mountainside/ use of embankment.	D
		Loss of visual continuity of townscape.	B
13	Noise, vibration	Noise, dust and vibration during construction	B
		Increased noise and vibration due to the traffic level increase.	C
14	Air pollution	Increased air pollution due to traffic levels increase	C

Note A: significant, B: major, C: minor, D: less significant, U: Unknown

Table 12.8-2 Scoping (Avenida Caracas).

Element		Impact	Importance
Natural Environment			
1	Soils	Potential for soil erosion during/and after the construction period.	D
2	Seismisty	Risk of earthquake damage due to the existence of fault line (Falla Piedemonte Llonero).	B
3	Vegetation	Destruction of mountainside vegetation.	D
		Destruction of roadside vegetation.	C
4	Birds	Disturbance to bird habitats during construction.	D
5	Run-off	Local flood/or inundation due to torrential rain.	C
6	River flow	Risk of pollution to major tributaries during construction.	D
		Excessive water blockage of drainage system.	C
7	Groundwater	Groundwater quality degradation during construction.	B
		Groundwater level drawdown during construction.	B
		Drainage of discharged groundwater during construction.	B
		Disturbance to regional groundwater flow.	B
		Enhanced consolidation due to drawdown of groundwater level during/and after construction.	B
Socio-Economic			
8	Land Take	Land Take due to alignment roads.	B
		Disruption to local development plan.	B
		Demolition of roadside houses.	B
		Demolition of illegal squatter's lots.	D
9	Education	Disruption to school during/and after construction.	C
10	Road Safety	Increased risk of accidents due to increased road traffic during construction.	B
11	Archaeology/ historical and monumental	Conflict with the setting of historical/or monumental facilities.	B
12	Landscape	Visual conflict with surrounding community.	C
		Cutting of hill or mountainside/ use of embankment.	D
		Loss of visual continuity of townscape.	C
13	Noise, vibration	Noise, dust and vibration during construction	B
		Increased noise and vibration due to the traffic level increase.	C
14	Air pollution	Increased air pollution due to traffic levels increase	C

Note A: significant, B: major, C: minor, D: less significant, U: Unknown

Table 12.8-3 Scoping (Avenida Quito).

Element		Impact	Importance
Natural Environment			
1	Soils	Potential for soil erosion during/and after the construction period.	D
2	Seismisty	Risk of earthquake damage due to the existence of fault line (Falla Piedemonte Llonero).	C
3	Vegetation	Destruction of mountainside vegetation.	D
		Destruction of roadside vegetation.	C
4	Birds	Disturbance to bird habitats during construction.	D
5	Run-off	Local flood/or inundation due to torrential rain.	D
6	River flow	Risk of pollution to major tributaries during construction.	D
		Excessive water blockage of drainage system.	D
7	Groundwater	Groundwater quality degradation during construction.	C
		Groundwater level drawdown during construction.	C
		Drainage of discharged groundwater during construction.	C
		Disturbance to regional groundwater flow.	C
		Enhanced consolidation due to drawdown of groundwater level during/and after construction.	C
Socio-Economic			
8	Land Take	Land Take due to alignment roads.	C
		Disruption to local development plan.	C
		Demolition of roadside houses.	C
		Demolition of illegal squatter's lots.	D
9	Education	Disruption to school during/and after construction.	C
10	Road Safety	Increased risk of accidents due to increased road traffic during construction.	B
11	Archaeology/ historical and monumental	Conflict with the setting of historical/or monumental facilities.	C
12	Landscape	Visual conflict with surrounding community.	C
		Cutting of hill or mountainside/ use of embankment.	D
		Loss of visual continuity of townscape.	B
13	Noise, vibration	Noise, dust and vibration during construction	B
		Increased noise and vibration due to the traffic level increase.	C
14	Air pollution	Increased air pollution due to traffic levels increase	C

Note A: significant, B: major, C: minor, D: less significant, U: Unknown

Table 12.8-4 Scoping (Avenida Suba).

Element		Impact	Importance
Natural Environment			
1	Soils	Potential for soil erosion during/and after the construction period.	D
2	Seismisty	Risk of earthquake damage due to the existence of fault line (Falla Piedemonte Llonero).	C
3	Vegetation	Destruction of mountainside vegetation.	D
		Destruction of roadside vegetation.	C
4	Birds	Disturbance to bird habitats during construction.	D
5	Run-off	Local flood/or inundation due to torrential rain.	D
6	River flow	Risk of pollution to major tributaries during construction.	D
		Excessive water blockage of drainage system.	D
7	Groundwater	Groundwater quality degradation during construction.	C
		Groundwater level drawdown during construction.	C
		Drainage of discharged groundwater during construction.	C
		Disturbance to regional groundwater flow.	C
		Enhanced consolidation due to drawdown of groundwater level during/and after construction.	C
Socio-Economic			
8	Land Take	Land Take due to alignment roads.	C
		Disruption to local development plan.	C
		Demolition of roadside houses.	C
		Demolition of illegal squatter's lots.	D
9	Education	Disruption to school during/and after construction.	C
10	Road Safety	Increased risk of accidents due to increased road traffic during construction.	B
11	Archaeology/ historical and monumental	Conflict with the setting of historical/or monumental facilities.	C
12	Landscape	Visual conflict with surrounding community.	B
		Cutting of hill or mountainside/ use of embankment.	D
		Loss of visual continuity of townscape.	C
13	Noise, vibration	Noise, dust and vibration during construction	B
		Increased noise and vibration due to the traffic level increase.	C
14	Air pollution	Increased air pollution due to traffic levels increase	C

Note A: significant, B: major, C: minor, D: less significant, U: Unknown

Table 12.8-5 Scoping (Avenida 68).

Element		Impact	Importance
Natural Environment			
1	Soils	Potential for soil erosion during/and after the construction period.	D
2	Seismisty	Risk of earthquake damage due to the existence of fault line (Falla Piedemonte Llonero).	D
3	Vegetation	Destruction of mountainside vegetation.	D
		Destruction of roadside vegetation.	C
4	Birds	Disturbance to bird habitats during construction.	D
5	Run-off	Local flood/or inundation due to torrential rain.	D
6	River flow	Risk of pollution to major tributaries during construction.	D
		Excessive water blockage of drainage system.	D
7	Groundwater	Groundwater quality degradation during construction.	C
		Groundwater level drawdown during construction.	C
		Drainage of discharged groundwater during construction.	C
		Disturbance to regional groundwater flow.	C
		Enhanced consolidation due to drawdown of groundwater level during/and after construction.	C
Socio-Economic			
8	Land Take	Land Take due to alignment roads.	C
		Disruption to local development plan.	C
		Demolition of roadside houses.	C
		Demolition of illegal squatter's lots.	D
9	Education	Disruption to school during/and after construction.	C
10	Road Safety	Increased risk of accidents due to increased road traffic during construction.	B
11	Archaeology/ historical and monumental	Conflict with the setting of historical/or monumental facilities.	C
12	Landscape	Visual conflict with surrounding community.	C
		Cutting of hill or mountainside/ use of embankment.	D
		Loss of visual continuity of townscape.	C
13	Noise, vibration	Noise, dust and vibration during construction	C
		Increased noise and vibration due to the traffic level increase.	C
14	Air pollution	Increased air pollution due to traffic levels increase	C

Note A: significant, B: major, C: minor, D: less significant, U: Unknown

Table 12.8-6 Scoping (Calle 170).

Element		Impact	Importance
Natural Environment			
1	Soils	Potential for soil erosion during/and after the construction period.	D
2	Seismisty	Risk of earthquake damage due to the existence of fault line (Falla Piedemonte Llonero).	C
3	Vegetation	Destruction of mountainside vegetation.	D
		Destruction of roadside vegetation.	C
4	Birds	Disturbance to bird habitats during construction.	D
5	Run-off	Local flood/or inundation due to torrential rain.	C
6	River flow	Risk of pollution to major tributaries during construction.	D
		Excessive water blockage of drainage system.	C
7	Groundwater	Groundwater quality degradation during construction.	C
		Groundwater level drawdown during construction.	C
		Drainage of discharged groundwater during construction.	C
		Disturbance to regional groundwater flow.	C
		Enhanced consolidation due to drawdown of groundwater level during/and after construction.	C
Socio-Economic			
8	Land Take	Land Take due to alignment roads.	C
		Disruption to local development plan.	C
		Demolition of roadside houses.	C
		Demolition of illegal squatter's lots.	D
9	Education	Disruption to school during/and after construction.	C
10	Road Safety	Increased risk of accidents due to increased road traffic during construction.	B
11	Archaeology/ historical and monumental	Conflict with the setting of historical/or monumental facilities.	C
12	Landscape	Visual conflict with surrounding community.	C
		Cutting of hill or mountainside/ use of embankment.	D
		Loss of visual continuity of townscape.	D
13	Noise, vibration	Noise, dust and vibration during construction	B
		Increased noise and vibration due to the traffic level increase.	C
14	Air pollution	Increased air pollution due to traffic levels increase	C

Note A: significant, B: major, C: minor, D: less significant, U: Unknown

Table 12.8-7 Scoping (New Circunvaral).

Element		Impact	Importance
Natural Environment			
1	Soils	Potential for soil erosion during/and after the construction period.	B
2	Seismisty	Risk of earthquake damage due to the existence of fault line.	C
3	Vegetation	Destruction of mountainside vegetation.	C
		Destruction of roadside vegetation.	C
4	Birds	Disturbance to bird habitats during construction.	C
5	Run-off	Local flood/or inundation due to torrential rain.	C
6	River flow	Risk of pollution to major tributaries during construction.	C
		Excessive water blockage of drainage system.	B
7	Groundwater	Groundwater quality degradation during construction.	B
		Groundwater level drawdown during construction.	B
		Drainage of discharged groundwater during construction.	B
		Disturbance to regional groundwater flow.	B
		Enhanced consolidation due to drawdown of groundwater level during/and after construction.	C
Socio-Economic			
8	Land Take	Land Take due to alignment roads.	D
		Disruption to local development plan.	D
		Demolition of roadside houses.	D
		Demolition of illegal squatter's lots.	B
9	Education	Disruption to school during/and after construction.	D
10	Road Safety	Increased risk of accidents due to increased road traffic during construction.	C
11	Archaeology/ historical and monumental	Conflict with the setting of historical/or monumental facilities.	D
12	Landscape	Visual conflict with surrounding community.	B
		Cutting of hill or mountainside/ use of embankment.	B
		Loss of visual continuity of townscape.	B
13	Noise, vibration	Noise, dust and vibration during construction	C
		Increased noise and vibration due to the traffic level increase.	C
14	Air pollution	Increased air pollution due to traffic levels increase	C

Note A: significant, B: major, C: minor, D: less significant, U: Unknown

12.9. INITIAL ENVIRONMENTAL EVALUATION (IEE).

12.9.1. THE ENGINEERING/ENVIRONMENTAL PROBLEM.

There are three alternative route plans for Inner Ring Expressway project. The most preferred expressway route will be selected among those alternatives, reflecting several evaluation factors such as structural characteristics, social and environmental impact, land acquisition and compensations, conformity with existing facilities, and so on. Here, based on the information summarized previously, the features for each plan will be evaluated, and consequently, the best plan for each item will be chosen, separately. Only one alternative route for the new bus way is presented within this project, so full EIA will be undertaken based on this route plan in following sections.

12.9.2. ENGINEERING OPTIONS.

(1) Alternative Routes of Inner Ring Expressway

Following three expressway-route options were initially under consideration (Figures. 11.1-1 to 11.1-3):

1) Alternative Route1	Quito-Cirucunvaral: closed-type
2) Alternative Route 2	Quito-7a: closed-type
3) Alternative Route 3	Quito: open-type

Based on the knowledge of the local bio-physical/ and socio-cultural environment surrounding the study area, summarized in previous sections, it was found that environmental impacts on the visual resources, historical/or monumental facilities to be preserved, the effect of the regional hydrological balance, the location of the fault line, and the related resettlement issues would become the most critical discussion points throughout the initial environmental evaluation (IEE) process. As a result of this IEE (see Table 12.9-1), Alternative Route 3 was selected as the preferred option, and this option is now being developed and the full EIA undertaken.

Table 12.9-1 Summary of Environmental Impacts Identified for Three Route Options (Expressway).

Element		Impact	Importance		
			Alt.1	Alt.2	Alt.3
Natural Environment					
1	Soils	Potential for soil erosion during/and after the construction period.	B	D	D
2	Seismisty	Risk of earthquake damage due to the existence of default line (Falla Piedemonte Llonero).	C	A	C
3	Vegetation	Destruction of mountainside vegetation.	B	D	D
		Destruction of roadside vegetation.	C	D	D
4	Birds	Disturbance to bird habitats during construction.	D	D	D
5	Run-off	Local flood due to torrential rain.	C	C	C
6	River flow	Risk of pollution to major tributaries during construction.	D	D	D
		Excessive water blockage of drainage system.	B	D	D
7	Groundwater	Groundwater quality degradation during construction.	B	B	C
		Groundwater level drawdown during construction.	B	B	C
		Drainage of discharged groundwater during construction.	B	B	C
		Disturbance to regional groundwater flow.	B	B	C
		Enhanced consolidation due to drawdown of groundwater level during/and after construction.	B	B	C
Socio-Economic					
8	Land Take	Land Take due to alignment roads.	D	B	D
		Disruption to local development plan.	D	B	D
		Demolition of roadside houses.	D	B	D
		Demolition of illegal squatter's lot	B	D	D
9	Education	Disruption to school during/and after construction.	C	C	C
10	Road Safety	Increased risk of accidents due to increased road traffic during construction.	B	B	B
11	Archaeology/ historical and monumental	Conflict with the setting of historical/or monumental monuments.	D	B	D
12	Landscape	Visual conflict with surrounding community.	B	A	B
		Cutting of hill or mountainside/ use of embankment.	B	D	D
		Loss of visual continuity of townscape.	B	B	B
13	Noise, vibration	Noise, dust and vibration during construction	C	C	C
		Increased noise and vibration due to the traffic level increase.	C	C	C
14	Air pollution	Increased air pollution due to traffic levels increase	C	C	C
15	Other	Improvement in the local economy due to induced development.	A	A	A

Note A: significant, B: major, C: minor, D: less significant, U: Unknown

(2) Alternative Structure Types of the Inner Ring Expressway

Here, there are two alternative structure type plans for Inner Ring Expressway, reflecting various roadside environmental conditions of each route: elevated structure and Undergrounded one. Based on the environmental condition described in previous sections, comparison is made for two/or three typical sections of each road, separately.

1) Avenida 7a

Two alternative structural plans of the new expressway for three different cross-sections (i.e., elevated structure and Undergrounded one for sections a-a', b-b' and c-c', respectively) are prepared for Avenida 7a by JICA Study Team. Based on the environmental information, summarized previously, environmental evaluation is made for three different sections, shown in this figure, respectively (Tables 12.9-2 through 12.9-4).

Table 12.9-2 Summary of Environmental Impacts Identified for Two Design Options.

	Section a-a' (Avenida 7a)	
	Alternative 1 (Elevated)	Alternative 2 (Undergroundeded)
Run-off	**1.** Risk of uncontrolled expressway run-off. **2.** Interference with regional surface and groundwater hydrology.	Less disturbance to surface run-off.
Groundwater	Less disturbance to regional groundwater flow.	**1.**Groundwater quality degradation during the construction period. **2.**Groundwater level drawdown during/or after construction. **3.** Enhanced consolidation due to the drawdown of groundwater level during/and after construction.
Landscape	**1.** Loss of visual continuity of townscape and scenic value. **2.** Visual conflict with surrounding community.	Less visual conflict with surrounding community.
Noise and Vibration	**1.** Risk of increased sound level to the community caused by sound reflection from bridge structure. **2.** Risk of increased sound/or vibration caused by big truck passing.	None.
Air Quality	Tend to be smooth to disperse exhaustion gas.	Require ventilation system.

Table 12.9-3 Summary of Environmental Impacts Identified for Two Design Options.

	Section b-b'(Avenida 7a)	
	Alternative 1 (Elevated)	Alternative 2 (Undergrounded)
Run-off	**1.** Risk of uncontrolled expressway run-off. **2.** Interference with regional surface and groundwater hydrology.	Less disturbance to surface run-off.
Groundwater	Less disturbance to regional groundwater flow.	**1.**Groundwater quality degradation during the construction period. **2.**Groundwater level drawdown during/or after construction. **3.** Enhanced consolidation due to the drawdown of groundwater level during/and after construction.
Landscape	**1.** Loss of visual continuity of townscape and scenic value. **2.** Visual conflict with surrounding community.	Less visual conflict with surrounding community.
Noise and Vibration	**1.** Risk of increased sound level to the community caused by sound reflection from bridge structure. **2.** Risk of increased sound/or vibration caused by big truck passing.	None.
Air Quality	Tend to be smooth to disperse exhaustion gas.	Require ventilation system.

Table 12.9-4 Summary of Environmental Impacts Identified for Two Design Options.

	Section c-c'(Avenida 7a)	
	Alternative 1 (Elevated)	Alternative 2 (Undergrounded)
Run-off	**1.** Risk of uncontrolled expressway run-off. **2.** Interference with regional surface and groundwater hydrology.	Less disturbance to surface run-off.
Groundwater	Less disturbance to regional groundwater flow.	**1.**Groundwater quality degradation during the construction period. **2.**Groundwater level drawdown during/or after construction. **3.** Enhanced consolidation due to the drawdown of groundwater level during/and after construction.
Landscape	**1.** Loss of visual continuity of townscape and scenic value. **2.** Visual conflict with surrounding community.	Less visual conflict with surrounding community.
Noise and Vibration	**1.** Risk of increased sound level to the community caused by sound reflection from bridge structure. **2.** Risk of increased sound/or vibration caused by big truck passing.	None.
Air Quality	Tend to be smooth to disperse exhaustion gas.	Require ventilation system.

2) *Calle 100*

Two alternative structural plans of the new expressway for two different cross-sections (i.e., elevated structure and Undergrounded one for sections a-a' and b-b', respectively) are prepared for Calle 100 by JICA Study Team. Based on the environmental information, summarized previously, environmental evaluation is made for two different sections, shown in this figure, respectively (Tables 12.9-5 and 12.9-6).

Table 12.9-5 Summary of Environmental Impacts Identified for Two Design Options.

	Section a-a' (Calle 100)	
	Alternative 1 (Elevated)	Alternative 2 (Undergrounded)
Run-off	**1.** Risk of uncontrolled expressway run-off. **2.** Interference with regional surface and groundwater hydrology.	Less disturbance to surface run-off.
Groundwater	Less disturbance to regional groundwater flow.	**1.**Groundwater quality degradation during the construction period. **2.**Groundwater level drawdown during/or after construction. **3.** Enhanced consolidation due to the drawdown of groundwater level during/and after construction.
Landscape	**1.** Loss of visual continuity of townscape and scenic value. **2.** Visual conflict with surrounding community.	Less visual conflict with surrounding community.
Noise and Vibration	**1.** Risk of increased sound level to the community caused by sound reflection from bridge structure. **2.** Risk of increased sound/or vibration caused by big truck passing.	None.
Air Quality	Tend to be smooth to disperse exhaustion gas.	Require ventilation system.

Table 12.9-6 Summary of Environmental Impacts Identified for Two Design Options.

	Section b-b' (Calle 100)	
	Alternative 1 (Elevated)	Alternative 2 (Undergrounded)
Run-off	**1.** Risk of uncontrolled expressway run-off. **2.** Interference with regional surface and groundwater hydrology.	Less disturbance to surface run-off.
Groundwater	Less disturbance to regional groundwater flow.	**1.**Groundwater quality degradation during the construction period. **2.**Groundwater level drawdown during/or after construction. **3.** Enhanced consolidation due to the drawdown of groundwater level during/and after construction.
Landscape	**1.** Loss of visual continuity of townscape and scenic value. **2.** Visual conflict with surrounding community.	Less visual conflict with surrounding community.
Noise and Vibration	**1.** Risk of increased sound level to the community caused by sound reflection from bridge structure. **2.** Risk of increased sound/or vibration caused by big truck passing.	None.
Air Quality	Tend to be smooth to disperse exhaustion gas.	Require ventilation system.

3) *Avenida Quito*

Two alternative structural plans of the new expressway for three different cross-sections (i.e., elevated structure and Undergrounded one for sections a-a', b-b' and c-c', respectively) are prepared for Avenida Quito by JICA Study Team. Note there is only structural plan prepared for the section c-c'. Based on the environmental information, summarized previously, environmental evaluation is made for three different sections, shown in this figure, respectively (Tables 12.9-7 through 12.9-9).

Table 12.9-7 Summary of Environmental Impacts Identified for Two Design Options.

	Section a-a' (Quito)	
	Alternative 1 (Elevated)	Alternative 2 (Undergrounded)
Run-off	**1.** Risk of uncontrolled expressway run-off. **2.** Interference with regional surface and groundwater hydrology.	Less disturbance to surface run-off.
Groundwater	Less disturbance to regional groundwater flow.	**1.**Groundwater quality degradation during the construction period. **2.**Groundwater level drawdown during/or after construction. **3.** Enhanced consolidation due to the drawdown of groundwater level during/and after construction.
Landscape	**1.** Loss of visual continuity of townscape and scenic value. **2.** Visual conflict with surrounding community.	Less visual conflict with surrounding community.
Noise and Vibration	**1.** Risk of increased sound level to the community caused by sound reflection from bridge structure. **2.** Risk of increased sound/or vibration caused by big truck passing.	None.
Air Quality	Tend to be smooth to disperse exhaustion gas.	Require ventilation system.

Table 12.9-8 Summary of Environmental Impacts Identified for Two Design Options.

	Section b-b' (Quito)	
	Alternative 1 (Elevated)	Alternative 2 (Undergrounded)
Run-off	**1.** Risk of uncontrolled expressway run-off. **2.** Interference with regional surface and groundwater hydrology.	Less disturbance to surface run-off.
Groundwater	Less disturbance to regional groundwater flow.	**1.**Groundwater quality degradation during the construction period. **2.**Groundwater level drawdown during/or after construction. **3.** Enhanced consolidation due to the drawdown of groundwater level during/and after construction.
Landscape	**1.** Loss of visual continuity of townscape and scenic value. **2.** Visual conflict with surrounding community.	Less visual conflict with surrounding community.
Noise and Vibration	**1.** Risk of increased sound level to the community caused by sound reflection from bridge structure. **2.** Risk of increased sound/or vibration caused by big truck passing.	None.
Air Quality	Tend to be smooth to disperse exhaustion gas.	Require ventilation system.

Table 12.9-9 Summary of Environmental Impacts Identified for Two Design Options.

	Section c-c' (Quito)
	Alternative 1 (Elevated)
Run-off	**1.** Risk of uncontrolled expressway run-off. **2.** Interference with regional surface and groundwater hydrology.
Groundwater	Less disturbance to regional groundwater flow.
Landscape	Less visual conflict with surrounding community.
Noise and Vibration	**1.** Risk of increased sound level to the community caused by sound reflection from bridge structure. **2.** Risk of increased sound/or vibration caused by big truck passing.
Air Quality	Tend to be smooth to disperse exhaustion gas.

(3) New Circunvaral

In this section, the environmental evaluation of the New Circunvaral Route based on proposed structural design concepts is carried out. This proposed route is located around the elevation of 2,800 EL-m, and mainly consists of tunnel section. Table 12.9-10 summarizes pros and cons of this evaluation.

Table 12.9-10 Summary of Environmental Impacts Identified for New Circunvaral.

	Open	Tunnel
Soils	Exposure of soil to erosion and cause excessive soil erosion.	Less significant.
Run-off	**1.** Risk of uncontrolled expressway run-off. **2.** Interference with regional surface and groundwater hydrology.	Less disturbance to surface run-off.
Groundwater	**1.**Groundwater quality degradation during the construction period. **2.**Groundwater level drawdown during/or after construction. **3.** Disturbance to regional groundwater flow. **4.** Enhanced consolidation or vegetation pattern change due to the drawdown of groundwater level during/and after construction.	**1.**Groundwater quality degradation during the construction period. **2.**Groundwater level drawdown during/or after construction. **3.** Disturbance to regional groundwater flow. **4.** Enhanced consolidation or vegetation pattern change due to the drawdown of groundwater level during/and after construction.
River Flow	**1.** Downstream water quality degradation caused by soil erosion. **2.** Excessive water blockage of drainage system caused by soil erosion. **3.** Increased sedimentation caused by soil erosion.	None
Vegetation	**1.** Vegetation cover removal. **2.** Vegetation pattern change due to the drawdown of groundwater level during/and after construction.	**1.** Vegetation pattern change due to the drawdown of groundwater level during/and after construction.
Landscape	**1.** Loss of visual continuity of townscape and scenic value. **2.** Visual conflict with surrounding community.	Less visual conflict with surrounding community.
Noise and Vibration	**1.** Risk of increased sound level to the surrounding communities.	None.
Air Quality	Tend to be smooth to disperse exhaustion gas.	Require ventilation system.

CHAPTER 13
Initial Evaluation of Alternative Routes

13. INITIAL EVALUATION OF ALTERNATIVE ROUTES

13.1. FUTURE TRAFFIC VOLUME ASSIGNMENT

13.1.1. TRAFFIC ASSIGNMENT ON INNER RING EXPRESSWAY

(1) Assignment Conditions

The future traffic demand in 2005 and 2015 on the inner ring expressway are forecast based on the results of person trip survey which was conducted by the JICA Study Team in 1995 during the Master Plan stage of the urban transport in Santa Fe de Bogota. The outline of the methodologies of the future traffic demand forecast is described in Chapter 6 in this report.

Considering the functions and characteristics of the inner ring expressway, this road should introduce a full access traffic control system with toll system. At present, how much is the optimum traffic charge on inner ring expressway can not be decided, therefore, some alternative toll charge cases are identified for examination of toll charge and scale of infrastructure for the inner ring expressway. The optimum traffic toll charge rate will be decided after examination of economic and financial evaluation and it will be conducted in the later stage. In addition to the above, some alternative routes of inner ring expressway are also identified for selection of optimum route. Taking into account the above mentioned conditions, the various cases of traffic assignment are carried out to evaluate the alternative routes, and to conduct the preliminary design, and to examine economic and financial evaluation.

(2) Results of Traffic Assignment

The traffic assignment study is conducted on the various alternatives such as three (3) alternative routes, three (3) different toll charge (1,000, 2,000, and 3,000 pesos), in the year 2005 and 2015. The major results are shown in following figures. Without a project the inner ring expressway is not constructed.

1) Without project in 2005 (see Figure 13.1-1)
2) Without project in 2015 (see Figure 13.1-2)
3) Alternative route-1 in 2015(2,000, 3,000 pesos) (see Figure 13.1-3 to 4)
4) Alternative route-2 in 2015(2,000, 3,000 pesos) (see Figure 13.1-5 to 6)
5) Alternative route-3 in 2015(2,000, 3,000 pesos) (see Figure 13.1-7 to 9)

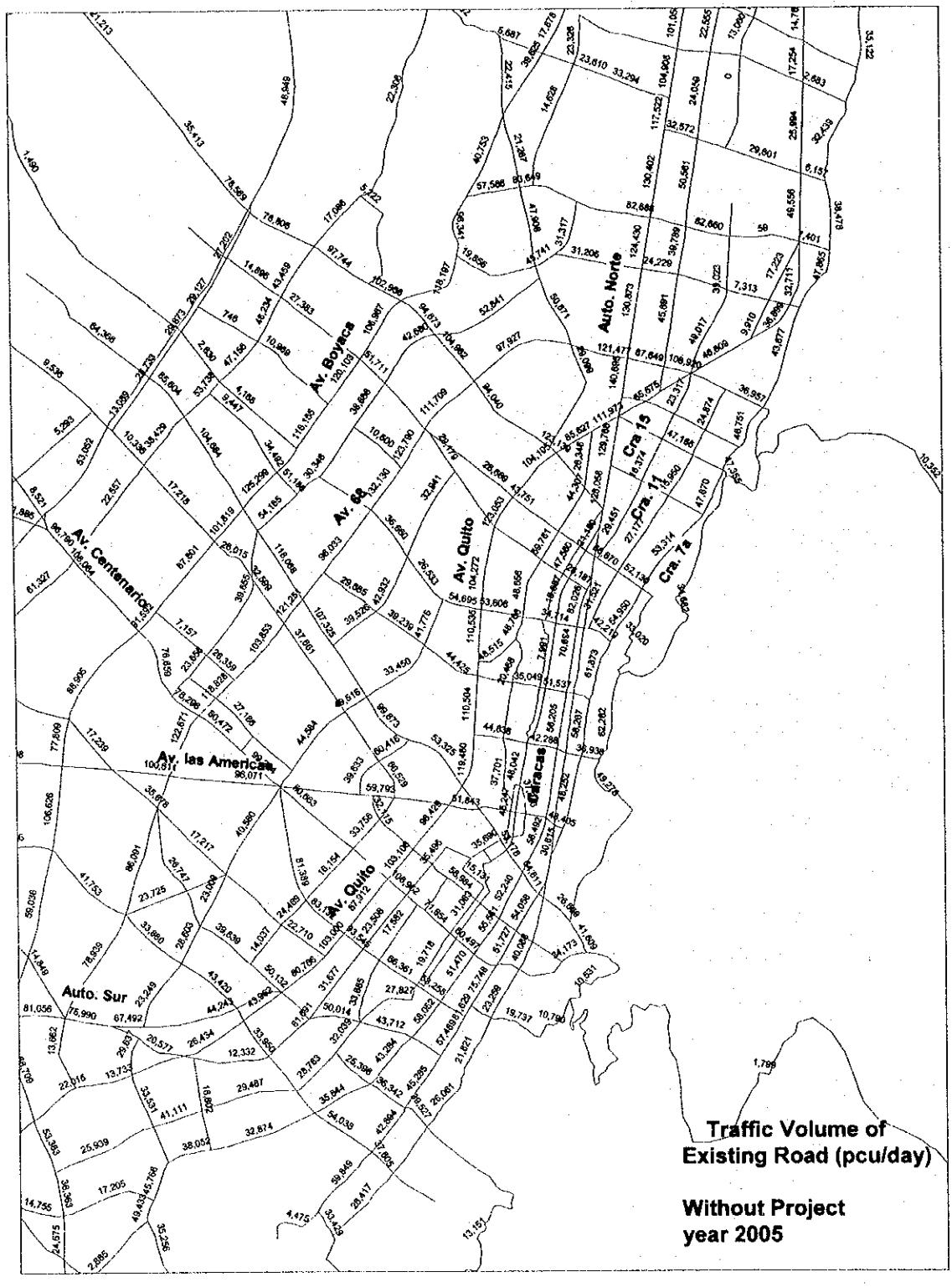


Figure 13.1-1 Traffic Assignment Without Project in 2005 (pcu/ day)

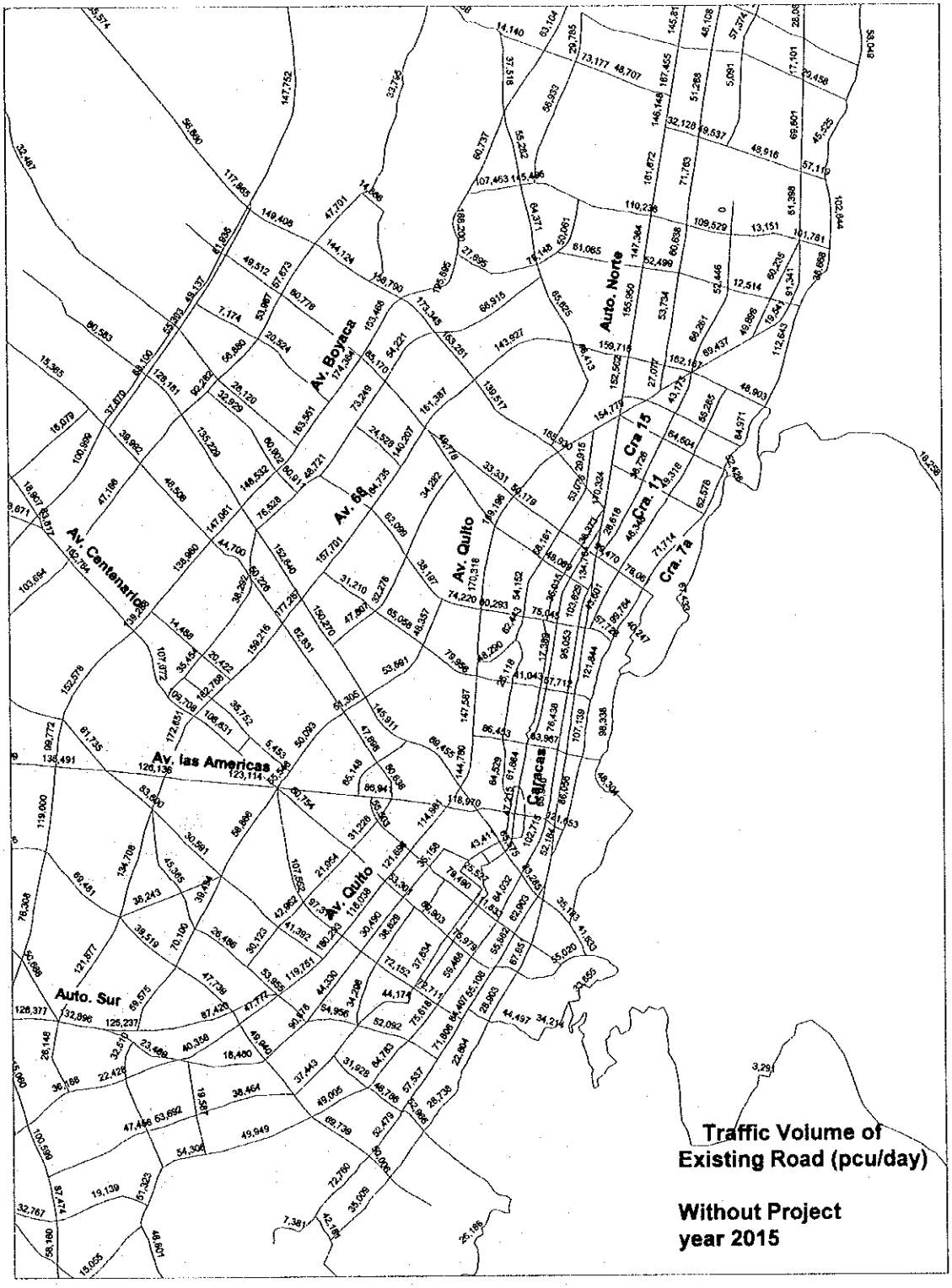


Figure 13.1-2 Traffic Assignment Without Project in 2015 (pcu/day)

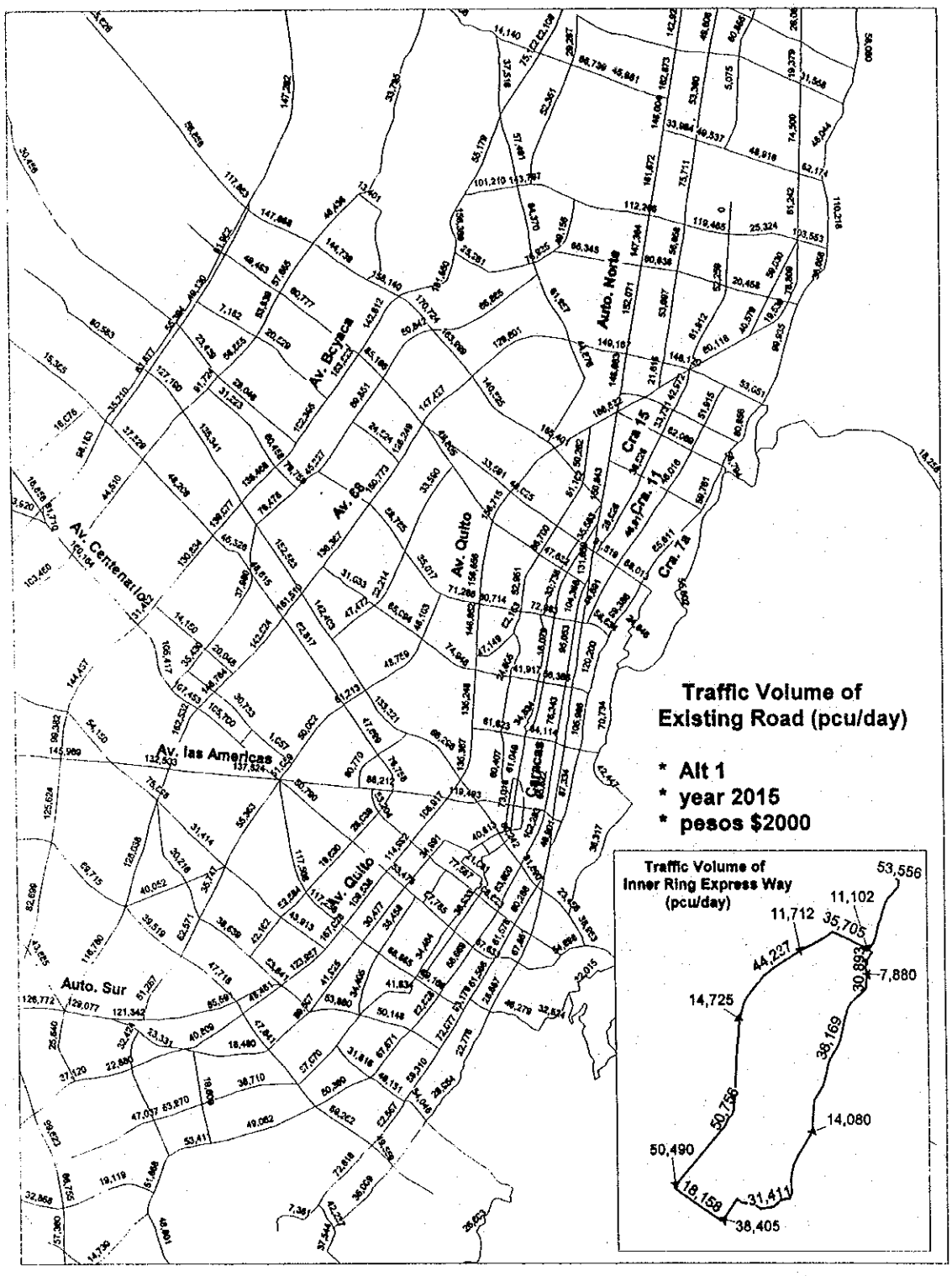


Figure 13.1-3 Traffic Assignment on Alt. Route-1 in 2015 (2,000 pesos) (pcu/day)

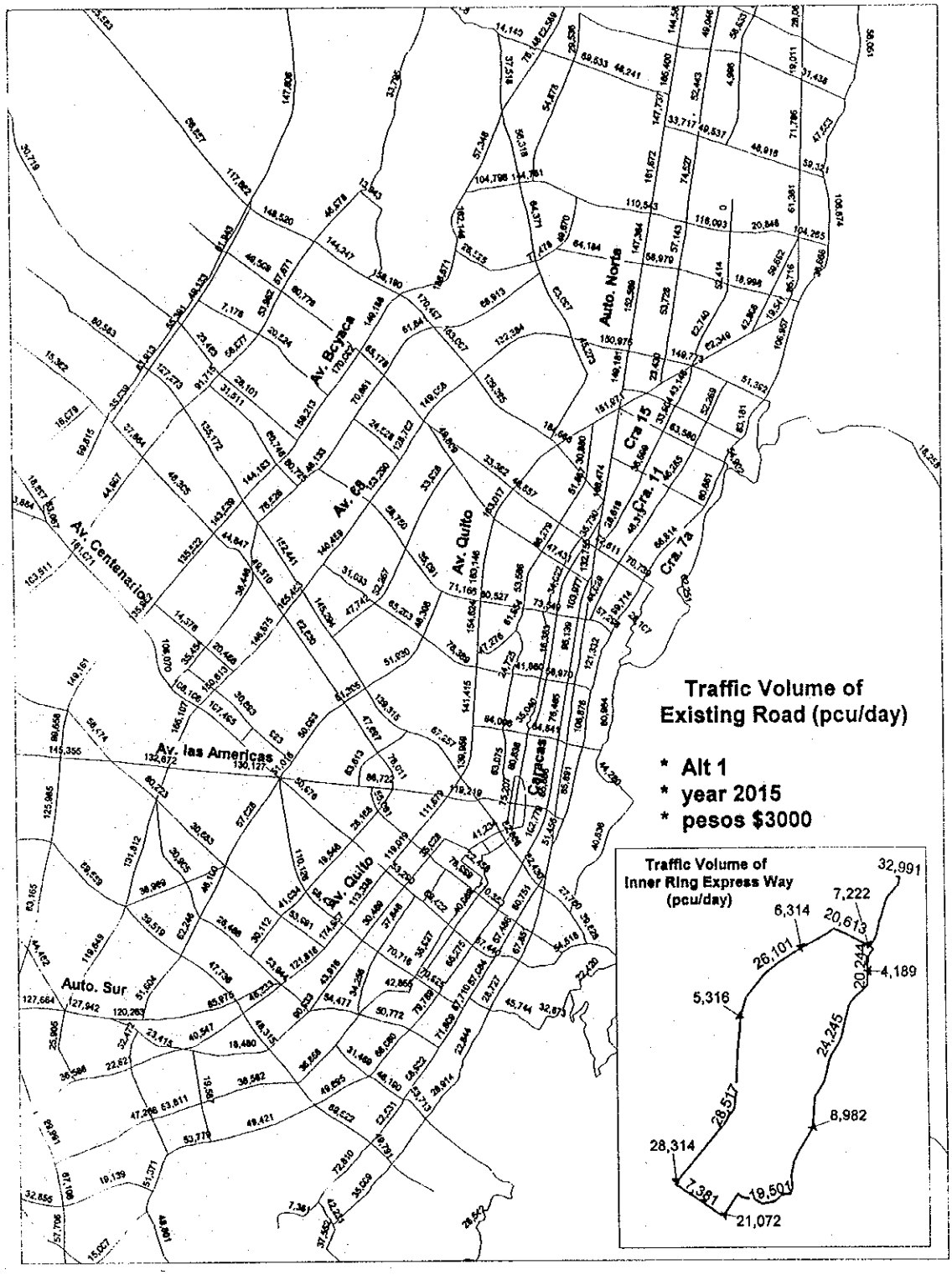


Figure 13.1-4 Traffic Assignment on Alt. Route-1 (3,000 pesos) (pcu/day)

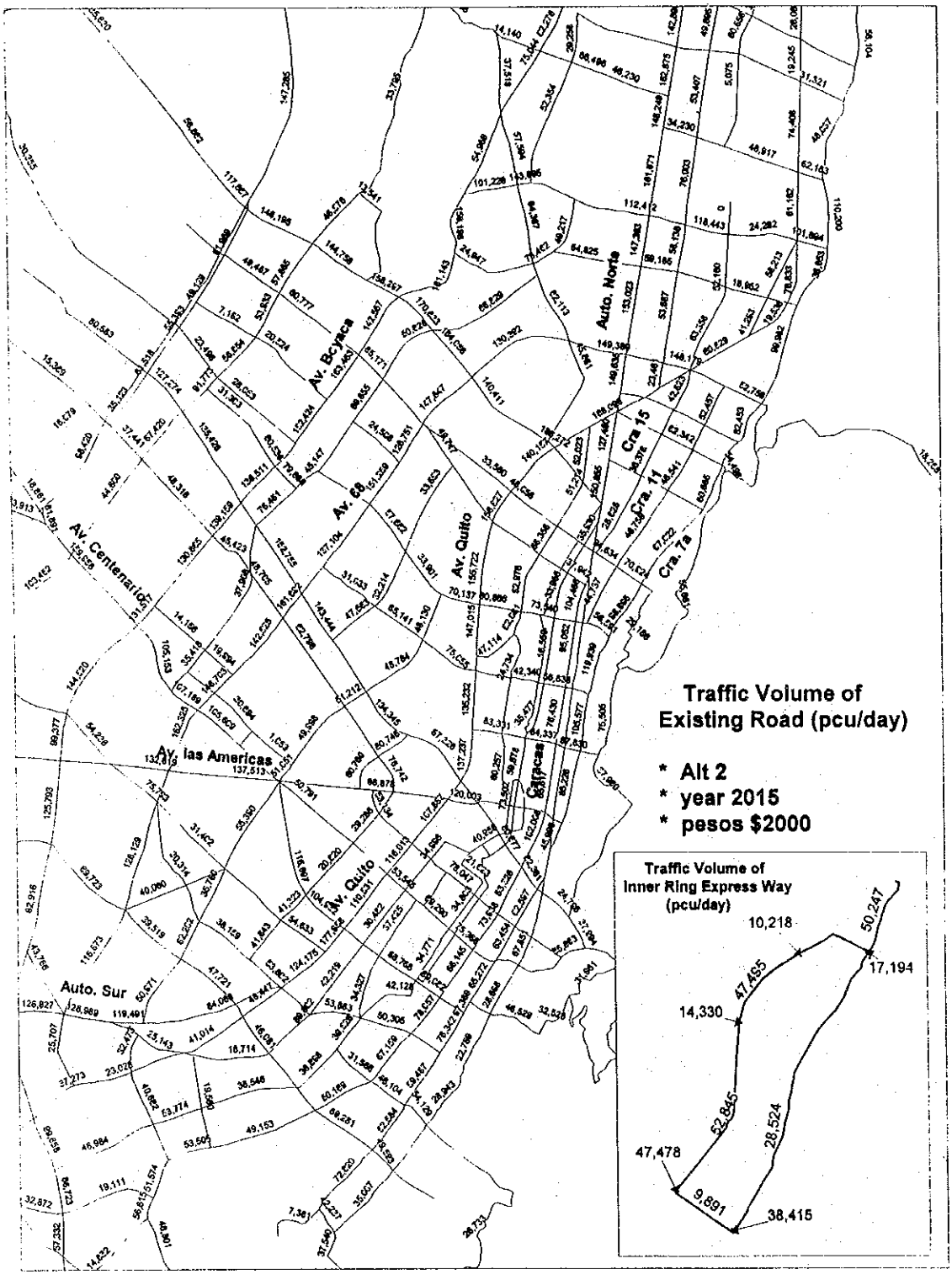


Figure 13.1-5 Traffic Assignment on Alt Route-2 (2,000 pesos) (pcu/day)

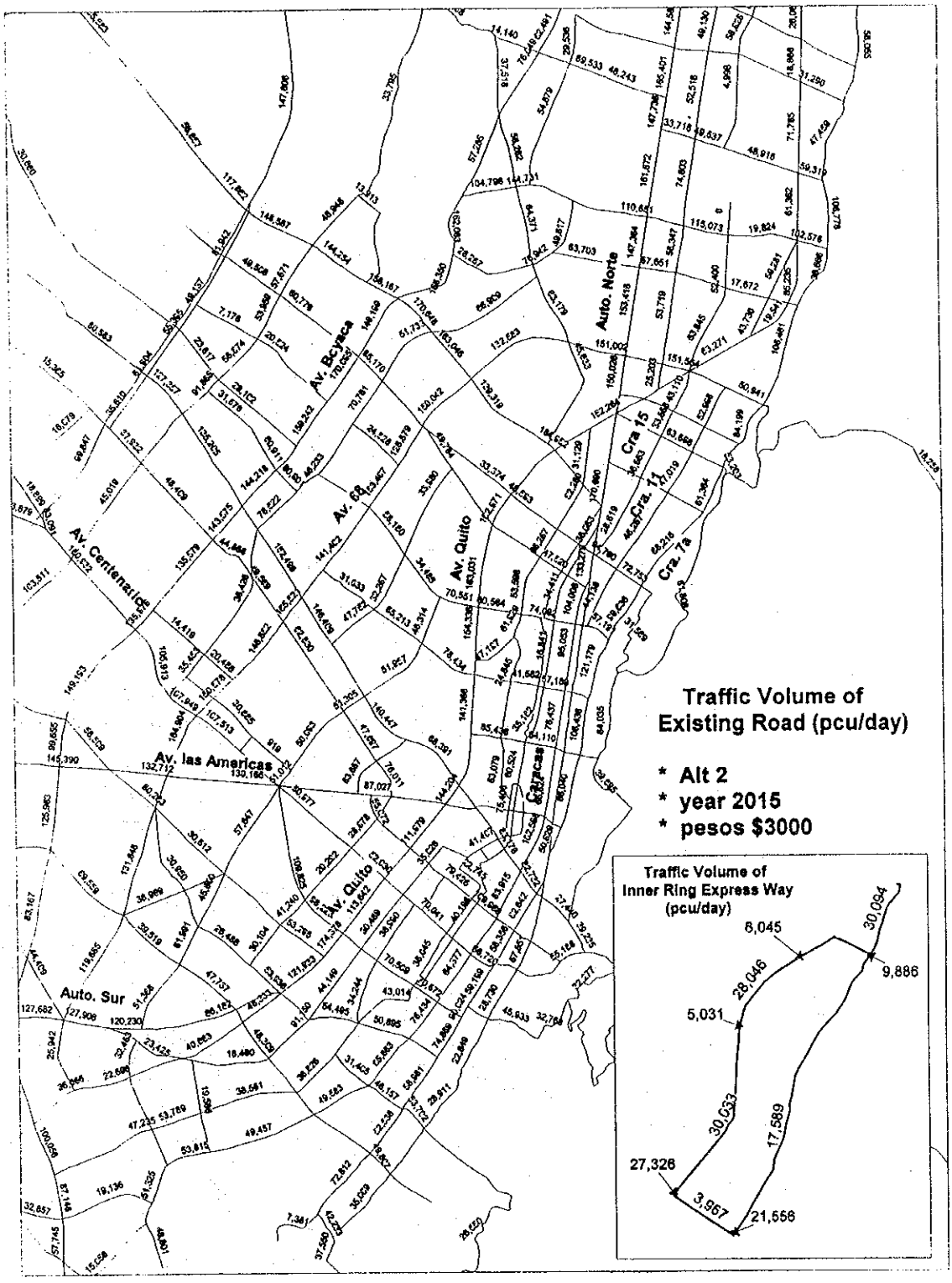


Figure 13.1-6 Traffic Assignment on Alt-2 (3,000 pesos) (pcu/day)

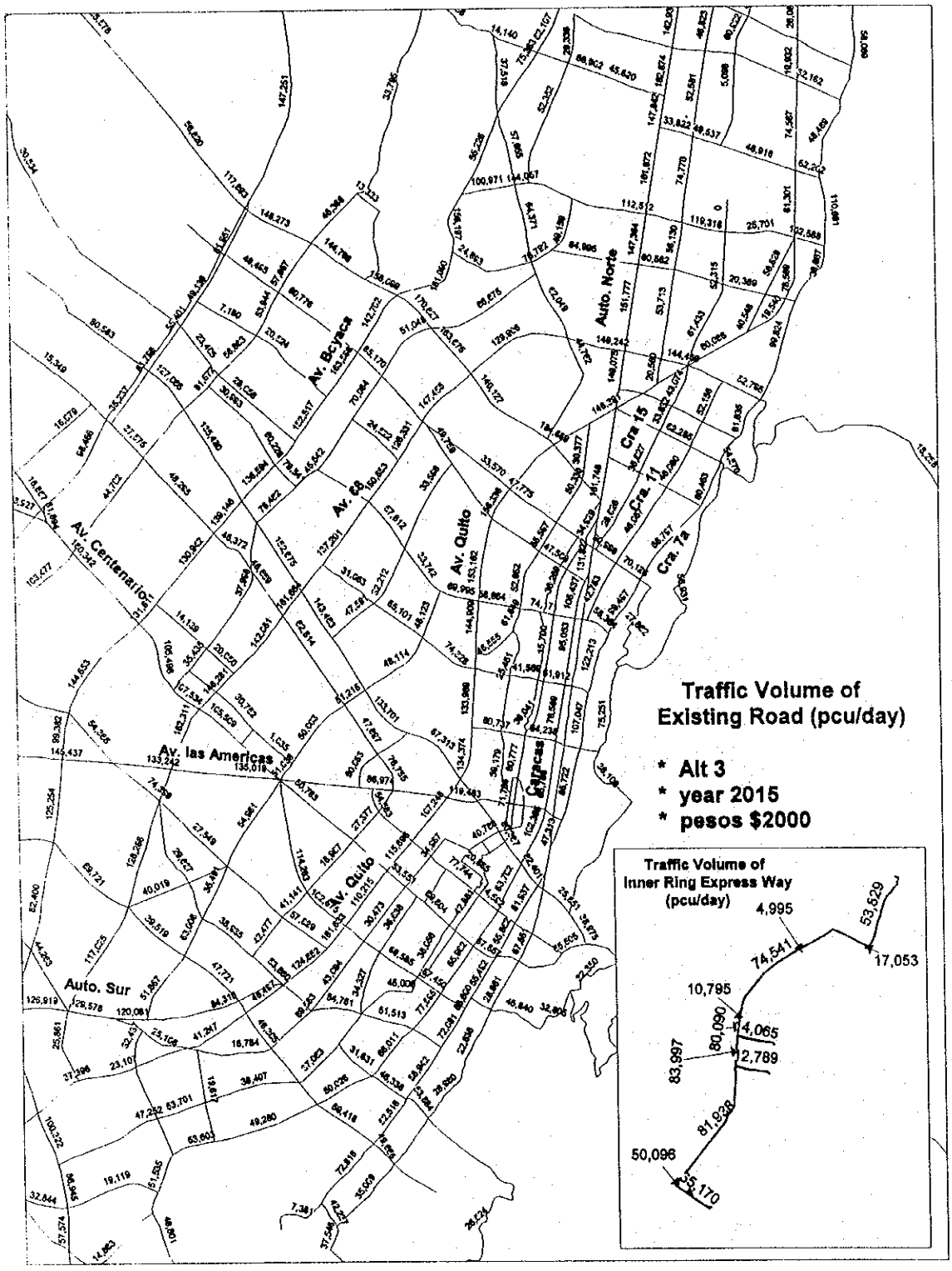


Figure 13.1-7 Traffic Assignment on Alt. Route-3 (2,000 pesos) (pcu/day)

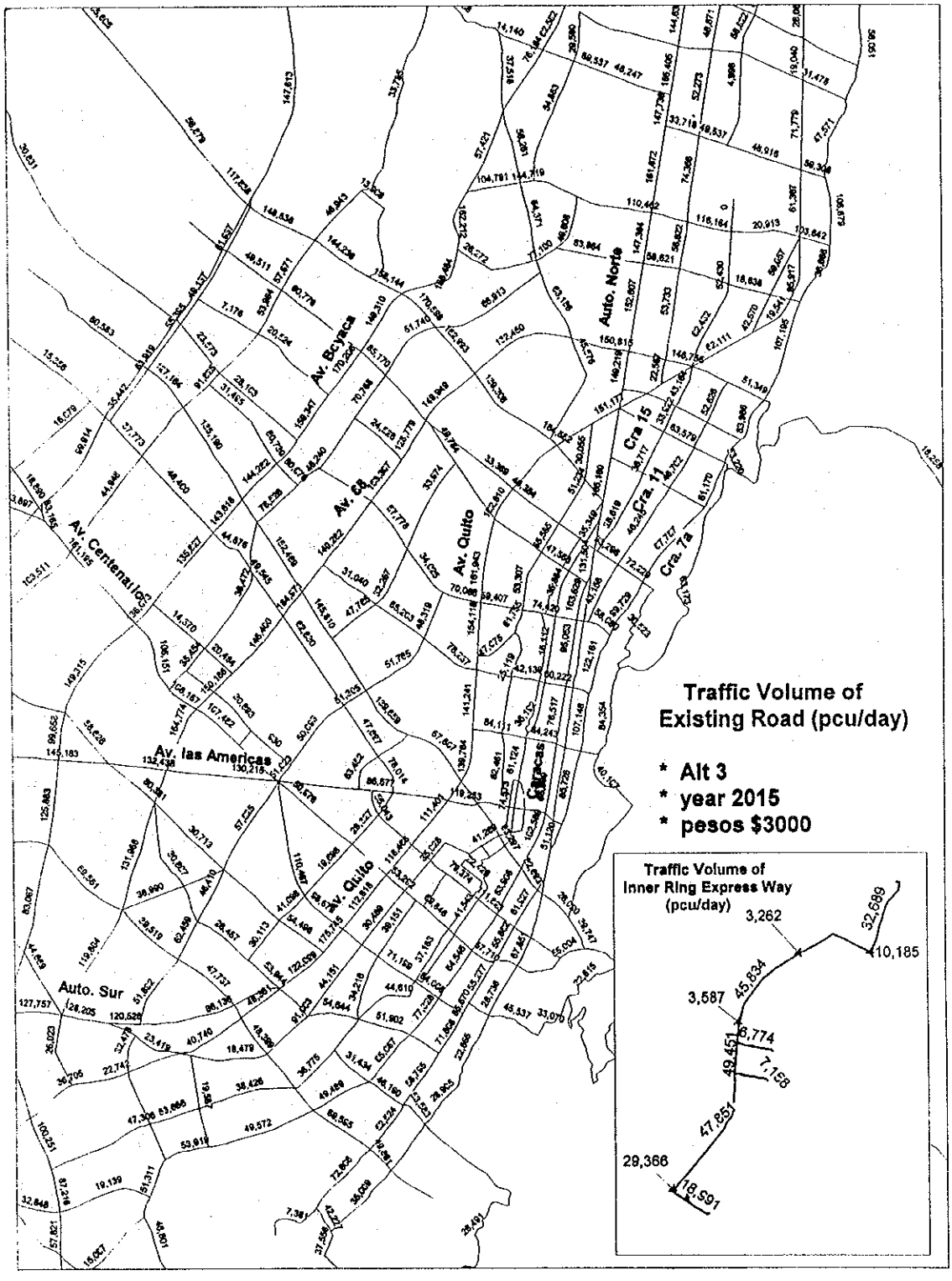


Figure 13.1-8 Traffic Assignment on Alt.Route-3 (3,000 pesos) (pcu/day)

13.2. SELECTION OF ALTERNATIVE ROUTES

13.2.1. EVALUATION OF ALTERNATIVE ROUTES

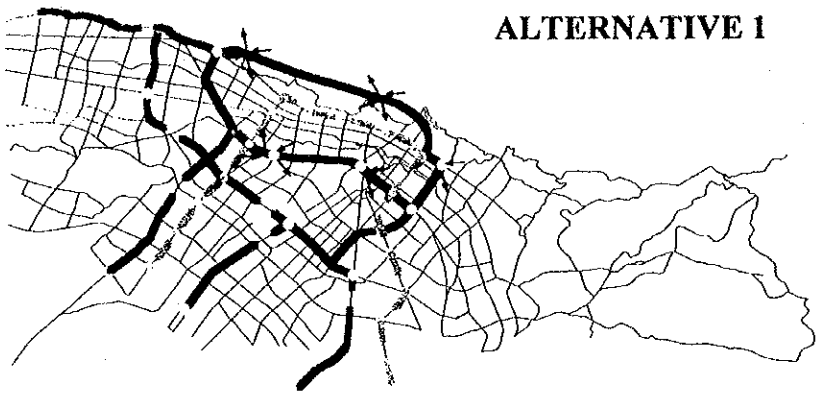
(1) Outline Of Alternative Routes

The three (3) alternative routes were identified in previous chapter 5 on this Report considering the traffic conditions and characteristics of Bogota city as well as existing and future road network configuration in the city of Bogota. The route locations of each alternative routes are shown in Figure 13.2-1, and the general dimensions of each route are shown in Table 13.2-1 respectively.

Table 13.2-1 Dimension of Alternative Routes

Items / Alternative Routes	Alt. Route-1	Alt. Route-2	Alt. Route-3
Design speed(km/h)	60-80	60-80	60-80
1. No. of lane required	4-lane dual	4-lane dual	4-lane dual
2. Type of road adopted	Bridge type Tunnel type Earth type	Bridge type Wall type	Bridge type Wall type
3. No. of interchange	6 locations	5 locations	4 locations
4. No. of lane on ramp	2-lane dual	2-lane dual	2-dual
5. Location of routes	Av.7a(116-100) Calle100 Av. Quito Calle6 Cirucunvaral	Av.7a(116-100) Calle100 Av.Quito Calle6 Av.7a	Av.7a(116-100) Calle100 Av.Quito Calle6
6.Total road length(km)	34.87	29.42	18.82
6-1 Bridge length(km)	25.89	29.42	18.82
6-2 Tunnel length(km)	6.84	0	0
6-3 Earth length(km)	2.14	0	0

Prior to the evaluation study for the Alternative Routes, the initial preliminary design of the each road segment of Inner Ring Expressway is carried out to recognize the outline of the road structure conditions of each Alternative Route. The results of the initial preliminary design are shown from Figure 13.2-2 to Figure 13.2-14.



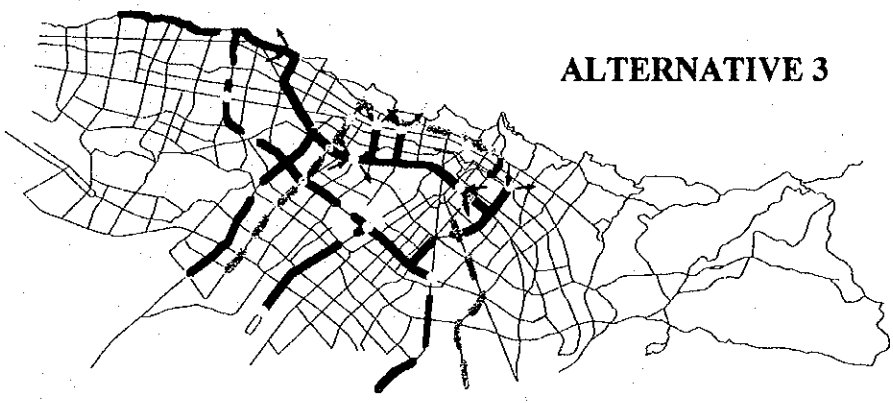


Figure 13.2-1 Location of Each Alternative Route

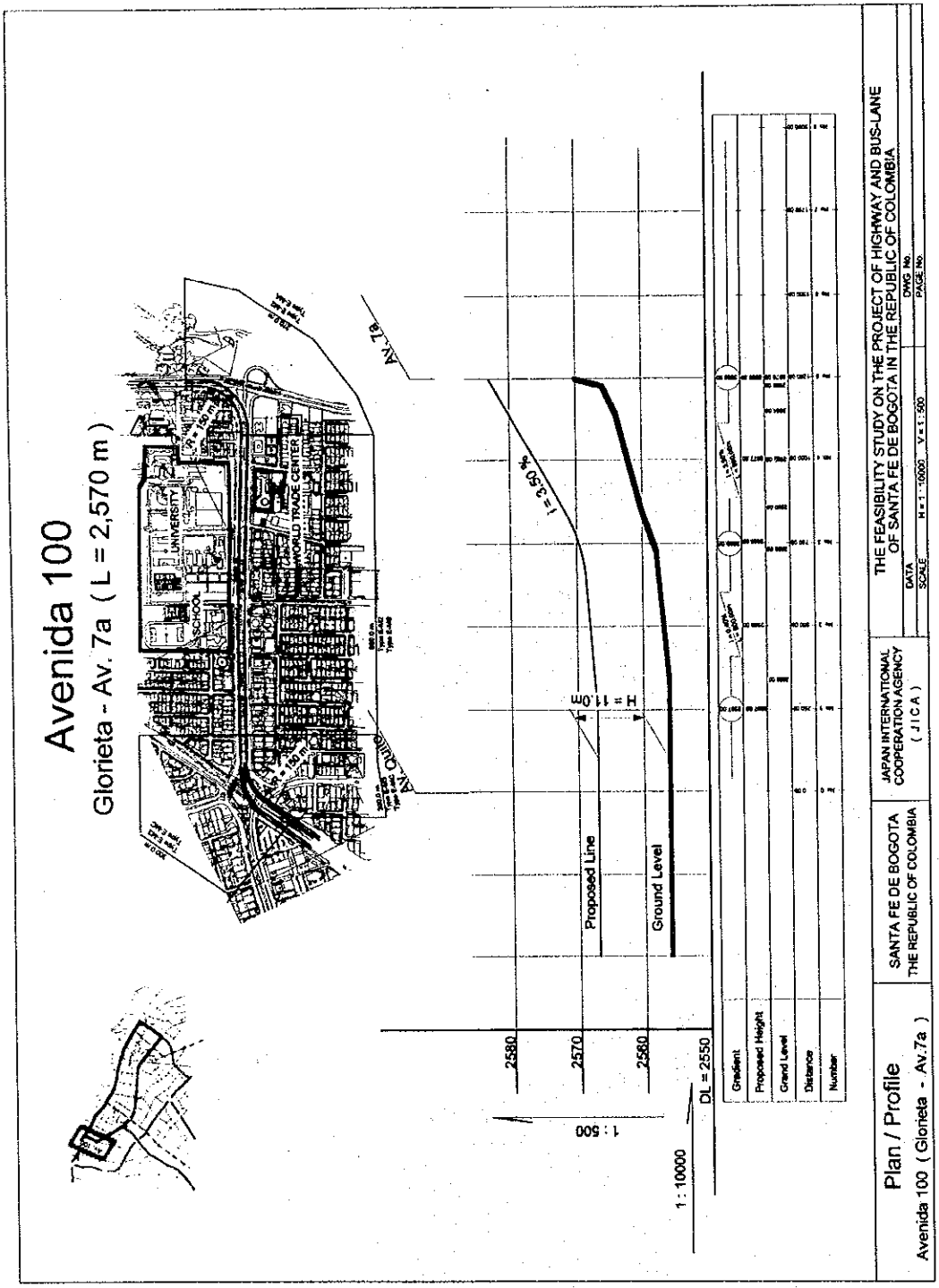


Figure 13.2-2 General Road Design on Calle 100

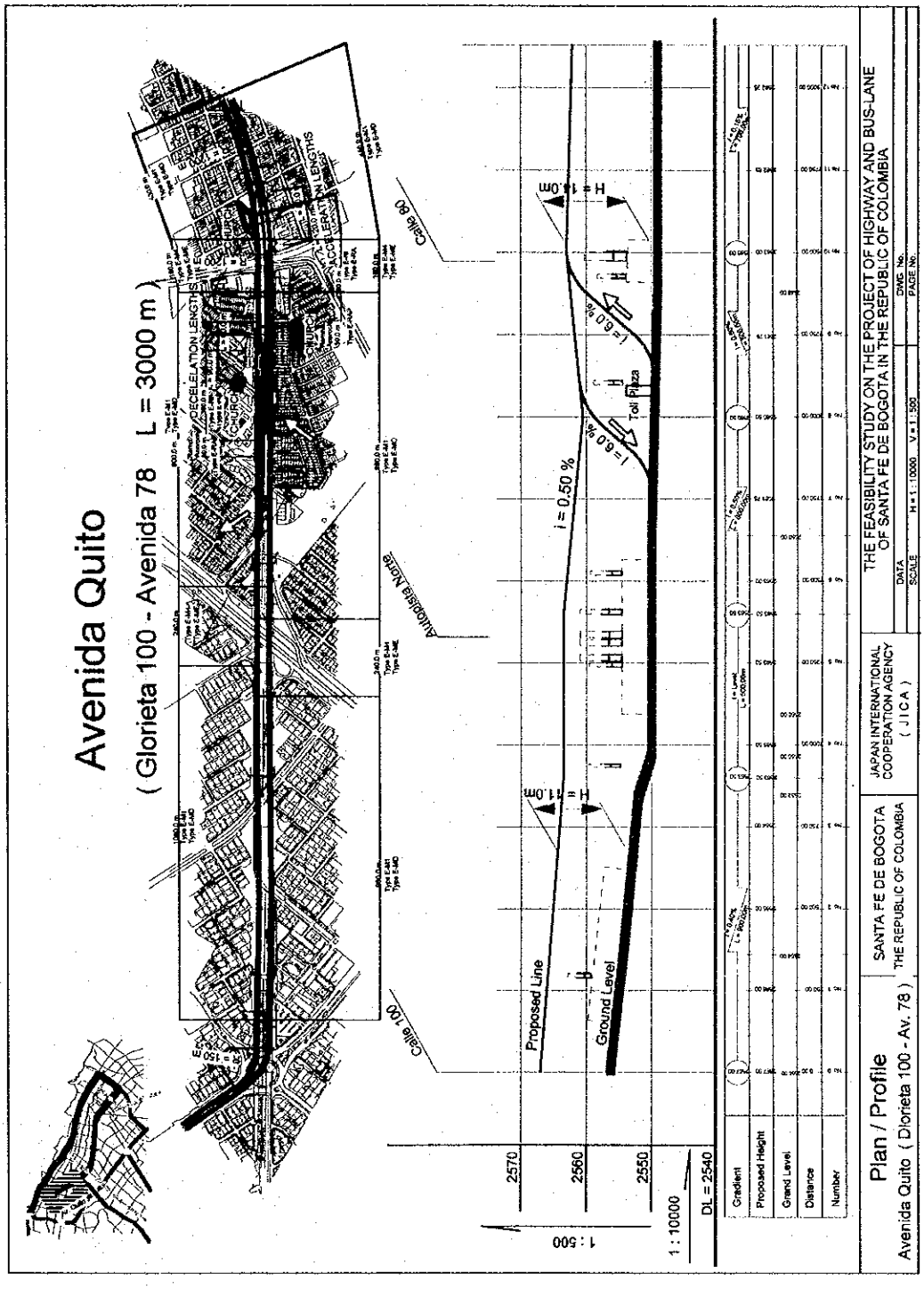


Figure 13.2-3 General Road Design on Av. Quito (1)

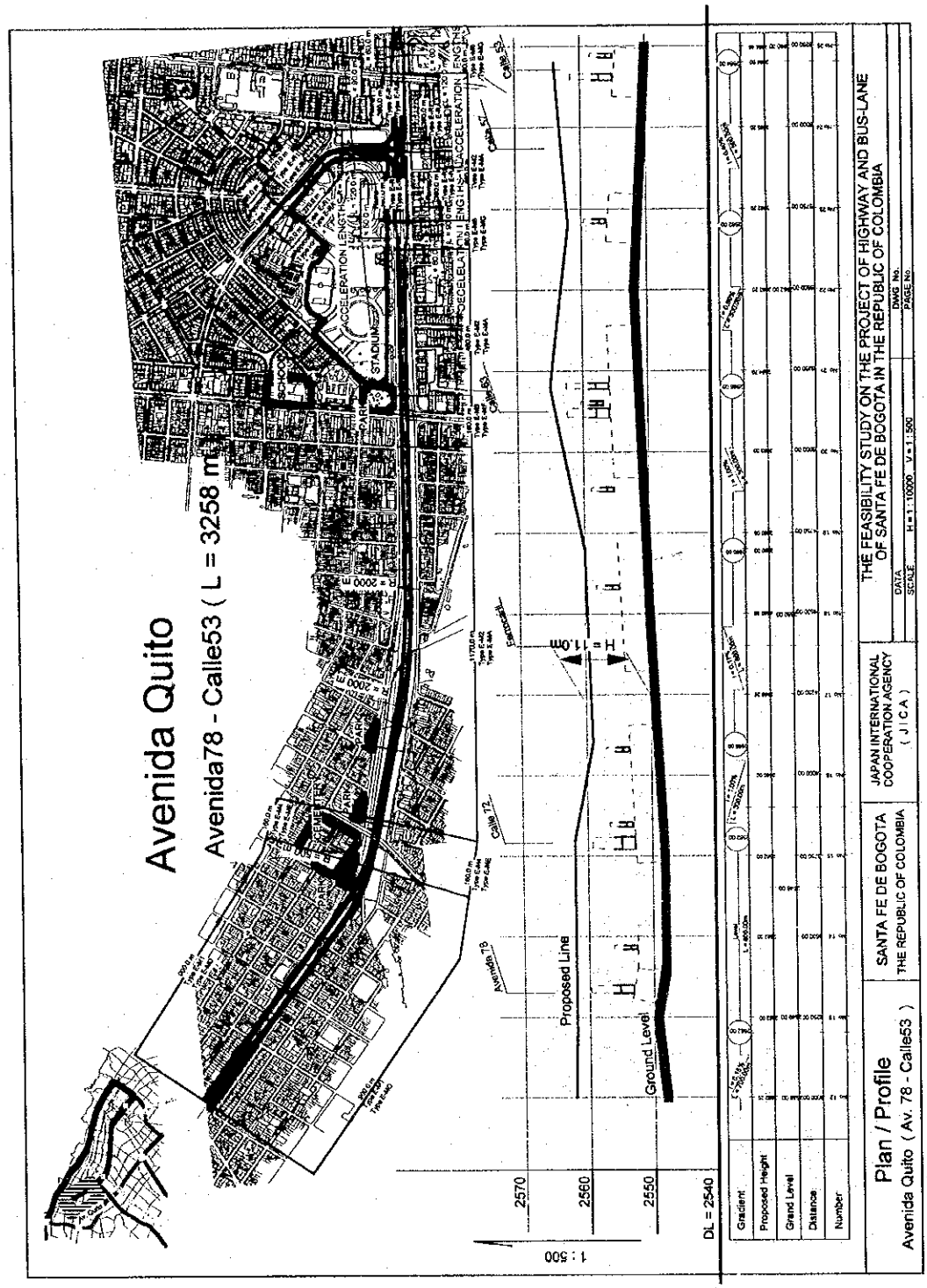


Figure 13.2-4 General Road Design on Av. Quito (2)

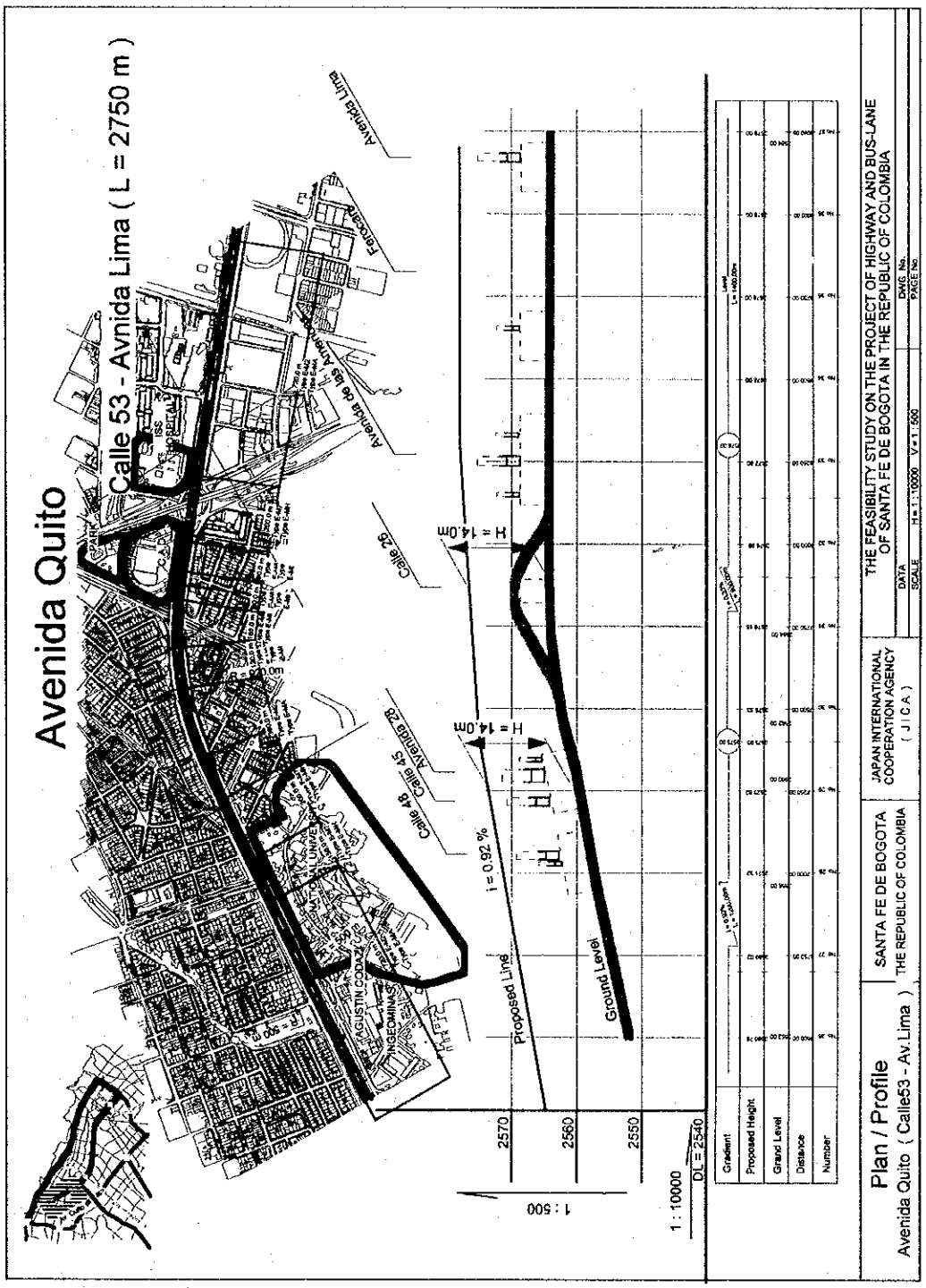


Figure 13.2-5 General Road Design on Av. Quito (3)

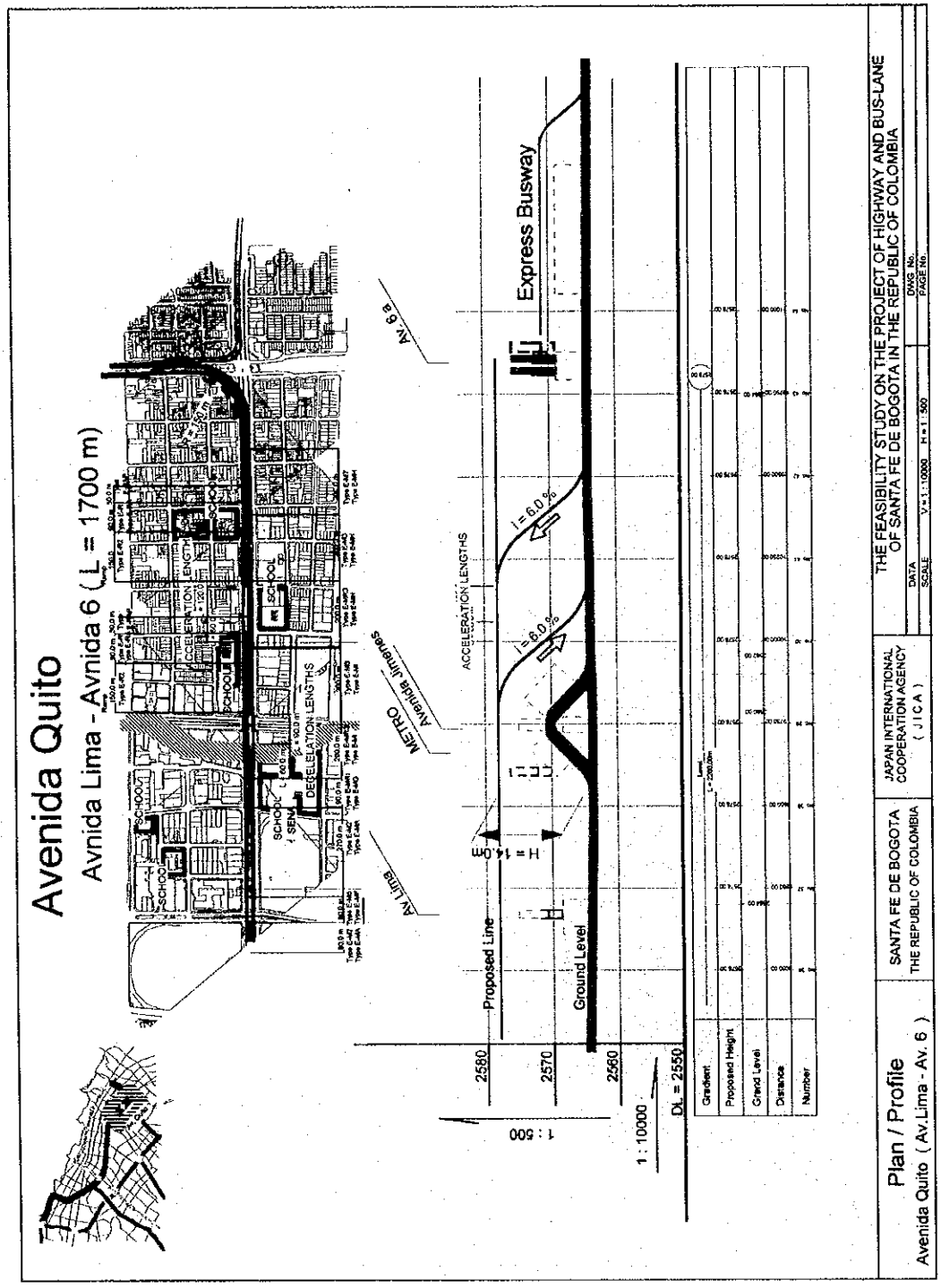


Figure 13.2-6 General Road Design on Av. Quito (4)

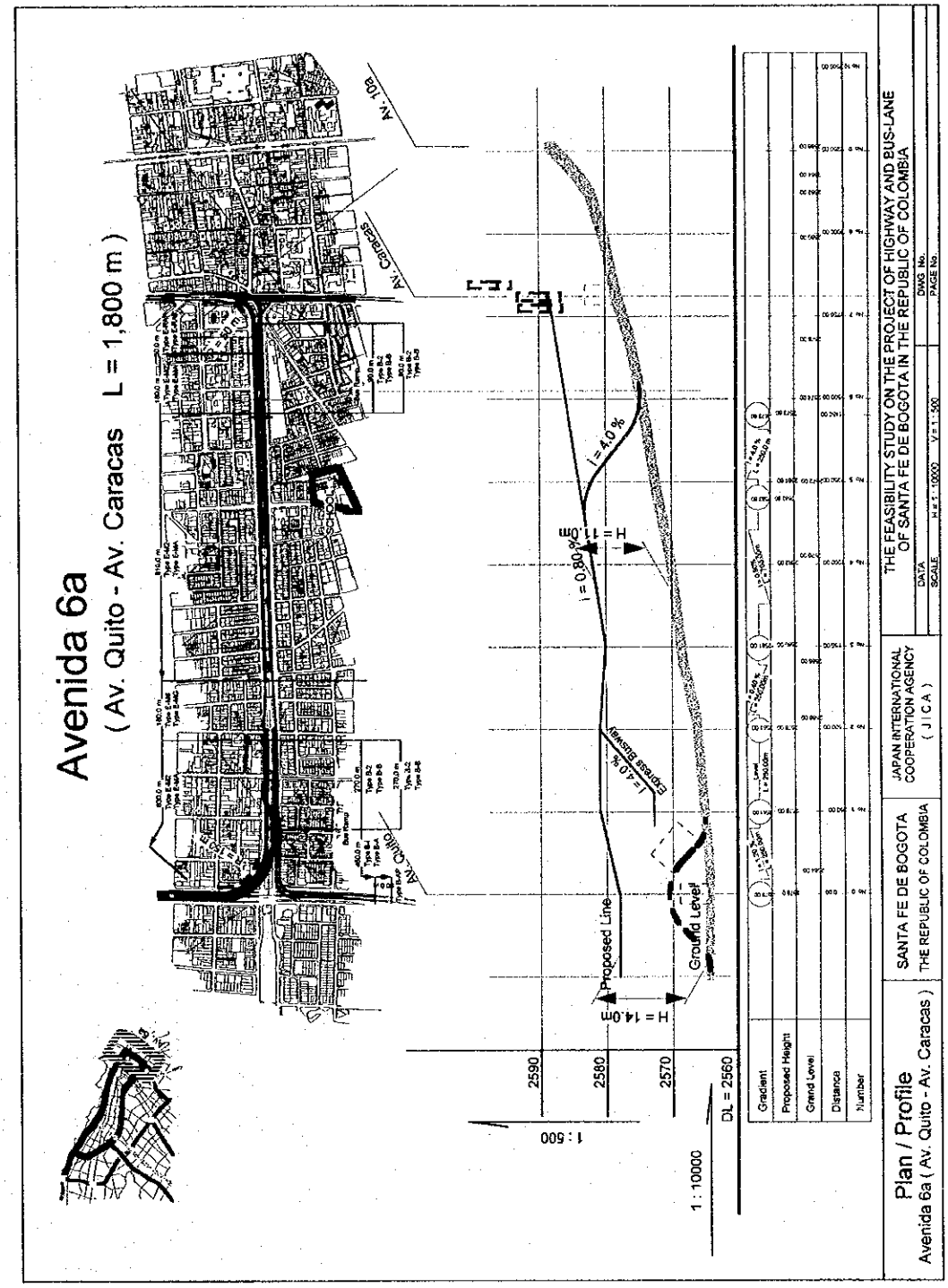


Figure 13.2-7 General Road Design on Calle 6

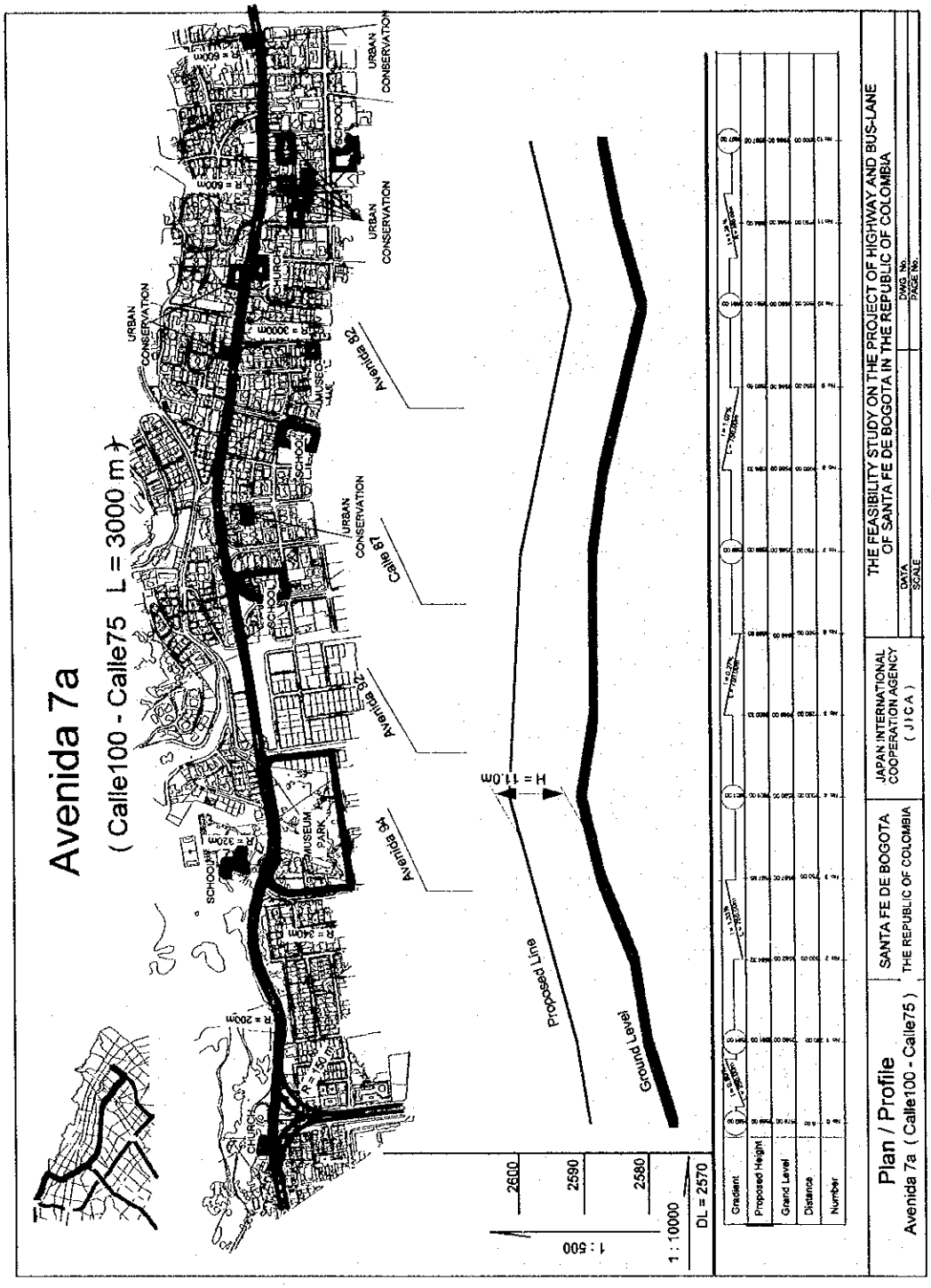


Figure 13.2-8 General Road Design on Av. 7a (1)

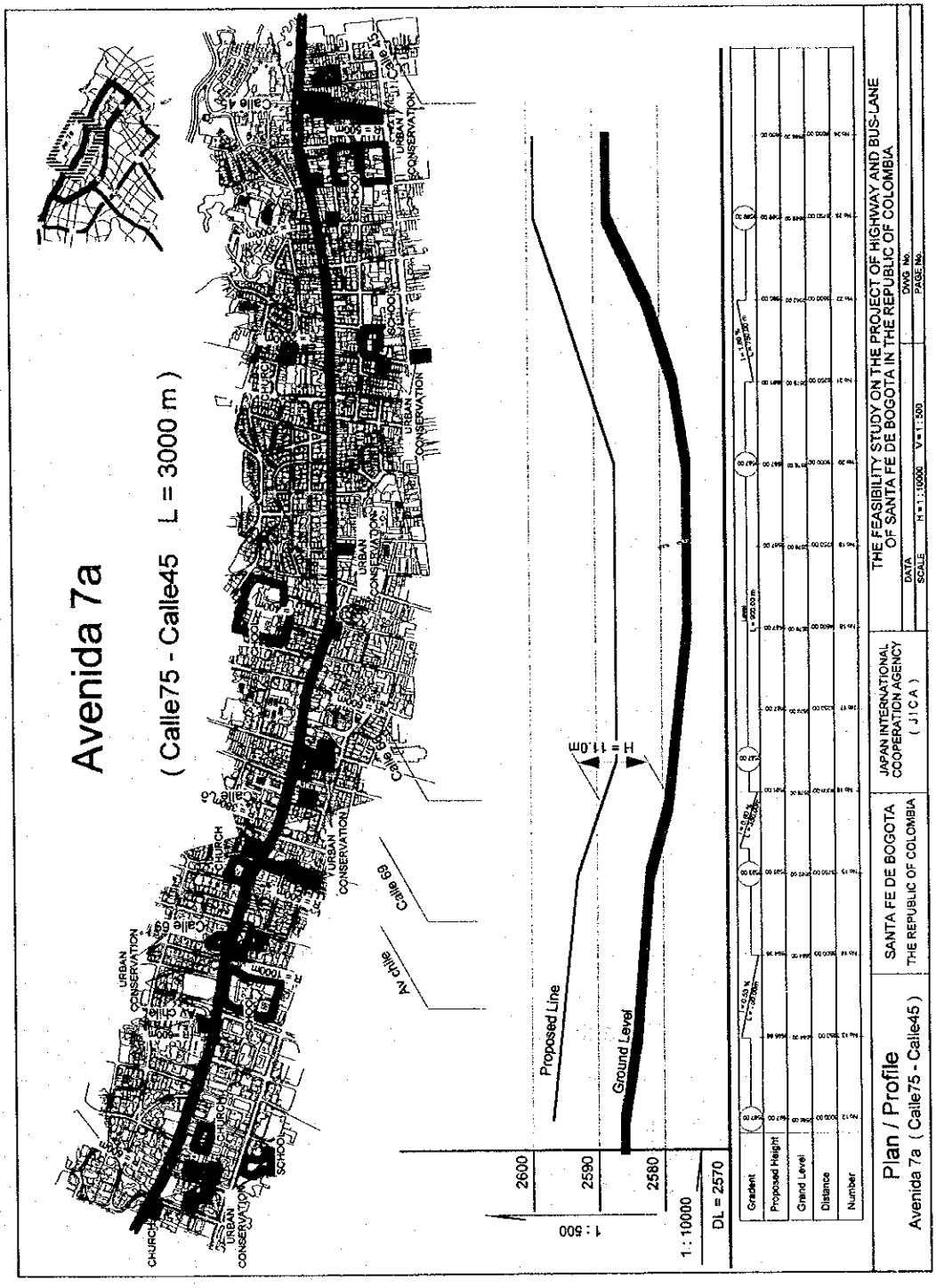


Figure 13.2-9 General Road Design on Av. 7a (2)

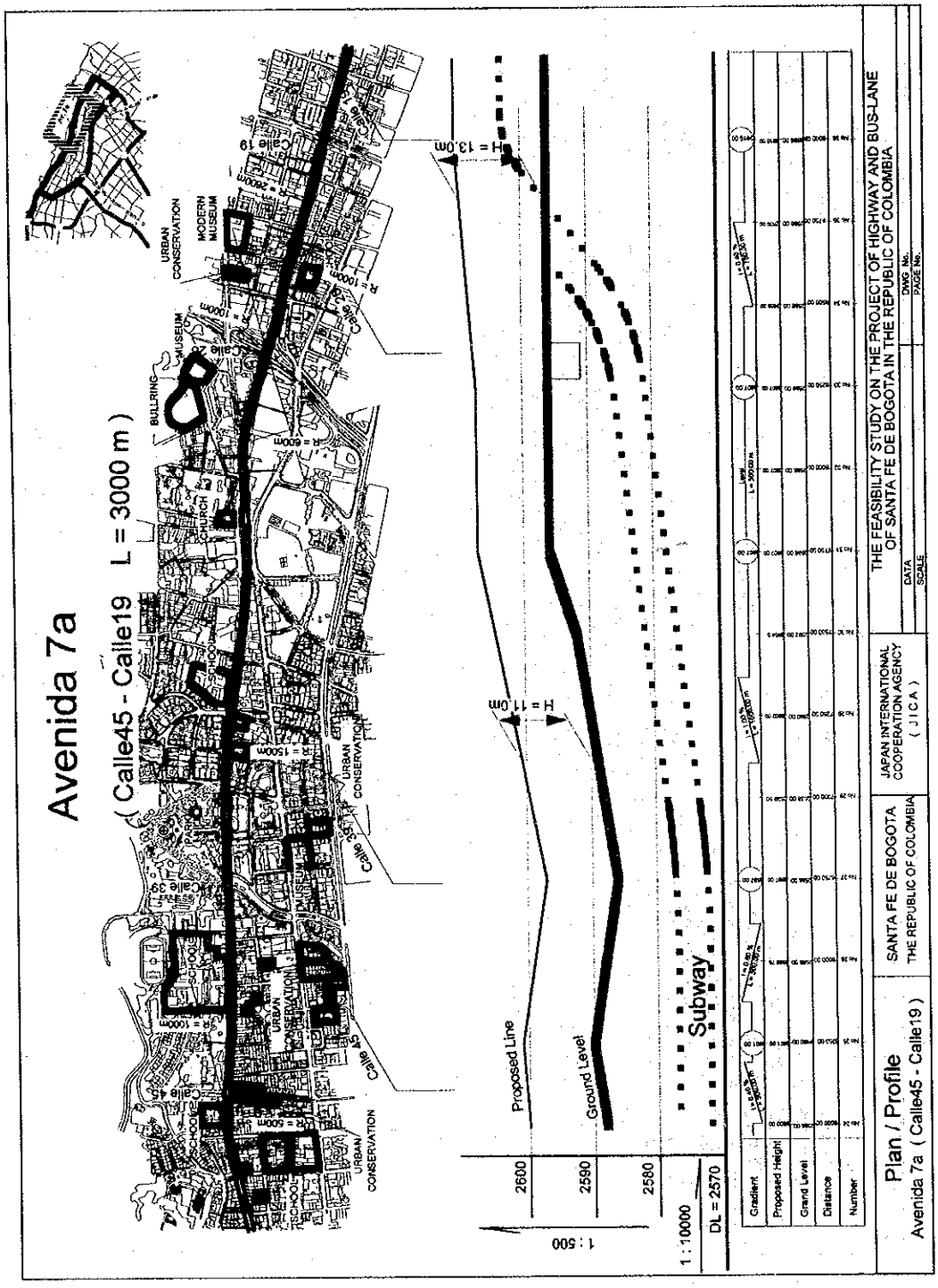


Figure 13.2-10 General Road Design on Av. 7a (3)

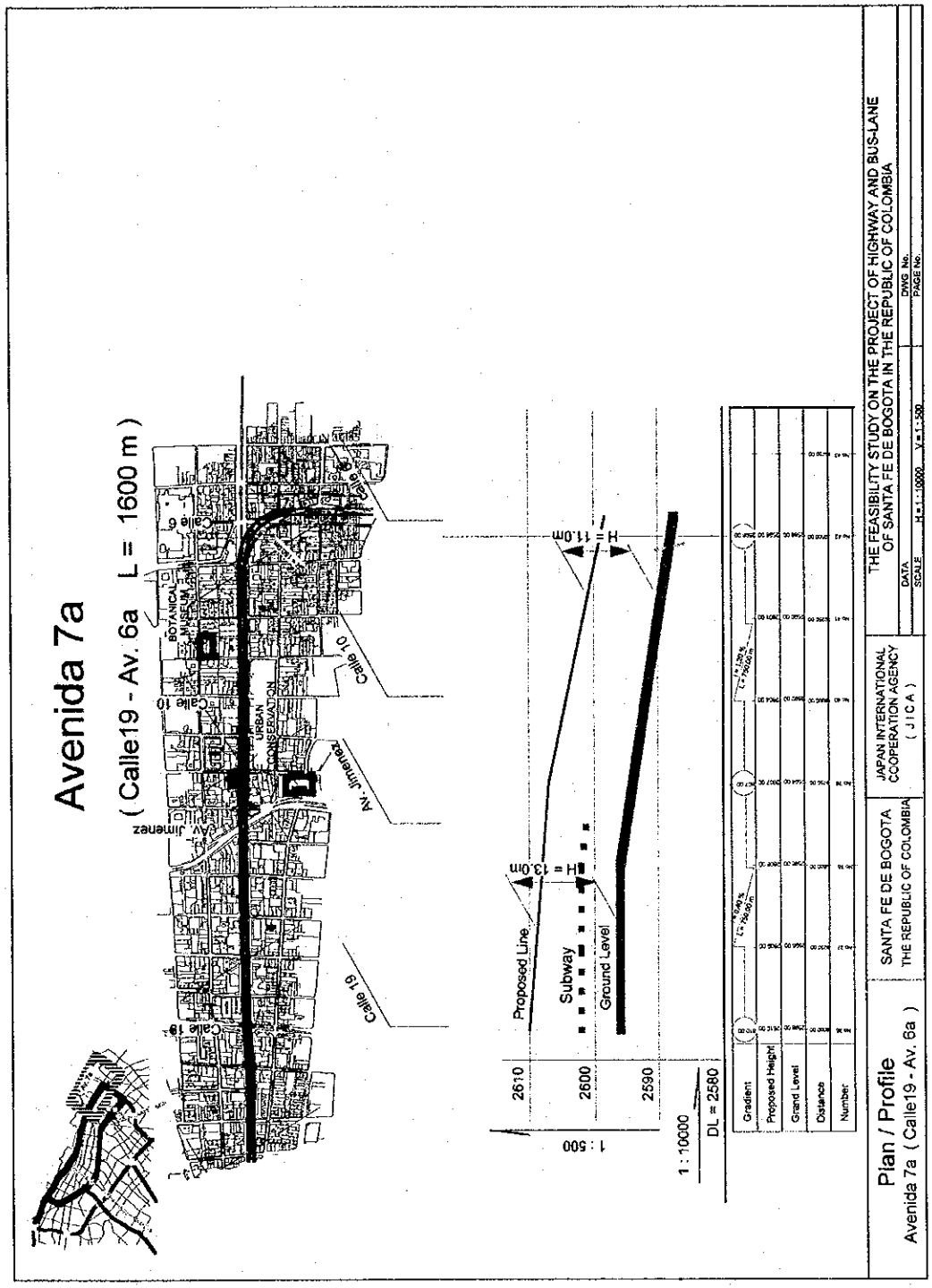


Figure 13.2-11 General Road Design on Av. 7a (4)

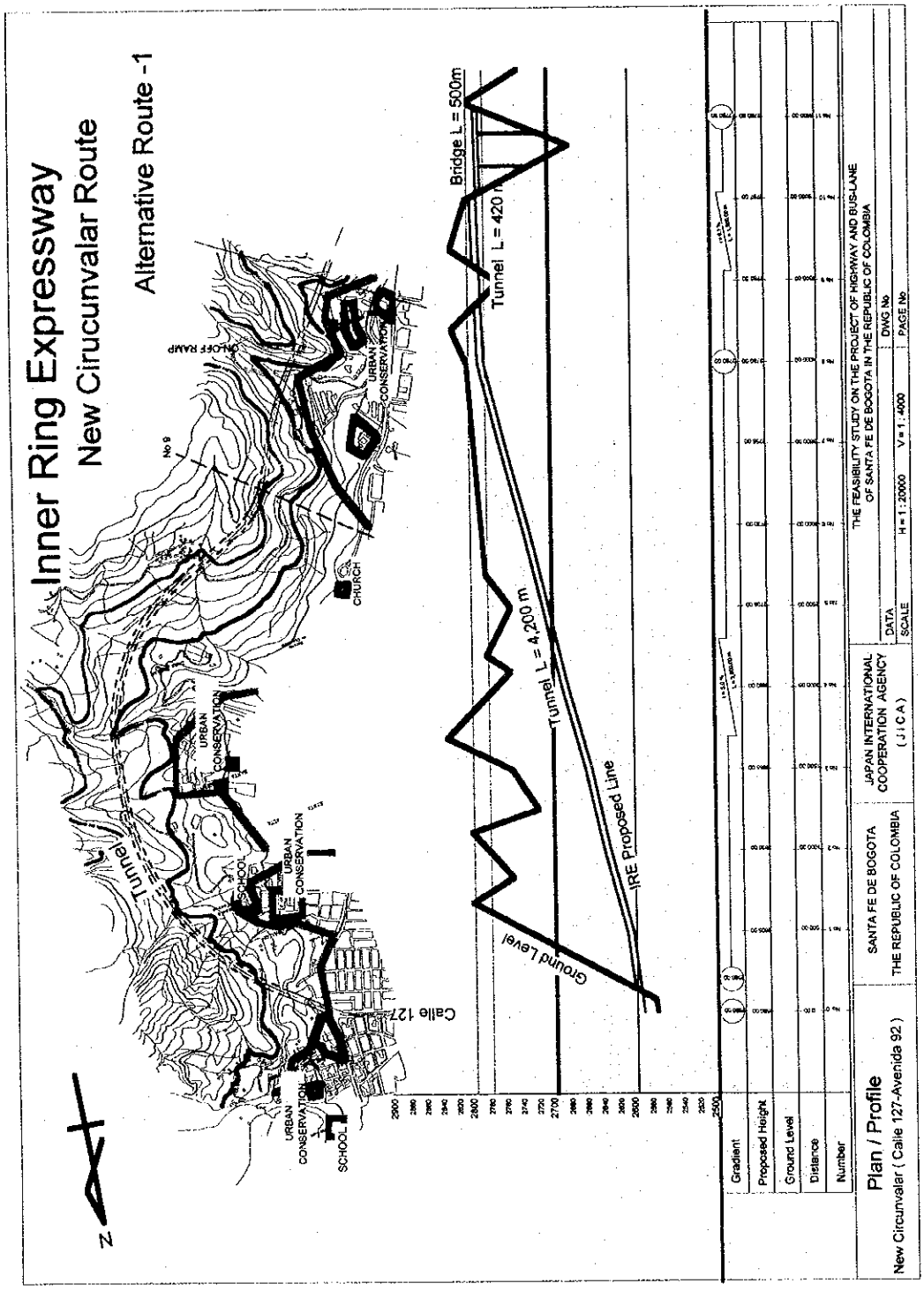


Figure 13.2-12 General Road Design on New Cirucunvalar (1)

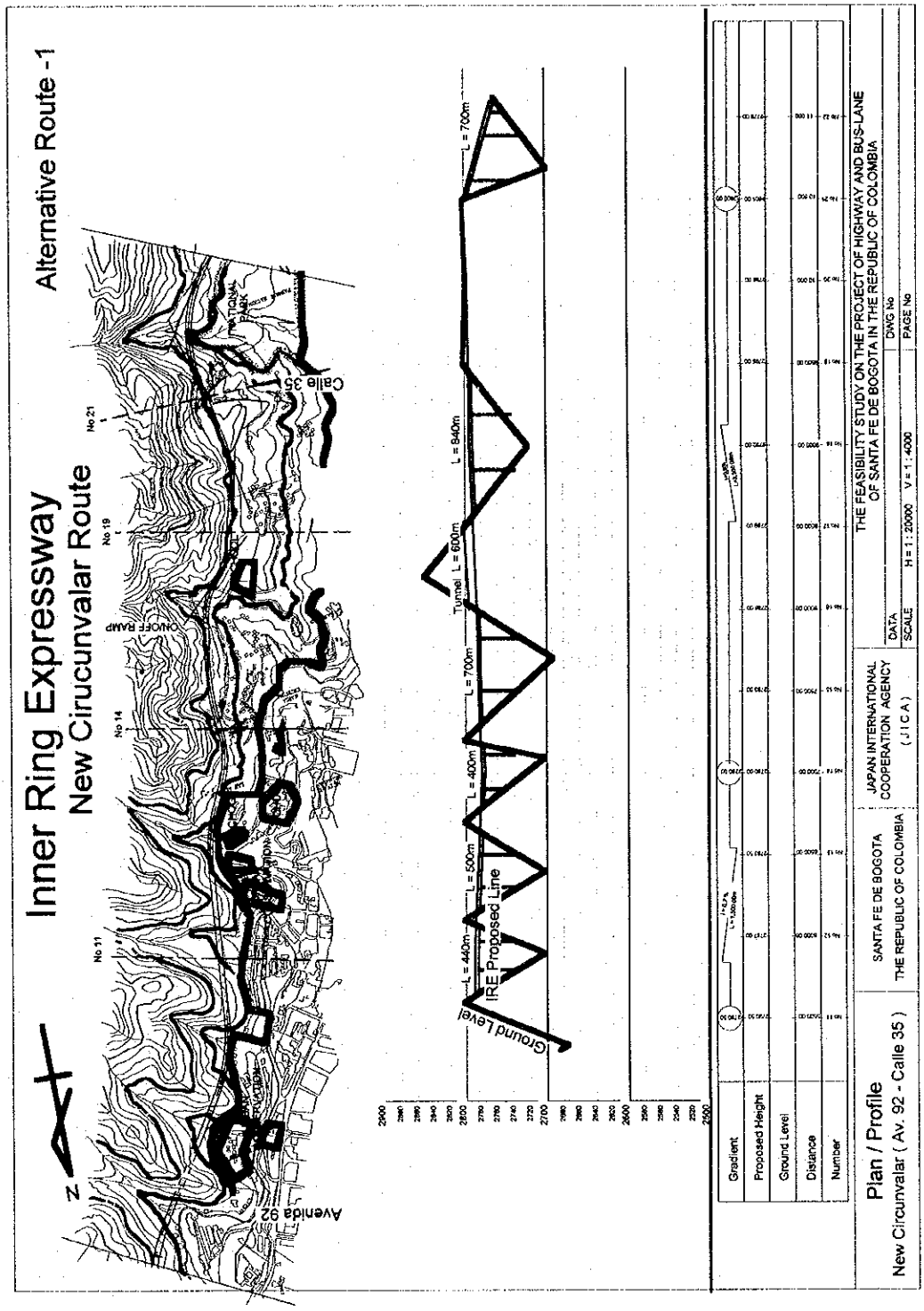


Figure 13.2-13 General Road Design on New Cirucunvalar (2)

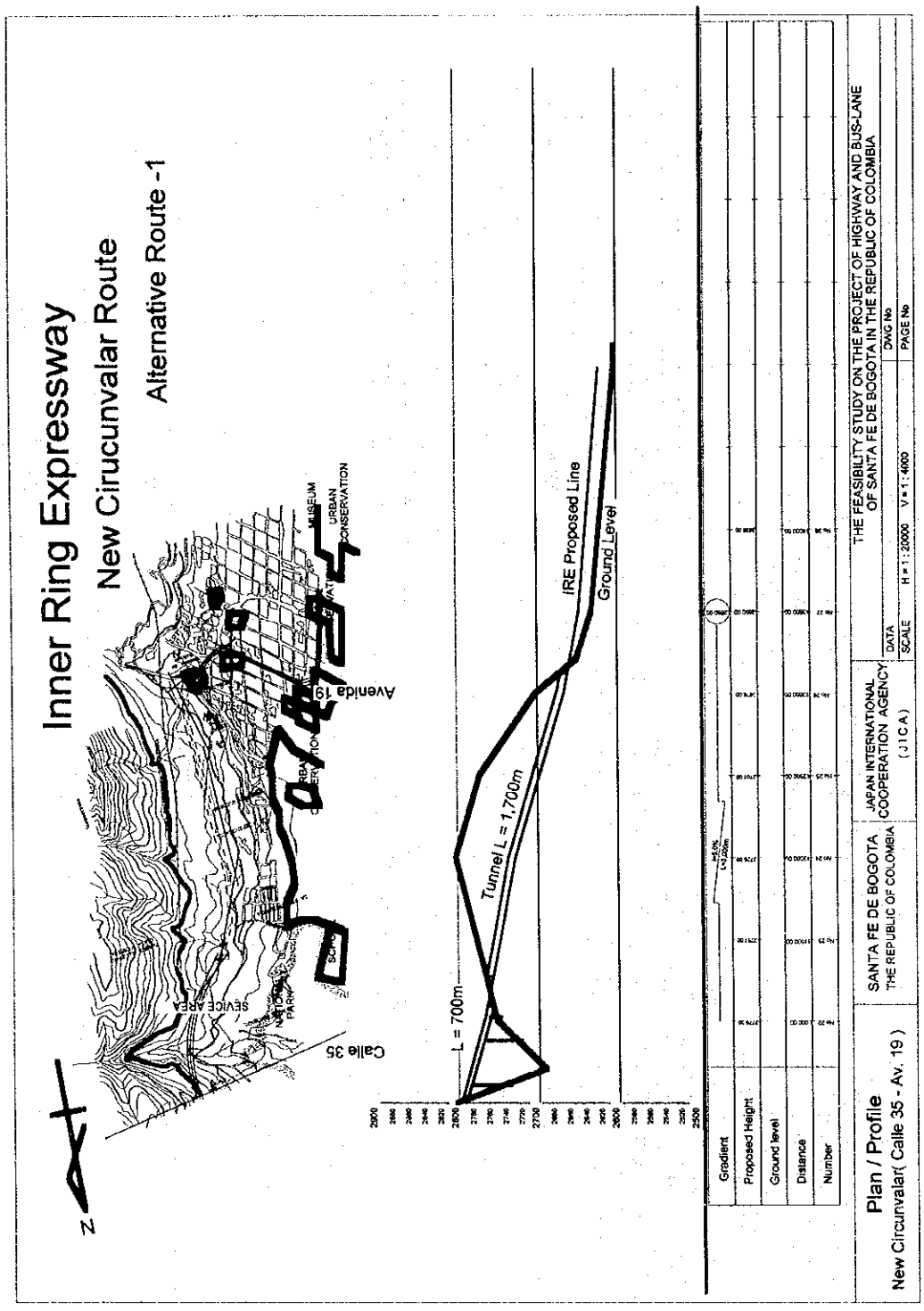


Figure 13.2-14 General Road Design on New Cirucunvalar (3)

(2) Traffic Volume On Alternative Routes

Based on the results of traffic assignment study on each alternative route, the traffic volume on two different toll charges such as 2,000 and 3,000 pesos in 2015 on the each road segment of alternative routes is summarized in Table 13.2-2. From this table, the following traffic conditions are pointed out.

1) The traffic volume on alternative route-3 has shown the highest volume among the three alternative routes.

2) The traffic volume on each road segments has shown the different in accordance with toll charge rate such as 2,000 pesos, and 3,000 pesos. The optimum toll charge rate will be decided after examination of economic and financial evaluation in later stage.

3) The traffic volume on the Av. Quito segment of three (3) alternative routes in 2015 (toll chage=2,000 pesos) is estimated as about 30,000 to 75,000 pcu/day. Considering the traffic capacity of the inner ring expressway, a 4-lane dual carriageway will be required.

4) The traffic volume on New Cirucunvalar route which is a part of alternative route-1 is estimated at about 38,000 pcu/day. The function of this road is classified as by-pass of the existing Avenida Cirucunvalar.

Table 13.2-2 Summary of Traffic Volume on Each Alternative Route

Unit; pcu/day (year in 2015)

Alt. Route / Road Segment	Calle100	Quito(1)	Quito(2)	Calle6	Av.7a	New Cirucunvalar
2015 (2,000 pesos)						
Alt. Route-1	3,600	44,000	51,000	19,000	---------	38,000
Alt. Route-2	29,000	48,000	53,000	10,000	29,000	----------
Alt. Route-3	54,000	75,000	82,000	36,000	--------	--------
2015 (3,000 pesos)						
Alt. Route-1	21,000	26,000	29,000	8,000	---------	25,000
Alt. Route-2	13,000	28,000	30,000	4,000	18,000	----------
Alt. Route-3	43,000	46,000	48,000	19,000	---------	----------

(3) Traffic Conditions on the Major Existing Trunk Roads Without Inner Ring Expressway in 2005 and 2015

The traffic conditions on major existing roads in 2005 and 2015 without the inner ring expressway are shown in Table 13.2-3. Figure 13.2-15 shows the location of those major roads. From this table, the following traffic conditions are pointed out.

1) In 2005, the average congestion degree on almost all trunk roads will exceed 0.6 to 1.7 degree. This means that the heavy traffic congestion will be occurring on the major intersections.

2) By the year in 2015, the average congestion degree on almost trunk roads will range from 0.9 to 2.6. This means that the heavy traffic jam will be occurred on the major roads during almost all day long.

3) The average running speed on major roads in 2005 will be estimated at about 10 to 20 km/h, and by the year 2015 it will be decreased at 5 to 7 km/h. However, during the peak hour, the running speed will be estimated at below 5 km/h.

Table 13.2-3 Traffic Conditions on Major Roads in 2005 and 2015 without Project

Name of Roads	2005		2015	
	Congestion	Speed	Congestion	Speed
Calle 100	0.6	46.9	0.9	33.3
Av. Quito	1.2	15.4	1.6	6.0
Cra. 7a	1.6	11.7	2.6	7.1
Calle 26	1.4	5.2	1.7	5.0
Av. Caracas	1.5	6.6	2.2	5.0
Circunvalar	1.7	5.0	2.5	5.0
Autopista Norte	1.1	22.2	1.3	6.8
Calle 80	0.9	35.2	1.4	12.7

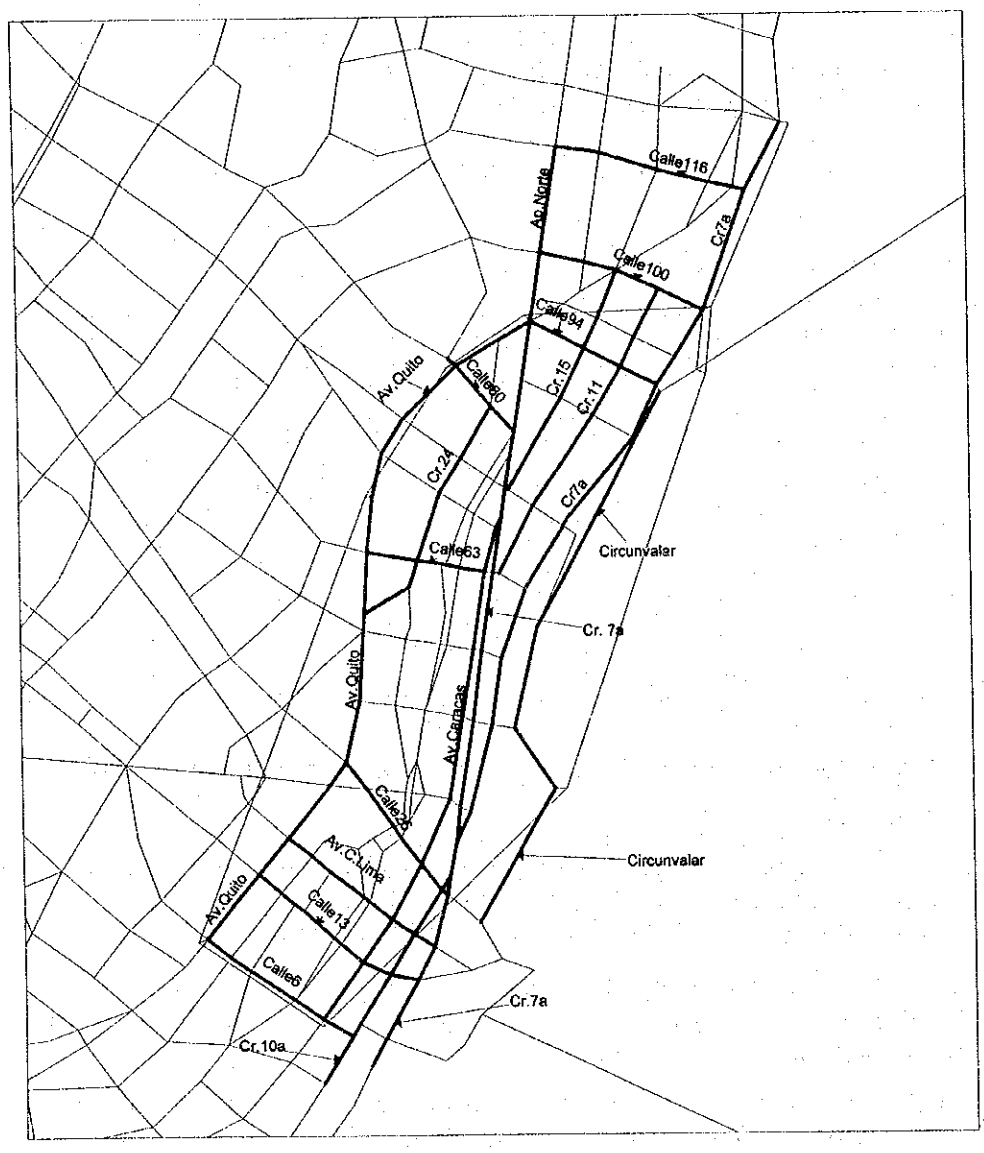


Figure 13.2-15 Locations of the Existing Major Roads

(4) Effects of Inner Ring Expressway to Major Existing Roads

When the inner ring expressway it will be constructed, in this section, how to change the traffic volume or traffic conditions on the existing roads. Table 13.2-4 is shown how to change the traffic conditions on the existing roads in 2005 in accordance with each alternative route, and Table 13.2-5 shows the traffic conditions in 2015 respectively. From these tables, the following matters are pointed out.

1) The daily average congestion degree on the existing roads in 2005 and 2015 comparing the Absence of project or Without project (inner ring expressway is not constructed) and With project (inner ring expressway is constructed) is not remarkably changed. However, daily congestion degree on the existing roads which are located along the inner ring expressway will certainly be improved.

2) In 2005, the daily average running speed on the existing roads is also not remarkably changed compared with Without project and With project. However, running speed in 2015 on the existing roads on With project case will be improved certainly.

3) Pcu-km and pcu-hour on the existing roads will be improved after completion of the inner ring expressway, in accordance with improvement of running speed and traffic congestion.

4) Among three (3) alternatives, the alternative route-3 is the most variable to improve the traffic conditions on the existing roads.

Table 13.2-4 Comparison of Traffic Condition between Without Project and Alternative Routes in 2005

	In 2005		Without	Alt-1	Alt-2	Alt-3
No.	Via	Item				
1	Calle100	Average Congestion	0.3	0.3	0.3	0.2
		Average Speed	59.6	59.7	59.7	59.7
	D = 2.3	PCU-km	103838.9	104225.8	103790.5	102603.9
		PCU-hour	1750.3	1754.8	1747.1	1726.5
2	Av.Quito	Average Congestion	0.8	0.8	0.8	0.8
		Average Speed	39.2	39.9	39.7	39.9
	D = 9.7	PCU-km	1180418.5	1162427.3	1165810.7	1162961.4
		PCU-hour	31747.5	30549.8	30805.5	30585.3
3	Cr7a	Average Congestion	1.0	0.9	0.9	1.0
		Average Speed	30.8	32.7	32.7	30.9
	D = 13.3	PCU-km	756961.2	718760.3	719893.4	754997.1
		PCU-hour	42408.8	36929.0	36877.0	41903.5
6	Calle26	Average Congestion	1.2	1.1	1.1	1.2
		Average Speed	14.6	14.8	14.9	14.6
	D = 2.2	PCU-km	194826.6	193675.0	193765.6	194480.2
		PCU-hour	23057.7	22752.0	22790.8	22968.2
7	Calle63	Average Congestion	0.7	0.7	0.7	0.7
		Average Speed	36.8	36.8	36.9	36.9
	D = 1.5	PCU-km	67912.3	67972.2	67692.9	67695.2
		PCU-hour	2516.8	2520.5	2507.3	2503.1
8	Av.Caracas	Average Congestion	1.0	0.9	0.9	0.9
		Average Speed	28.4	28.8	28.8	28.6
	D = 8.2	PCU-km	610922.0	604773.9	604132.8	607304.9
		PCU-hour	28063.0	27532.8	28082.6	27896.0
9	Circunvalar	Average Congestion	0.7	0.7	0.8	0.7
		Average Speed	35.7	35.4	34.8	36.2
	D = 8.8	PCU-km	311891.2	312825.3	316388.1	307335.2
		PCU-hour	9904.2	10301.0	10905.2	9600.1
12	Ap.Norte	Average Congestion	0.8	0.8	0.8	0.8
		Average Speed	46.1	46.3	46.2	46.1
	D = 3.8	PCU-km	621385.4	619218.4	620009.4	621986.0
		PCU-hour	14052.1	13960.2	13992.9	14092.0
13	Calle80	Average Congestion	0.4	0.4	0.4	0.4
		Average Speed	57.1	57.0	57.5	57.0
	D = 1.3	PCU-km	74218.6	74254.2	72538.9	74262.1
		PCU-hour	1378.8	1380.8	1340.9	1380.4
19	Express Way	Average Congestion	0.0	0.1	0.1	0.1
		Average Speed	0.0	78.8	79.0	78.5
		PCU-km	0.0	119299.4	114410.6	71039.6
		PCU-hour	0.0	1524.0	1459.7	904.2

D: distance (km)

Table 13.2-5 Comparison of Traffic Conditions between Without Project and Alternative Routes in 2015

	In 2015		Without	Alt-1	Alt-2	Alt-3
No.	Via					
1	Calle100	Average Congestion	0.5	0.5	0.5	0.5
		Average Speed	52.1	53.2	53.1	53.1
	D = 2.3	PCU-km	194530.7	185437.8	187535.3	187097.7
		PCU-hour	4207.4	3841.2	3893.3	3887.1
2	Av.Quito	Average Congestion	1.0	1.0	1.0	1.0
		Average Speed	28.2	30.3	30.2	30.1
	D = 9.7	PCU-km	1446222.7	1402035.1	1402836.1	1406391.5
		PCU-hour	62774.1	53735.2	54020.9	54870.7
3	Cr7a	Average Congestion	1.2	1.2	1.2	1.2
		Average Speed	19.8	21.3	20.5	20.5
	D = 13.3	PCU-km	959838.1	932461.7	944745.8	946055.8
		PCU-hour	79545.0	74877.4	77339.7	78070.6
6	Calle26	Average Congestion	1.4	1.3	1.4	1.4
		Average Speed	6.6	6.6	6.5	6.5
	D = 2.2	PCU-km	231607.9	227260.0	228759.7	228145.8
		PCU-hour	43495.3	42682.6	42923.7	42799.9
7	Calle63	Average Congestion	1.0	1.0	1.0	1.0
		Average Speed	23.8	24.1	24.2	24.3
	D = 1.5	PCU-km	98637.2	98186.9	97823.2	97736.3
		PCU-hour	4953.1	4826.3	4792.6	4740.4
8	Av.Caracas	Average Congestion	1.1	1.2	1.1	1.1
		Average Speed	17.2	17.1	17.0	17.3
	D = 8.2	PCU-km	737066.0	738850.0	738451.8	735903.8
		PCU-hour	80774.4	77304.0	79935.1	80739.9
9	Circunvalar	Average Congestion	1.2	1.1	1.1	1.2
		Average Speed	16.0	18.9	17.1	16.7
	D = 8.8	PCU-km	493424.4	456291.1	474570.4	488494.9
		PCU-hour	69398.9	60481.5	66925.5	69294.5
12	Ap.Norte	Average Congestion	1.0	1.0	1.0	1.0
		Average Speed	34.6	34.7	34.8	34.5
	D = 3.8	PCU-km	751449.6	747604.4	747922.6	749229.7
		PCU-hour	23501.8	23272.0	23124.5	23621.8
13	Calle80	Average Congestion	0.7	0.7	0.7	0.7
		Average Speed	45.9	46.8	46.7	46.8
	D = 1.3	PCU-km	128453.3	125268.3	125718.3	125291.7
		PCU-hour	3423.9	3268.7	3293.5	3305.5
19	Express Way	Average Congestion	0.0	0.3	0.2	0.3
		Average Speed	0.0	78.8	79.0	76.5
		PCU-km	0.0	528034.0	468095.6	427413.5
		PCU-hour	0.0	6729.4	5971.4	5640.5

D: distance (km)

(5) Traffic Conditions On Alternative Routes

The traffic conditions on the three (3) alternative routes with each road segment are summarized in Table 13.2-6. From this table, the following matters are pointed out.

1) The traffic conditions such as the average running speed per day and average congestion degree per day among the three (3) alternative routes are not remarkably different.

2) Pcu-km and pcu-hour among three (3) alternative routes are also not remarkable different. However, the figure of alternative route-3 is shown as the smallest value, due to the fact that road length is shortest.

3) From viewpoint of traffic conditions, there is no distinct difference among the three (3) alternative routes.

Table 13.2-6 Summary of Traffic Conditions on Alternative Routes

Items / Alternatives	Alt. Route-1	Alt. Route-2	Alt. Route-3	Remarks
Year 2005				
Average Congestion	0.4	0.4	0.4	
Average Speed (km/h)	80.0	80.0	80.0	
Pcu-km	148,355	126,908	151,847	
Pcu-hour	1,854	1,586	1,898	
Year 2015				
Average Congestion	0.6	0.8	1.0	
Average Speed (km/h)	58.0	57.4	13.2	
Pcu-km	1,181,509	1,077,602	1,200,076	
Pcu-hour	20,382	18,852	90,664	

13.2.2. Initial Evaluation Of Alternative Routes

The initial evaluation of the three (3) alternative routes is conducted based on the following four (4) viewpoints, to select the optimum route for the inner ring expressway. The preliminary design will is carried out in accordance with the selected alternative route.

1) From viewpoint of traffic aspect
2) From viewpoint of construction technology
3) From viewpoint of economic aspects
4) From viewpoint of environmental aspects
5) From viewpoint of related development plans

(1) From Viewpoint of Traffic Aspect

1) The results of traffic conditions comparative study between the With project and Without project cases, the pcu-km on the existing roads will be improved after completion on the inner ring expressway (With project case).

2) Also, pcu-hour on the existing roads will be improved after construction of the inner ring expressway (With project case).

3) Especially, the traffic conditions on Avenida 7a and Avenida Quito which are located near the inner ring expressway will be improved after construction of the inner ring expressway.

(2) From Viewpoint of Construction Method.

1) A part of the route on the alternative route-1 (New Cirucumvalar road) is located on the very steep mountain area, therefore, long tunnels and long span bridges will be required. Considering these topographic conditions, it is very difficult to construct of the road.

2) A part of route on the alternative route-2 (On Avenida 7a road) is located on the existing Avenida 7a, and also, the Metro line is located at the Avenida 7a with tunnel structure. Therefore, the construction of the new road on the Avenida 7a with viaduct structure is very difficult.

3) The alternative route-3 is located on the existing Avenida Quito which is classified as V-2 road (ROW=60 meters). Therefore, the inner ring expressway can be constructed to be used within the right of way of the existing Avenida Quito.

(3) From Viewpoint of Economic Aspects

1) At present, the preliminary design with cost estimate is not completed yet, however, the construction cost of Alternative-1 is the highest obviously, and Alternative route-3 is the lowest, considering topographic conditions, road length of each alternative, and construction method.

2) The maintenance cost of Alternative route-1 is the highest obviously and Alternative -3 is the lowest, considering construction size of each alternative route.

(4) From Viewpoint of Environmental Aspects

1) A part of route on the alternative route-2 (On Avenida 7a road) is located at the Avenida 7a with 6-lane road (ROW=30 meters). There are many buildings which have been constructed along both sides of the road, and also it is very difficult the widening of existing road. From viewpoint of preservation of landscape or city open space, the construction of inner ring expressway on the existing Avenida 7a is very difficult.

2) New Cirucunvalar route which is a part of alternative route-1 is passing through in the mountain area with about 2,800 meters from sea level, and there is no structures to be preserved in this area.

3) However, New Cirucunvalar route is passing through two existing small size housing areas which are located in the mountain area with about 2,800 to 2,900 meters from sea level. Some houses should be demolished.

4) There are no structures to be preserved in the areas where the inner ring expressway will be constructed to use the existing right of way (ROW). Therefore, there is no problem for preservation of historical structures.

5) When the inner ring expressway among three (3) alternative routes is constructed, cutting or demolish or re-plantation of the road side trees may be required. Therefore, the preservation of road side trees should be considered in the preliminary design as much as possible.

6) During and after construction of inner ring expressway, noise problems and air pollution problems may be expected. Therefore, mitigation measurements of these problems should be considered in the preliminary design.

(5) From Viewpoint of Development Potential

1) When the New Cirucunvalar road which is a part of alternative route-1 is constructed, it is possible to construct a new service area along the road for public open space, considering the good perspective from this road.

2) And also, the New Cirucunvalar road can be formed as a part of Outer Ring Road (the future road) of the city of Bogota.

The above mentioned matters are summarized in Table 13.2-7 respectively.

Table 13.2-7 Comparison of Alternative Routes

Items	Alt. Route-1	Alt. Route-2	Alt. Route-3	Remarks
1. Viewpoint of Traffic				See Section 13.1
1.1 Effects of pcu-km decreased	○	○	○	
1.2 Effects of pcu-hour decreased	○	○	○	
1.3 Effects of running speed increased	○	○	○	
1.4 Effects of congestion degree decreased	○	○	○	
2. Viewpoint of construction				
2.1 Construction difficulty	△	×	○	
2.2 Traffic control during const.	○	×	○	
2.3 Demolishing of existing facilities	△	○	○	
2.4 Safety	△	△	○	
3. Viewpoint of economic aspects				
3.1 Construction cost	×	△	○	
3.2 Maintenance cost	×	△	○	
4. Viewpoint of environment				See Chapter 12
4.1 Effects on landscape	△	×	△	
4.2 Effects on city open space	△	×	△	
4.3 Effects on historical building or monument preserved	○	○	○	
4.4 Preservation of plantation	△	△	△	
4.5 No. of resettlement effected	△	○	○	
4.6 No. of scatter effected	△	○	○	
4.7 Effects of noise	△	△	△	
4.8 Effects of air pollution	△	△	△	
5. Viewpoint of development				
5.1 Development Potential	○	△	△	
5.2 Meet of metro project	△	×	△	

(6) Conclusion of Alternative Routes Selection

The three (3) alternative routes such as route-1, route-2, and route-3 are identified, and in previous section, the evaluation of alternative routes study is conducted from the viewpoint of the various fields. As a result of the evaluation study, **the Alternative Route-3 is selected** for the optimum route of the inner ring expressway, and this expressway will be constructed **by the year 2005** which is the target year of this Feasibility Study. The preliminary design will be conducted based on the Alternative Route-3.

The Alternative Route-1 is also a very important road, considering the trunk road network configuration in Bogota and preparation of the public open space. Taking into account this, the Alternative Route-1 will be constructed after the year 2005. Therefore, the preliminary design of Alternative Route-1 is out of scope of this Feasibility Study, because, target year of the Study is 2005 for preparation of urgent action program.

The horizontal alignment of Alternative Route-3 is located on the following existing roads.

1) On the Avenida 7a (section between Calle 116 and Calle 100): L= 2.80 km
2) On the Calle 100 (section between Avenida 7a and Carrera 15): L= 2.57 km
3) On the Avenida Quito (section between Carrera 15 and Calle 6): L=11.20 km
4) On the Calle 6 (section between Avenida Quito and Avenida Caracas): L=2.25 km

Total length: L=18.82 km