

### 3. SITE ANALYSIS.

The analysis of the Project's site is focused on five scales, covering the Project site itself, the sector, the zone, the city, and the region. Each scale generates determining factors and guidelines for design, and allows detailed information on specific subjects to be organized.

#### 3.1. Site Survey. Figure 3.1.(1). and Figure 3.1.(2).

The Office of the Mayor of Armenia informed JICA in communication A.M. 0982 of 2 June 2000 that it had begun negotiations for the site Lindaraja. In the *Commitment Act* dated 1 June 2000, signed by the Mayor, by the owner of the site, and by the director of the legal department of the municipality, the municipality was authorized to undertake studies of the "site in accordance with the agreement signed with JICA." On 6 June 2000, it was signed by the members of the management committee for the Project, expressly authorizing JICA to initiate the studies.

The site has an approximate area of 21,294 square meters, in accordance with deed 62 of 9 January 1993. It is located in the south-western side of the city on 50<sup>th</sup> Street, which leads to the country village of Pueblo Tapao. The site is 300 meters inside the urban perimeter determined by the land-use plan PORTE. The boundaries are:

- North : 50<sup>th</sup> Street, for some 200 meters.
- South : the Venus stream, for about 180 meters.
- West: The Puerto Espejo development, its first sector, for some 130 meters.
- East: the Lindaraja development, second sector, for some 120 meters.

According to FOREC's reconstruction program, the site is part of zone 13, and its Zone Management is in the hands of the National University of Colombia.

- **Ownership.** The site was bought by the Mayor of Armenia from the FRANCISCO DE PAULA SANTANDER Foundation. According to information supplied by the Office of Competitiveness and Economic development, the deeds are ready to be signed as of 6 July 2000.

#### 3.1.1. Topography and slopes. Figure 3.3.1.(1) and Figure 3.1.1.(2).

- **Boundaries.** The survey must be compared to the definite deeds in order to determine the boundaries and exact area of the site.
- **Topography.** The site has rolling terrain. From the highest point in the south-eastern corner to the lowest point in the south-western corner there is a difference of 26 meters in altitude. On 50<sup>th</sup> Street, the difference in terrain altitude is 8 meters along the 200-meter stretch. The lowest point is 35 meters from the road; this is, 13 meters below the 50<sup>th</sup> Street's highest point.
- **Slopes.** The areas resulting from the study of slopes are:

**Table 3.1.1. Analysis of slopes.**

Slope Analysis	Area	Percentage
Area of site according to survey, according all peripheral roads	21,228 m <sup>2</sup>	100 %
Slopes steeper than 25°. Areas of environmental protection	3,272 m <sup>2</sup>	15.4 %
12m shoulder area from the point where the slope breaks. Subject to be occupied with roads and parking spaces.	2,364 m <sup>2</sup>	11.1 %
Net Area to be used with constructions.	15,592 m <sup>2</sup>	73.5 %

It comes from previous page. Table 3.1.1.

Slopes from 0° to 15°	14,734 m2	69.4 %
Slopes from 15° to 25°	3,921 m2	18.5 %
Slopes from 25° to 40°. Areas for passive recreation. They have protecting.	2,532 m2	11.9 %
Slopes steeper than 40°. Totally Restricted Areas.	41 m2	0.2 %

Source: Temporary Partnership. Analysis with the ARC – VIEW software for topographical surveys.

The survey was conducted according to the following procedures:

- Leica TC-600 total electronic station was used.
- Data recorded for the preparation of the survey document: station point, observed point, azimuth, vertical angle, inclined distance, Eastern coordinate, Northern coordinate, altitude above sea level, height of the prism, and observations. All this information was processed on Excel-type spreadsheets, and drawn out on AutoCad.
- In order to determine the geographical coordinates, reference was taken to the scale' reading of the geographical map number 30 of IGAC, dated 1995. Provisional coordinates were assigned to plates EDEQ-12 and EDEQ-13, which belonged to a geographical network in the reviewing process by Armenia's City Council. It should be possible to make an appropriate conversion once an official certification for these sheets is obtained.
- Documents delivered: survey drawing, list of coordinates, and related calculations. See attachment.

The survey includes the sector of the *La Fachada* (The Façade) development to incorporate a sector constructed in the prospective West Avenue's route. The constructed profile totals 48 meters, corresponding to the *Avenida Perimetral del Café* whose route was modified by PORTE, and shifted 700 meters to the south.

### 3.1.2. Environmental analysis. Figures 3.1.2.(1). and 3.1.2.(2).

The most outstanding environmental components are the vegetation, the Venus stream and the Dry Watercourse.

- **Vegetation.** Based on the analyses of aerial photographs (Agustín Codazzi Geographical Institute No. 138 and 139 of 1999), the following conditions are to be found:
  - Heath and shrubs : 60%.
  - Tall grass : 22%
  - Bamboo : 12%
  - Empty land : 6%

The following units were identified<sup>1</sup>:

Heath and shrubs	<b>Ma</b>	High shrub. It is possible to walk around standing up.
Tall grass	<b>P</b>	Vegetation layer with predominance of grasses such as <i>India Estrella</i> and <i>piperacea</i> <sup>2</sup> .
Bamboo	<b>Ch</b>	The bank by the stream has a dense zone of bamboo on the southern side, in the Santa Rita district, and this has been identified on the survey
Isolated trees	<b>Aa</b>	Trees with landscape value due to their height and age.
Empty land	<b>Sd</b>	Land without vegetation and susceptible to erosion.

<sup>1</sup> Foundation Bachaqueros. DAMA. District Protocol for Ecological Restoration, 1998.

<sup>2</sup> CRQ opinion of 23 December 1999

- **Venus Stream. Characteristics:**

- There are signs of contamination due to refuse thrown on the banks. There are unpleasant odors most probably caused by the discharge of waste water from Lindaraja II, Santa Rita, and La Virginia. The construction of a main sewer, currently in process, may improve the situation at least in the northern part of the stream.
  - The Municipality will have to control the discharge of wastewater by developments on the southern side of the stream.
  - Waste handling and environmental education of local population will be essential factors in order to obtain long-term sustainable environmental conditions.
  - The environmental conditions imposed by the land-use plan PORTE correspond to the watercourse and banks at the break point of the slope, greater than 25 degrees or 46.63 per cent, with a 12-meter fringe. According to the City Workshop<sup>3</sup>, the management area for the bank and the environment protection area will be defined from the survey made by JICA.
- **The Dry Watercourse.** It is the natural drainage for the site, and it is located in the northern side of the site, parallel to 50<sup>th</sup> Street. The dry watercourse is subject to restrictions of environmental protection in the plan for risk zones prepared in its preliminary form in 1999. However, these restrictions were subsequently lifted with the authorization of Quindio's Regional Corporation CRQ, which is the competent environmental authority of the Department. The document issued by CRQ is held by the Office of Competitiveness and Economic Development.

- a). **Geological and geotechnical considerations.** These consist of the following :

- Study of soil and water quality : geological base, physical characteristics of the soil, tolerance, location, quantity and quality of groundwater.
- Drilling : subsoil testing, diagram of stratigraphical column, and water table levels.
- Soil quality tests : simple compression, specific weight, granulometry and proportion of water content.
- Analysis of water table: depth, quantity, content, number of elements, and hardness analysis.
- Results of the tests for each analysis.
- Plans and drawings for probes made.

- b). **Risk study.** Figure 3.1. 2.(3). The Armenia's City Council agreement and the corresponding drawing determining the zones of risk and Armenia's city limits are under study. It is expected that they will be issued officially during June 2000.

In accordance with the microzoning study, and as confirmed by a visit made to the City Workshop in mid-June, on the western side of the site, in the area to be crossed by the prospective West Avenue, there is a zone of risk due to the possibility of slippage in middle levels. The cause of this is the human-made infill deposited on natural drainage. This affects 1682 square meters. 121 square meters are inside the site and it affects 0.57% of the total area.

The risk condition is associated with the possibility that there may be slippage on the banks running along the streams, and in the drainage which runs parallel to 50<sup>th</sup> Street. The following points should be mentioned in this regard:

- The high rainfall levels mean that the banks do not conserve an appropriate vegetation layer, and, therefore, they are highly susceptible to slippage.
- Some of the constructions in neighboring city districts, Lindaraja II and Santa Rita, are on the brink of the break of the slope, and there is an apparent risk should slippage occur.

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<sup>3</sup> Meeting with architect Jorge Mario Patiño, representative of the City Workshop on the Project's Management Committee.

- It is quite possible that there should be technically inadequate infills in neighboring districts, without proper management of the many existing routes for surface water and natural drainage. This may cause soil stability problems in the medium and long run.

### 3.1.3. Availability of Public Services, and Restrictions.

The present condition regarding public utility services is as follows :

- **Tap Water.** The main pipe is located on 50<sup>th</sup> Street.
- **Sewage.** A 1,500 meter collector is being built on the eastern and northern perimeter of the site. It collects the wastewater from the Lindaraja II development along the Venus stream and joins up with the main general system. Rainwater can be drained directly into the Venus stream.
- **Electricity.** The "New South" Sub-Station is 150 meters to the west of the site on 50<sup>th</sup> Street. This sub-station would provide electricity for the Project. The Executive Unit has already begun procedures to obtain availability for this service, and specifications of installations.
- **Telephones.** The South Central network runs along 50<sup>th</sup> Street as far as the Puerto Espejo development. The availability of the service is now being processed by the Executive Unit. A reply is expected in the course of July 2000.
- **Gas.** The network is available for the site, but its connection depends on whether there is money or not.
- **Garbage disposal.** Garbage is picked up three times a week by a municipal company.

The gas service is provided by *Gases del Quindio*, a private entity. According to information given by this company<sup>4</sup>, the following considerations should be taken into account during the development of the Project:

- An application should be processed with the definite scheme of urban design.
- The general network is not charged for, provided that more than 50 per cent of the future inhabitants of the Project wish to have it and are in the position of purchasing the service. The connection fee from the network to the front of each house is \$255,437 (June 2000).
- Installation is effected in accordance with the National Standards NTC2505 and 3728, plus the Appendix 2 of the Ministry of Mine and Energy Resources for the concession to Quindio.
- For the areas of workshops, it would be necessary to establish the specifications of the equipment to be used since this would determine the gauge, pressure, and type of meter required.
- For safety reasons, the network should be constructed in a high-flexibility polyethylene, with a shut-off valve for each block, and a shut-off valve for each house. These valves will be manual and must meet national standards.
- The internal installation of housing units or workshops will be for account of the user, and can be undertaken by the company, subject to a quotation and agreement between the parties, or by an installer who has permission from the company.
- In accordance with the scheme of urban design, the company would make recommendations to minimize installation costs, at urban and architectural levels.

The City Workshop has prepared a public service statute, determining the specifications for location of each of the infrastructure networks. They indicate the depth of the network, the minimum distances between one conduit and another, the profile of location of each pipe with respect to the others, and other aspects related to urban design.

The statute is part of the components which are being studied for approval by the city council. Through the Executive Unit, a request has been made for a copy of the draft document, to include it in the urban design schemes for the **Village of Life and Work**.

<sup>4</sup> Interview with engineer Gustavo Trigos, Gases del Quindio's Technical Sub-Manager.

#### **3.1.4. Access, Easements, and Restrictions.** Figure 3.1.4.

The site has restrictions due to two roads in the secondary arterial system, 50<sup>th</sup> Street and West Avenue. On the eastern side there is a local road up, which reaches the point of joining the regular system. The restrictions of these roads on the site, according to a demarcation for information purposes issued by the urban Curator I on 11 November 1999 are:

- 50<sup>th</sup> Street has a profile of 24 meters from the front of the construction of the Lindaraja development, first sector, on the northern side.
- The future West Avenue has a profile of 48 meters from the front of constructions in the Puerto Espejo development, first sector, which is also the boundary of the site. However, the City Workshop<sup>6</sup> has varied the profile of the road to 31 meters. This is the dimension which the Project should consider<sup>1</sup>.
- The local road on the eastern side has a profile of 40 meters.

Since the City Planning department has not defined the final layout of the road system in the sector, it was verbally agreed with the City Workshop that the Project would propose intersections, profiles, and routes for surrounding roadways.

According to the road plan proposed by the land-use regulations PORTE and by the City Workshop, West Avenue is designed to join the sector with the regional roads in the south of the city, El Eden Avenue, and the exit to Montenegro. 50<sup>th</sup> Street would be the principal connecting road from this sector running East-West to the center of the city.

The local road would have a maximum length of 120 meters, and would not have any easement since it would end at the break point of the Bank of the Venus stream.

#### **3.1.5. Relationship of the Site with the Neighborhood—Land Uses.**

The neighborhood consists of 100 per cent of low-income single-family housing units, one or two floors high, as part of regular urban development in accordance with current regulations.

Commercial activity and services of a local nature. On the northern side of the site, on 50<sup>th</sup> Street, there are corner shops, and on the Western side, 50 meters from the site on 50<sup>th</sup> Street, there is a third one.

In the immediate surroundings of the site, there is no institutional use, and no vacant area for development.

#### **3.1.6. Urban regulations.** Figure 3.1.6.

According to PORTE and other current regulations, the site of the Project is subject to the following norms: Consolidation treatment. Use of the main land: Housing for low and middle income inhabitants. Complementary uses: light industry and medium size retail businesses. Heights : 1 and 2 floors. Up to three floors are allowed. Parking spaces: for residents (social and economic stratum No. 3) 1 per every three houses; for visitors 1 per every 15 housing units. 1 per each 120 square meters built for industry, and 1 per each 100 square meters built for businesses.

<sup>6</sup> The architect Jorge Mario Patiño supplied information on the new specifications for this road at a meeting on 23 June 2000 at the City Workshop. The specifications were submitted for approval to the City Council.

<sup>1</sup> Four weeks before October 31, 2000, the deadline for the submission of this Final Report, the Urban Curator of Armenia informed JICA that the design of the Project should be adjusted to the 48 Mts. section because the City Council had not approved yet the 31 Mts. section.

In accordance with the Certificate of Land-use issued by Urban Curator I in June 2000, the site is governed by the following regulations:

- Treatment : Consolidation.
- Main use : single-family, two-family, multi-family and social interest housing.
- Complementary uses<sup>7</sup> : general personal services, media, offices, and basic services.  
Community uses : green zones and recreation, educational areas, health areas, and special areas.
- Daily small retail trade, frequent retail trade, and medium retail trade.
- Light industry.
- Restricted uses : gardens, greenhouses, woodlands, and ornamental parks.
- Aptitude of the zone : acceptable with restrictions. *"Suitable for construction, provided that NSR-98 seismic-resistant standards apply, and field and laboratory studies are made to clarify the dynamic properties of material. It will be a requirement to confirm thickness of materials in subsoil and the water table, and to effect at least one bore hole to penetrate a minimum of three meters in volcanic flows<sup>8</sup>."*
- The site is not in the risk zone.
- Height : 2-3 floors.
- Plots : single-family plots of 60 square meters, with a minimum front of five meters.
- Isolation : optional at sides, three meters at the back.
- Parking :
  - Housing strata 1 and 2: One per each ten housing units for residents. None for visitors.
  - Housing strata 3 and 4: One per every 3 housing units for residents, and one per every 15 housing units for visitors.
  - Commerce : One per every 150m<sup>2</sup> built for strata 1 and 2. One per every 100m<sup>2</sup> built for strata 3 and 4.
  - Industry: One per each 120m<sup>2</sup> built or a fraction bigger than 60m<sup>2</sup>.

General regulations for social interest housing, road profiles, isolation close to watercourses, types of housing, and assignment of public space are shown in Figure 3.1.6.

### 3.2. Analysis of the Sector. Figure 3.2.

The delimitation of the sector includes the set of neighborhoods that can be most directly served by a center for emergency assistance located in the site of the Project. The size of the sector was determined thinking of an easy access for pedestrians.

The analysis of the sector is based on the application of a methodological strategy known as *"regulating grids"*. Using this tool, the city can be conceived of as the superposition of diverse specialized systems (environmental, road, housing, public space, and public services systems) that complement each other and are articulated in space. Each system works as a net with homogeneous elements that possess spatial continuity and play a specific role within the city, such as protecting the environment, avoiding natural risks, gathering the community to perform various urban activities, offering employment as well as social and trading services and furnishing housings with services, etc.

The interaction among the diverse grids or systems must allow to see how such grids are affected and which kinds of implications occur when one of them is intervened. The theoretical framework that helps conform the *"regulating grids"* comes from the Strategic Urban Design,

<sup>7</sup> These uses coincide with the program proposed for the Village of Life and Work. Definitions of services, trade, industry, and community use appear in PORTE, chapter 7 of uses of land.

<sup>8</sup> Urban Curator I, Attached to Certificates and Demarcations, information version. Indicative seismic zoning for the reconstruction of Armenia.

*DUE*. This approach has been proposed by the firm MN&A, which permits to identify urban design projects and architectural works by analyzing an urban structure.

The objective of the Strategic Urban Design, *DUE*, is to identify, from private and public sectors, the most important works that are required in order to define the form, the character, and the function of an urban structure in specific situations. The strategic value of the works depends upon its capacity to maximize results with a minimum input.

The “*regulating grids*” as a whole must correlate and unfold themselves in their manifold of components. The superposition of grids and the evaluation of their operativeness should facilitate the identification of potential conflicts or flaws, as well as of positive situations that should be strengthened and preserved.

The Project “**Village of Work and Life**” must be integrated to these grids that have been identified in the sector, and become a model to show how such grids must be made and complement each other.

**3.2.1. Boundaries.** Figure 3.2.1.

The boundaries of the sector were defined based on main roads and the barriers imposed by natural streams. As an area of influence, a 700-meter distance from the site was established, equivalent to a 10-to-12 minute walk.

The boundaries of the sector are as follows :

- North: the Lindaraja stream, and the edges of the Lindaraja and Fachada districts. Distance, 400-700 meters from the site.
- South: the Santa Rita stream, and the route proposed by PORTE for Avenida Perimetral del Café. Distance from the site, 400-600 meters.
- West: Avenida Perimetral del Café. Distance from the site, 600 meters
- East: The Santa Rita stream. Distance from the site to the intersection with 50<sup>th</sup> street, 700 meters

**Table 3.2.1.** The Sector.

	Area (Ha)	% of total
Area within city limits	70.20	75.1
Expansion zone	23.25	24.9
<b>Total area</b>	<b>93.45</b>	<b>100</b>
Gross developed area*	50.69	54.2
Net developed area**	23.96	Included in gross area
Risk area	9.61	10.3
Environmental management areas	15.95	17.1
Area for development	17.20	18.4

Source: Measurements taken on a digitized PORTE plan with adjustments on aerial photographs, and fieldwork by the study team of the Temporary Partnership.

\* Gross developed area. An area containing roads and city blocks even if not fully constructed.

\*\* Net-developed area. It contains only the city blocks fully constructed with housing.

**3.2.2. Street Grid .** Figure 3.2.2.

The most important existing road is 50<sup>th</sup> Street. It connects the sector East West wise with Carrera 19 and then with the rest of the city.

**Table 3.2.2. Road and transport systems.**

Road	Type	Profile	Status
50 <sup>th</sup> Street	Secondary artery. VAS-2, public transport	24m. Roadway 9m. Green zones 1.5m, sidewalk 2m, frontage 4m.	Two-way street. To be widened and profile completed. Restrictions on the site.
West Avenue	Secondary artery. VAS-1 Possible public transport	31m. 2x7m carriage ways, 2m central reservation, green zones 1.5m, sidewalks 2.5m. frontage 3.5	Long-term project, route not settled. Pending approval by City Council. Junction of Eden Avenue with 30 <sup>th</sup> street, out to Montenegro. Restrictions on the site.
Transversal 48B	Local street, Santa Rita District. Public transport.	Two way traffic 7m, sidewalks 1.5m.	Built, needs maintenance. The oldest district in the sector.
Transversal 50 <sup>a</sup>	Local street, access to La Fachada. Public transport.	Two-way traffic.	Recently built, for widening to match urban development

Source: PORTE - City Workshop - Fieldwork study Temporary Partnership.

**3.2.3. Environmental grid. Figure 3.2.3.**

The areas of environmental protection are determined on the basis of the proposals of PORTE, and its update in the new draft delivered by the City Workshop to the City Council in the last week of June. This draft order identifies risk areas, environmental protection areas, and makes some changes to the street plan.

The environmental grid for the sector is composed of three restricted sloping areas: areas of watercourse, and the Lindaraja, Venus ("Los Naranjos," according to CRQ) and Santa Rita streams.

**Table 3.2.3 Water system**

Stream	Length m	Width m	Area sq.m.	Banks	Infills	Slopes	Collectors
Lindaraja	2,050	40	82,000	No squatters	Sports facilities	Partial vegetation General de-stabilization	Down slope
Venus	600	40	24,000	No squatters	Puerto Espejo development and sports facilities	Signs of slippage, little vegetation	Under construction
Santa Rita	1,350	50	67,500	Squatters	non reported	Unstable in squatter areas, active rotating slippage	Down slope

Source: PAZ National University of Colombia, fieldwork study group of Temporal Partnership

**3.2.4. Public space grid. Figure 3.2.4.**

The public space grid is organized on the basis of a series of recreational spaces left by the urban development in the sector. Some of these spaces have facilities, and others are free areas in which spontaneous sport activities take place.

Most of the districts have a multi-purpose sporting facility, or a set of courts for different sports, and there are some green zones without facilities.



**Table 3.2.4. System of open spaces, parks, and squares.**

Development	Type	Area sq.m.	Status
Santa Rita	1 Multi-sports courts	3,339	1 Formally constructed.
	2 Sports field	4,972	2 Pending. Free area.
La Virginia	3 Multi-sports courts	3,201	3 Built
	4 Green spaces unused due to slope or shape	4,535	4 Free areas with no facilities
Lindaraja I	5 Green space	7,337	
Lindaraja II	6 Green zone. Court near church.	760	Under construction and consolidation
	7 Pool and court	1,726	
	8 Green zone	1,003	
La Fachada	9 Park and court	7,005	Built and equipped
	10 Green zone	1,281	
Puerto Espejo	11 Park	3,233	Built
	12 Green zone.	1,443	
Villa Alejandra	13 Green zone and court	Outside sector to the east	9 Built
	14 Playing field		10 Free area pending construction.

Source: Fieldwork study Temporary Partnership

### 3.2.5. Housing and Land Use grid . Figure 3.2.5.

In the sector, single family housing units with a single story are predominant, in social-interest housing developments.

The sector was classified as social and economic stratum No. 3, and is formal (legal) in origin.

**Table 3.2.5. Housing population, densities.**

Development	Type	Approx. No. of properties	Approx. Population	Density houses/hectare
Lindaraja I and II	1 floor, 10x6 lots, 2x4 story buildings	643	1,575	Lind. I = 49 Lind. II = 89
La Fachada	½ floors, 5x8 lots	1,439	2,471	94
Puerto Espejo	1 floor, 6x10.20 lots	728	2,048	101
El Poblado	1 floor	211	613	110
Santa Rita	1 floor	287	1,553	41
La Virginia	1 floor	707	2,439	82
<b>TOTAL</b>		<b>4,015</b>	<b>10,699</b>	

Source: PAZ National University of Colombia - Drawing IGAC 1/2000 - aerial photos - Temporary Partnership

### 3.2.6. Community facility grid . Figure 3.2.6.

In the sector there is a Health Care Center, a Police Station, two churches, a Community Action Center, and six educational premises.

**Table 3.2.6.(1). Community facilities.**

Facility	Location	Comments
Santa Rita Health Center	Entrance to S. Rita, 48 <sup>th</sup> Street B, 700m from site	Being reconditioned, only center in the sector. Out-patient treatment
"Nuevo Sur" Police Station	On 50 <sup>th</sup> Street 250m west of the site	
Santa Rita Community Action		Meeting place in P. Salavarieta School
Santa Rita church	Santa Rita	
Chapel	Lindaraja II	South side of 50 <sup>th</sup> Street
P. Salavarieta primary school	Santa Rita	1,334 pupils Grades 1-8
Puerto Espejo Primary School	On 50 <sup>th</sup> Street 200m from site	350 transition/primary pupils
Colegio del Sur (South School)	Puerto Espejo II	Grades 1-9

Divino Maestro nursery	Santa Rita, on 50 <sup>th</sup> Street	Local service
Villa Alejandria nursery	Northern side of 50 <sup>th</sup> Street	Local service
Day-Care Center	Puerto Espejo	South side of 50 <sup>th</sup> Street, opposite side. Local service

Source: PAZ National University of Colombia - Fieldwork by Temporary Partnership.

### 3.2.7. Public service network grid. Figure 3.2.7.

The sector has two networks for all public services:

- Tap water. The main supply runs down 50<sup>th</sup> Street. The system is fully available.
- Sewage. In the process of extension, with the construction of collectors on the main roads.
- Electricity. The Nuevo Sur sub-station services the sector.
- Telephones. The South Central network goes along 50<sup>th</sup> Street as far as the Puerto Espejo development, and services the sector.
- Gas. A 4 inch polyethylene network runs down 50<sup>th</sup> Street to the present urban perimeter. Installation is determined by the number of potential users in each of the developments. At least half of the potential users must request the service.

### 3.3. Analysis of the Zone. Figure 3.3.

The site is located in zone 13, according to the zone-subdivision made by FOREC for the reconstruction program. Management of this zone was allocated to the National University of Colombia, which acts as a zone manager. The information given below was supplied entirely by the National University, Armenia Zone Management.

#### 3.3.1. General data of the zone.

- Approximate area: 355.9 hectares.
- Occupied area: 201.3 hectares.
- Environmental reserve area: 73.5 hectares.
- Area for potential development: 81.1 hectares.
- Population: 52,465
- Number of properties: 10,120

#### 3.3.2. Population of the Zone. General Characteristics.

The situation of the population after the earthquake can be summarized with the following figures:

- Number of houses affected: 38,009
- Number of population affected: 18,019
- Temporary accommodation: 2,780 inhabitants.
- Settlements in risk zones: 97 units.
- Communal organization: 80 per cent of districts have legally constituted groups.
- Low proportion of stable employment: A large number of people is engaged in sundry trades such as bakery, technical services, agriculture, woodwork, upholstery, panel-beating, painting, pottery, security services, mechanics, electricians, police, construction workers, taxi drivers, tailoring, welding, collection agents, etc.) and a low percentage of the population has professional education.
- The inhabitants of the zone are temporarily employed or unemployed in a ratio of 2-1.
- The inhabitants of the zone have no training to identify, mitigate, or face the risks or events of a natural or human-made nature.

### 3.3.3. Zone Action Plan (PAZ) Projects. Figure 3.3.3.

The current status of projects presented by the zone management in the PAZ to FOREC is as follows:

**Table 3.3.3.** Projects done in the zone. June 2000

Project	Content	Comment
Road system	West Avenue	Route to be decided by Planning Dept. Long term project
Special	MERCAR - country bus terminal, retail center, food market, geriatric home.	Private initiative. Not contemplated in short/medium term
	Puerto Espejo development	Private long-term initiative
	Southern Fire Station	To be built between 44 <sup>th</sup> St. Between Carrera 18 and Carrera 19
	Golden City sports and recreation center	In process, administered by National University.
Infrastructure	Works for collection and removal of wastewater. Wastewater treatment plant	Being defined by wastewater utility EDAR
	Stabilization of banks in micro-drainage areas	Being defined by CRQ
Health	Mercar health centers	Being constructed
	Santa Rita and Quindos Health Centers	Reconditioned
	Southern intermediate unit	The Health Department states that it is to be adapted from present Southern Hospital
	Southern Hospital	To be relocated close to the stadium
Education	José María Ocampo School	1,416 pupils. Grades 6-11. Being built
	Nuestra Señora de Belén School	798 pupils, grades 1-8. Being built.
	Rebuilding of Los Quindos School and N. Señora de Belén Day Care Center	1,349 pupils. Grades 1-9. In progress.
	Reconditioning of Zuldemayda, Golden City, P. Salavarieta, Nueva Granada, Francisco Miranda Schools.	4,258 pupils, grades 1-11. In process.

Source: PAZ National University of Colombia - Temporary Partnership fieldwork.

**3.3.4. Partial plans.** The land-use programmer PORTE has established partial plans for the zone:

- Partial expansion plan - Puerto Espejo. It calls for the incorporation of new urban land.
- Partial development plan - Mercar. It is a strategic project of development as a center for services and employment in the zone.

These partial plans have been proposed by the city administration, but development depends on private initiatives. Therefore, there has been no definition of content or extension so far.

### 3.4. The Site and the City. Figure 3.4.

The connection between the site and the city is established on the following basis:

- The present and planned system of main roads.
- Distance and possibility of access to emergency services in the city—hospitals, fire stations, etc.
- The relationship with the local emergency plan currently being prepared by the city disaster prevention office.

The plan for risk mitigation for the urban area of Armenia<sup>9</sup> determines processes and protocols for operation in the case of emergency, contingency plans, and plans for community education.

<sup>9</sup> Information from Marco Antonio Giraldo, Director of the Municipality's Disaster Prevention Office.

This is currently being prepared. This document shall define the zones of assistance in the City, the location of operating centers, the location in the zone managed by COFAMA of the Emergency Regulatory Center CRURE, and other complementary facilities. It will include a policy for the relocation of some 6,000 houses which are located in risk zones.

Also, the City Council should be issuing an order to determine the risk zones and the areas of environmental preservation in the city. The order has been prepared by the City Workshop, and one of its proponents, Jorge Mario Patiño, an architect, has taken part in the preliminary definition of risk, and areas for the preservation of the development Lindaraja II.

At a meeting with the Municipality's Disaster Prevention Office, it was agreed that a study should be made on the possibility of proposing the **Village of Life and Work** as a center of disaster prevention at a basic level, with minimum installations for primary assistance within its sector of influence. The intention is that it can be incorporated into the general plan that the Disaster prevention Office is drawing up. The intention also is to define the role that the Project may play in attention, contingency, and mitigation.

According to information supplied by the Health Department, there is a proposal to transfer the *Hospital del Sur* close to the football stadium on Eden Avenue. There are no other proposals for the construction of new health centers, and no other medical facilities in the part of the city where the site is located.

### 3.5. Relationship between the Site and the Region. Figure 3.5.

The relationship between the site and the region is determined on the basis of the potential which is generated by its strategic location, ease of access, and visibility, and by the possibility of linking the **Village of Life and Work** into existing tourism circuits.

At present, 50<sup>th</sup> Street is one of the roads which leads to the Coffee Park, and this is advantageous for the Project. The plan to consolidate this road, the construction of the prospective West Avenue (*Avenida de Occidente*) and *Perimetral del Café* Avenue will also benefit the Project and will significantly improve access and visibility. These projects will create a better connection to the airport and to hotels on Eden Avenue.

The site has excellent possibilities for engaging itself in the regional-type market and circuit in the long run. The development of 50<sup>th</sup> Street as a tourist road out of Armenia may generate a commercial structure that would benefit production in the Villa. At present, and in the short and medium run, the sector is in a stage of development, and the Project will help to consolidate urban development in the zone.

### 3.6. Geological analysis.

- Heterogeneous fill. Parts of the construction site are covered by heterogeneous fill materials.
- Top Soil. It consists of a thin layer of sandy silt with some ashes.
- Volcanic Ash. From the stand point of geotechnical engineering it classifies as occasionally clayey sandy silt. Due to the process of its formation the layer has developed some cementation influencing its behavior showing high strength in some intermediate layers.
- Residual Soil. This is a layer of cemented sandy silt that overlies the base layer of volcanic flow. Its strength is greater than the one surface layers exhibit.

Detailed Soil Properties show:

- Specific Gravity (Gs). Ranges between 2.38 and 2.56, with a slight tendency to increase with

depth.

- Water Content ( $w$ %). It is close to 70% at the surface and decrease to 35% with depth. Some superficial layers show values as low as 25%.
- Liquid Limit (LL%). It varies between 111% and 60.5%.
- Plastic Limit (LP%). It varies between 32% and 67%.
- Plasticity Index (IP). It is close to 36 at the surface, grows to 48 at 3.0mts. depth and decreases to 27 at 6.0 m depth.
- Liquidity Index (I.L.) It varies around 0.8, being negative in the more sandy layers.
- Equilibrium Water Content ( $W_{eq}$ ). It varies between 32% and 51% in a range lower than natural water content.
- Free Expansion. The results of the tests show 30% or 40% which indicate that the expansion possibilities are low.
- Grain Size Analysis. Grain size analyses indicate fine contents between 8.55% and 32.5%.
- pH. Hydrogen potential shows values as low as 6.2 and as high as 7.7.
- Unified Soil Classification (USCS). Soil in Armenia generally classify as MH according to the USCS. Counted samples classify as ML.

### 3.7. Vulnerability Assessment of Natural Disasters.

#### 3.7.1. Establishment of the Philosophy for Antiseismic Structural Approach.

In NSR-98, the earthquake-resistant design and construction standards, Law 400 of 1997, classified the city of Armenia as a zone of high seismic hazard, and therefore assigned it a peak acceleration coefficient (effective  $A_a$ ) of 0.25.

The Standard has defined the seismic behavior of structural systems and elements in accordance with the capacity to dissipate energy in the inelastic range. Therefore, the Standard includes three levels: DES (special), DMO (moderate) and DMI (minimum). For the high hazard zone, materials with special capacity for energy dissipation (DES) should be generally used. In some groups of use and materials, a moderate capacity (DMO) should be used.

Housing units belong to the so called use group I, "Structures of regular occupation." Therefore, they need an importance coefficient  $I=1.0$ . This coefficient changes the scope of the seismic design.

The Standard establishes which influence the characteristics of the soil will exert upon the construction. This assessment requires a site coefficient which is calculated from geotechnical data provided by a geotechnical engineer. Micro-Zoning studies, which comply to the Standard, draw the values that must be used.

The Standard maintains the limitations imposed by Decree 1400 of 1984 for non-reinforced brickwork, limiting it to zones of low seismic hazard, at  $A_a$  0.05 or lower. Therefore, it is plain that non-reinforced brickwork cannot be used in Armenia.

For zones of high seismic hazard, and in housing of one or two floors, the standard permits the use of the following structural systems, among others:

- Load-bearing walls. This includes concrete walls (DES), walls of reinforced block brickwork with vertical perforations with all cells filled (DES), brickwork reinforced walls of vertically perforated locks (DMO), partially reinforced, vertically perforated block brickwork walls (DMI), and confined brickwork walls (DMO).
- Open - porticos of momentum-resistant concrete (DES).

These structural systems are usual in housing of one and two floors, but the standards permit

the use of other structural systems in high seismic hazard zones (Tables A.3-1, A.3-2, A.3-3, and A.3-4).

- Specific Decisive Factors of the Project. The Project "**Village of Life and Work**" includes the following types of situation which must be structurally resolved in accordance with the criteria and Restrictions described above, and at all events, in terms of NSR-98.
- Single family constructions, two floors with reinforced structural brickwork. Two-storie block growth. No growth in height (no additional floors).- construction of communal workshops, with portico structure, for roofing and tiles, and with non-structural elements (walls) in structural brick and to support horizontal stress.
- Community hall with portico structure, roofed with wood and tiles, and non-structural elements (walls) in reinforced structural brickwork to support horizontal stress.
- Day-care center with portico structure, roofed with wood and tiles, and non-structural elements (walls) in reinforced structural brickwork to support horizontal stress.

#### Conclusion/ Structure and Anti-Seismic Materials Proposal:

- Strengthened masonry walls. Construction based on masonry pieces of vertical drilling joined by mortar. It should be internally strengthened with bars and steel wires.
- Partially strengthened masonry walls. Construction based on masonry pieces of vertical drilling joined by mortar. It should be internally strengthened with bars and steel wires.
- Bordered masonry walls. Construction based on masonry pieces, joined by mortar. It should be principally strengthened with reinforced concrete, such as, columns, beams, and fillets, built around the walls.
- The bordering columns should be anchored to the foundations. Overlapped couplings in the base of the column could be used. Anchoring the welt to the highest tie beam should finish them off. Bordering beams should be anchored to the terminal ends. Finally, tying fillets can be considered as supplementary elements to the highest tie beams. They can be used in windowsills, head ends, etc.
- Strengthened cavity masonry walls. This construction is made with two walls with masonry elements of parallel faces, strengthened or not, separated by a continuous space of reinforced concrete, of composite functioning.
- Porches and other systems. On the other hand, both concrete or steel structural porch systems can be used. A spatial porch, moment resistant, essentially complete, without diagonals resisting all vertical loads and horizontal strengths should make them up. However, for this type of housing, these systems are not affordable due to construction costs.

#### **3.7.2. Vulnerability Assessment of the Site to Natural Disasters.**

The site shows the following characteristics:

- There is no free water to cause liquefaction in the sandy surface layers.
- Foundations are not going to be affected by groundwater and design may proceed freely.
- Three major seismic sources are identified in the area. This are: 1) Near Surface Source. This is caused by surface faulting which constitute a seismicgenic area very close to the city of Armenia. Distance: less than 25 km. Depth: 10→20 km. 2) Deep Source. Wadatti-Benioff zone. Distance: 80→100 km. Depth: close to 100 km. 3) Subduction Zone. Located along the Pacific Coast, this is a very active source with rather low recurrence periods. Distance: 200 km.
- Cementation of local soils and depth of underground water, greater than 12.00m., considerably improve conditions to resist the effects of a possible tremor.

The site of the Project is located over volcanic ashes which are very unstable in case of an earthquake or when they have a highly superficial phreatic level. This condition would occur if land is saturated by heavy and recurrent rains in the area. However, studies conducted by Los

Andes University (Bogota) show that the phreatic level is 12-meter deep from the surface, based on drillings performed at Puerto Espejo. In general, leaving outstanding seismic amplifications aside, the site of the Project does not have any other significant natural threats.

### **3.7.3. Vulnerability Assessment of the Sector.**

Natural phenomena that can be the most frequent cause of emergencies or disasters in the region are related to geo-dynamic processes such as landslides, or massive displacements of land due to human forces, or instability of river banks caused by highly strong earth tremors.

This sector includes various settlements which are located in risk zones and need human modifications. Thus, the area also needs the application of preventive measures, including the relocation of housings and the construction of earth-stabilizing systems. A severe earthquake can cause serious damages to housings and to the infrastructure of the zone, as well as landslides in the most unstable and risky sectors of the zone.

Houses in some neighborhoods nearby the site of the Project seem to be fragile not only due to deficiencies in their construction (they were built before the enforcement of earthquake-resistance regulations), but also because they are located in zones with high risk of massive land displacements. Santa Rita Stream's basin is the zone that is most exposed to landslides, and it includes the settlements of Santa Rita and La Virginia neighborhoods. If a mild earth tremor were to occur, the structures of houses in the sector could be severely affected due to their high rate of risk. This would include 4,000 inhabitants (37%) out of 10,700 people in the sector.

## **3.8. Determinants for Site Planning – Conclusions.**

The following guidelines for urban and architectural design are drawn from the submitted analysis:

### **3.8.1. The Site.**

The most important conclusions refer to the ways to deal with the topography (i.e., adjusting the design to the structure of slopes in the terrain and avoid big fillings as much as possible) and then environmental protection (approach to the slopes by the banks of Venus Stream and use of vegetation in coordination with CRQ in order to avoid erosion and landslides). The norms for the appropriate land use, densities, and surfaces must comply to the standards established by *PORTE*. The connections to utility systems must also comply to current standards.

### **3.8.2. The Sector.**

The continuation of the road system must be guaranteed by adjusting the Project to the characteristics specified by *PORTE*, and by solving the conflicts that could arise due to the trading activities of the Project and the flow of traffic in the intersection between 50<sup>th</sup> Street and the prospective *Avenida de Occidente* (West Avenue). Parking on the city's main road system must be avoided, and the Project must include and specify public bus stops. Also, the environmental network—i.e., the streams and the natural drains of the terrain—must be preserved, and conflicts due to settlements in conservation zones must be avoided. This implies to take control once again of the banks of the stream by planting vegetation that would slow down and eventually eradicate erosion and landslides. The strategic location of the site and the program of the Project seems to disclose the potential to make a specific and special work for public space (for instance, a plaza with services) with great visibility and easy access for the nearly 11,000 residents of the sector. This point is crucial in order to create an emergency center. Likewise, the Project incorporates in its housing program the uses, typologies and densities of the sector.

### 3.8.3. The Zone.

The Project includes slightly less than 1% of the population in the Zone. This means that it ought to rely on the facilities available for education, health, recreation, and supplies. The city's main Food Market is located at the Zone. There is room available for approximately 8,000 school children. There are also sport grounds, recreational centers, and health facilities. The community services or equipment proposed in the Project must be channeled in order to fulfill strictly local needs (community room and day-care center for children of residents that work in the workshops), excepting the support to the system of city emergencies, of which there is no record in the Zone.

### 3.8.4. The City.

The strategic site of the Project depends on its relation to the city in order to develop its potential in tourism and trade. In the short run, the site depends on 50<sup>th</sup> Street as its main access. In the long and medium run, the site will depend on the construction of the prospective West Avenue (*Avenida de Occidente*).

### 3.8.5. The Region.

The site of the Project and its strategic location allows to incorporate such site into the region's tourist circuits, thereby increasing its potential for trade, specifically in relation to the selling of handicrafts and the supply of services to tourists. This presupposes that the city's present and future road system must be visually harmonious and facilitate access to both road networks.

### 3.8.6. Geological Analysis.

The site shows the following geological characteristics:

- Surface soils are firm enough to support the weight of forthcoming constructions.
- Housing construction by stages does not guarantee an uniform quality of supports.
- Within a zone of high seismic risk, and being uncertain about the future development of structures, it is recommended that the foundation be of the type of a waffle slab with border beams and inner beams as required.
- The soil must be prepared adequately, removing not-consolidated layers and loose materials, and pouring a layer of compacted sand of at least 0.30m. Its extra width should have this same dimension.
- Permanent drills must not exceed the 1 to 2.5 ratio. They must be protected with vegetation.
- An appropriate drainage system must be ensured to avoid puddles and the like.
- Slopes adjacent to constructions must be protected with natural vegetation.
- The NSR-98 Colombian Code of Seismic-Resistance must be applied according to the following prescriptions:

- Soil Profile :	S <sub>3</sub>
- Site Coefficient :	S = 1.5
- Use Group :	Group I
- Importance Coefficient :	I = 1.0
- Peak Ground Acceleration :	A <sub>a</sub> = 0.25
-Peak Ground Acceleration-damage threshold :	A <sub>d</sub> = 0.04

### 3.8.7. Vulnerability and Handling of Emergencies.

The urban and architectural design of the Project must comply to all the earthquake-resistant requirements specified in the national codes. Utility systems must anticipate precarious situations. The use of equipment and services in case of emergency will be encouraged. Likewise, the application of these measures inside the site must let people get in and out easily when evacuations are needed. Also, the Project ought to be conceived of as the basis to offer



primary assistance to the residents of the sector. Consequently, the Project must include spaces and facilities that can be adapted and utilized to support eventual victims of a disaster.

In a meeting with the Municipality's Agency for the Prevention of Disasters, upon common agreement it was decided to propose the construction of a basic center for the prevention of disasters in the site of the Project. Such center would have the minimum facilities and equipment to provide primary assistance in the sector of influence. The underlying purpose is to include this center in the General Plan that this Agency is making.



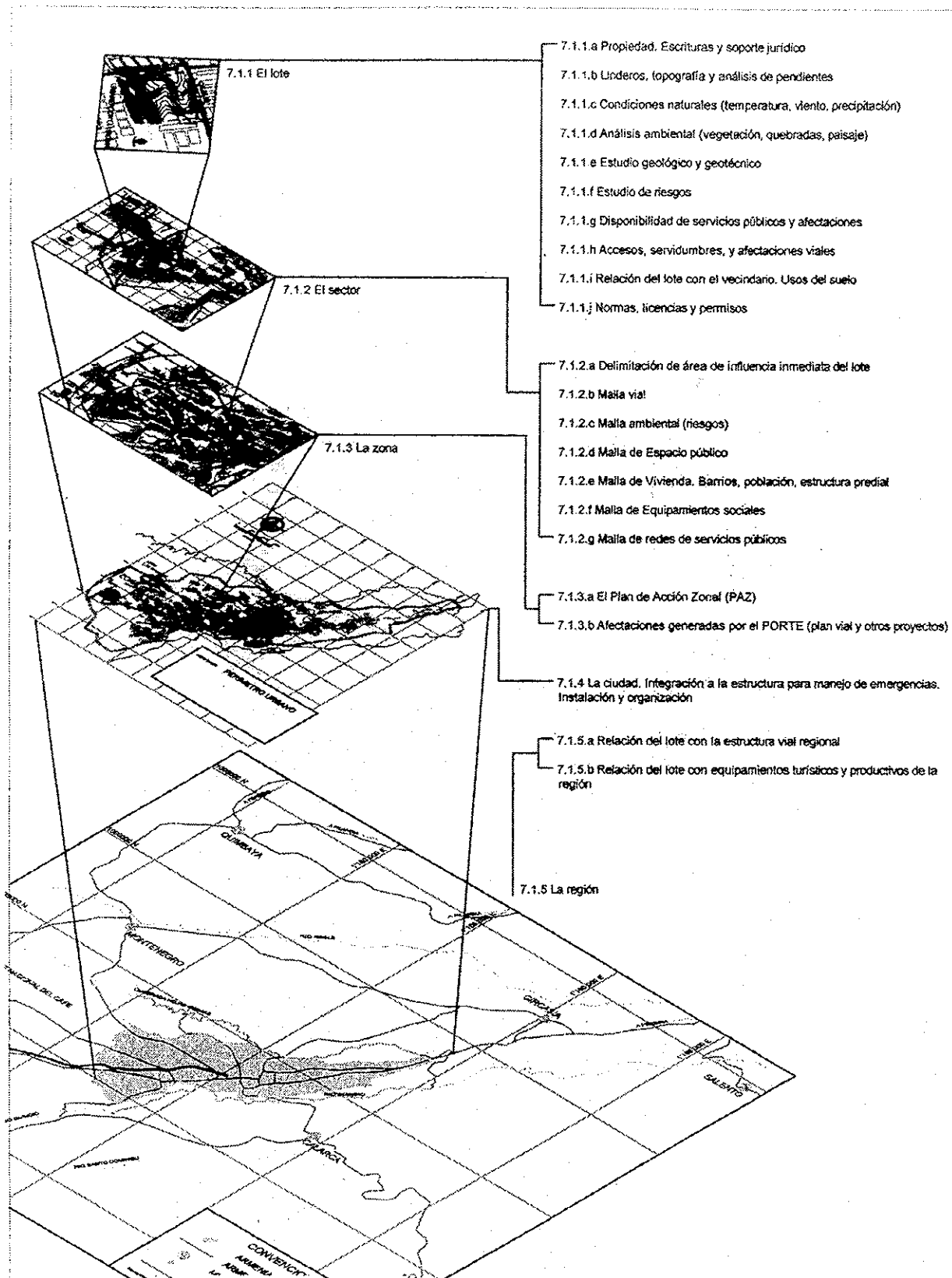


Figura 3.1.(1). Estudio del lote.  
 Figure 3.1.(1). Study of the site.

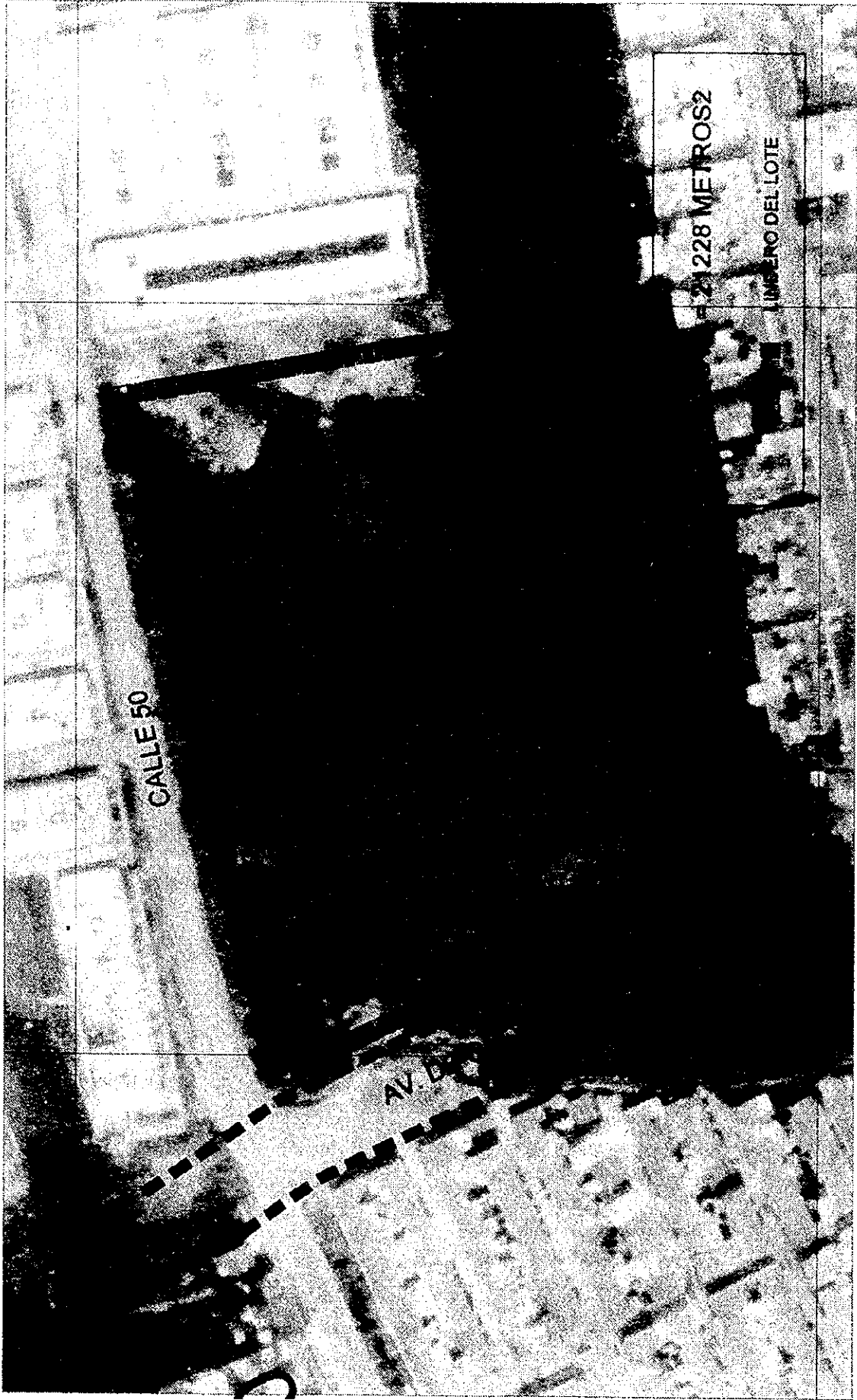


Figura 3.1.(2). El Lote  
Figure 3.1.(2). The Site

## LOTE - LINDARAJA AEROFOTOGRAFIA

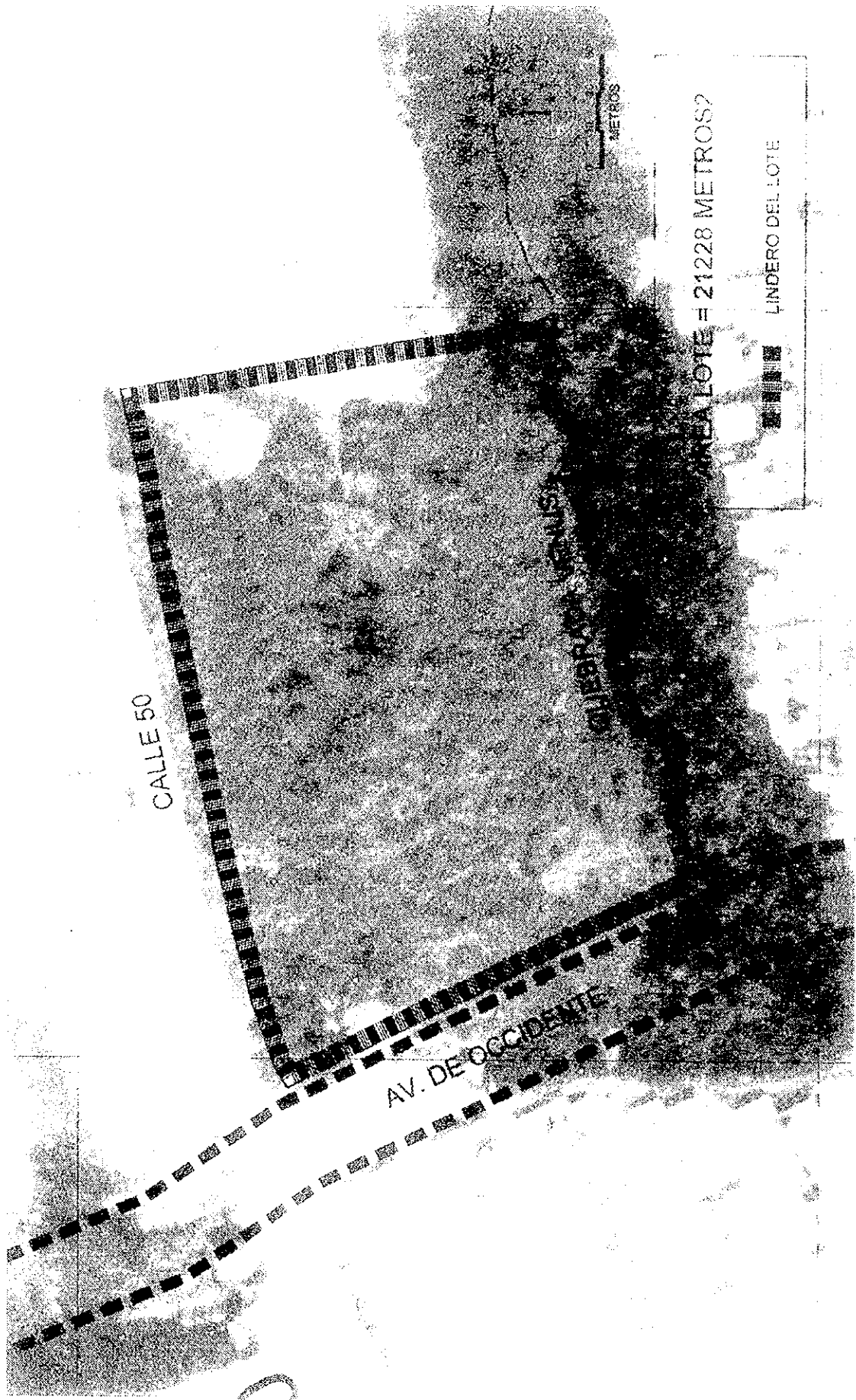
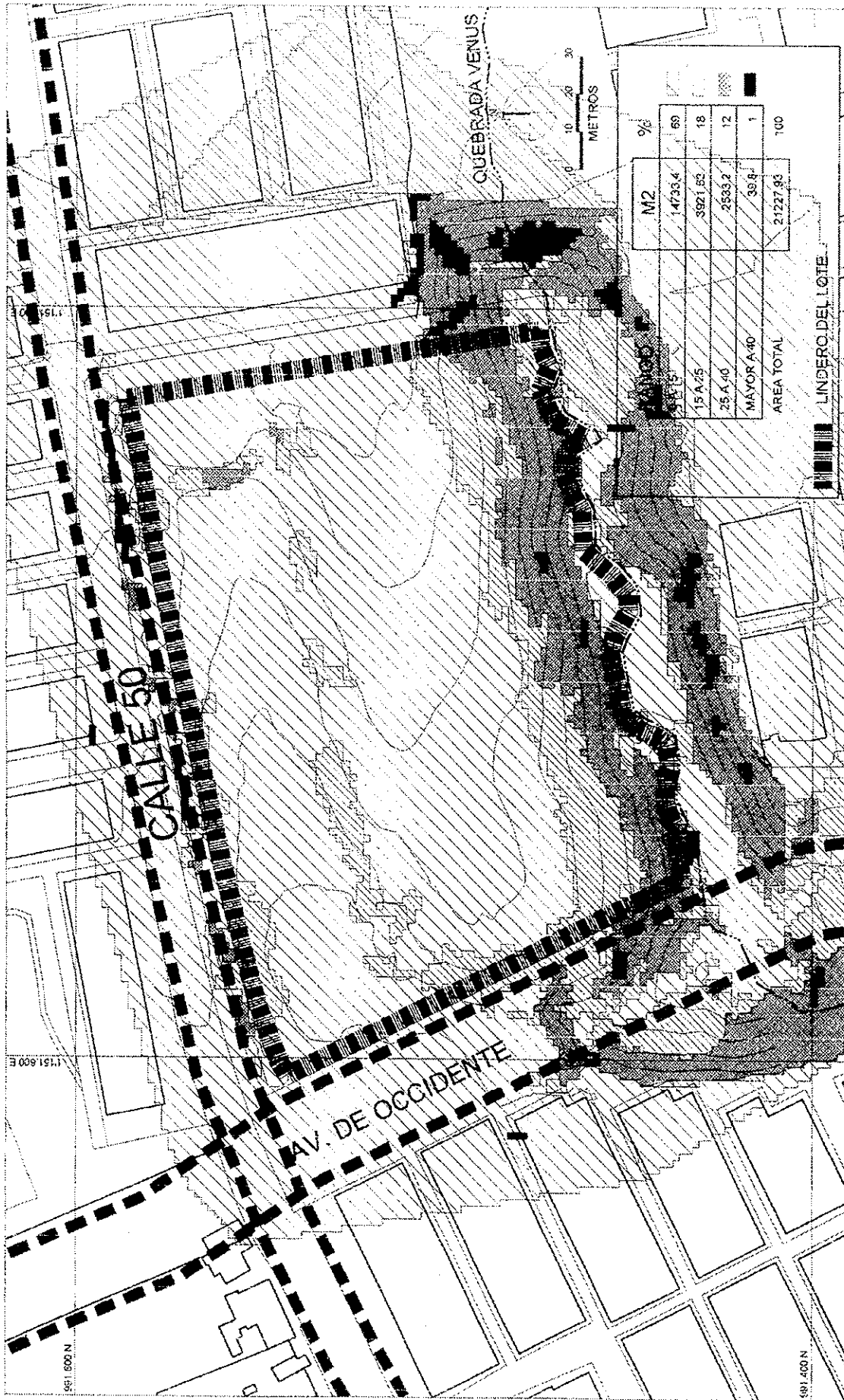


Figura 3.1.29. Lote 100.  
Figura 3.1.29. Lote 100.

LOTE - LINDARAJA  
AEROFOTOGRAFIA

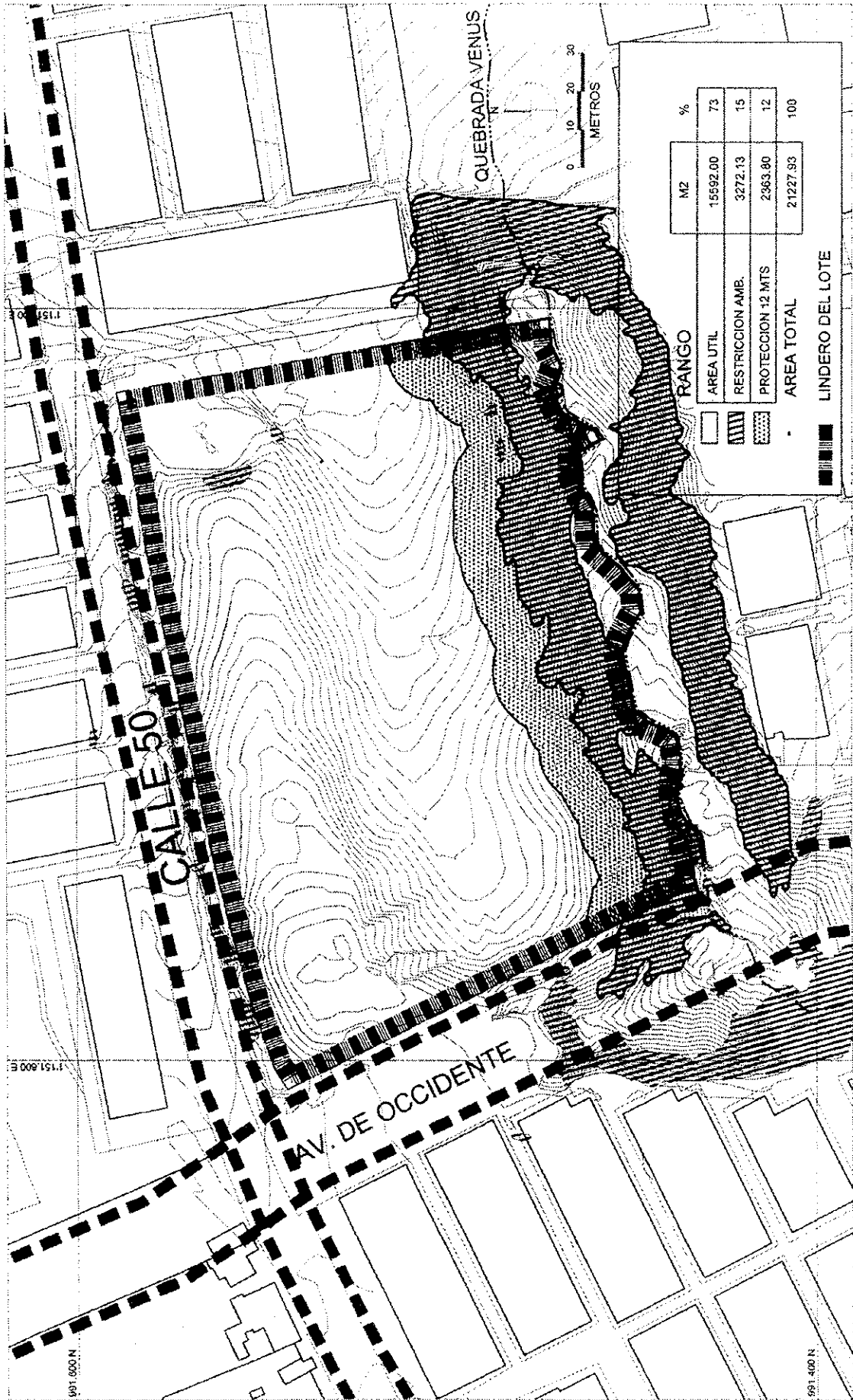




# LOTE - LINDARAJA

## PENDIENTES

Figura 3.1.1.(2). El Lote - Pendientes  
 Figure 3.1.1.(2). The Site - Analysis of Slopes.

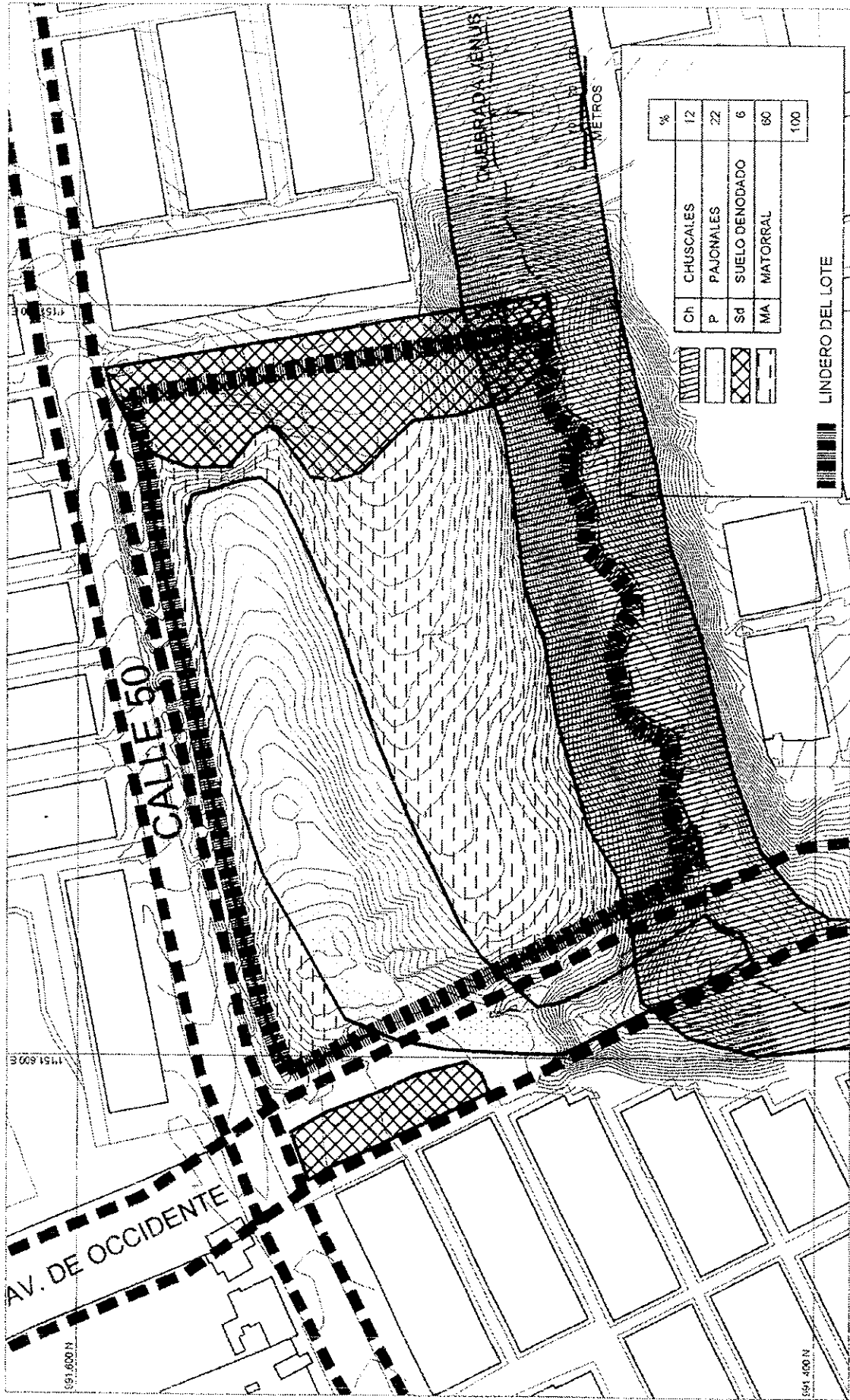


# LOTE - LINDARAJA

## AFECTACION AMBIENTAL

Figura 3.1.2. (1). El Lote Afectación ambiental  
 Figure 3.1.2. (1). The Site





# LOTE - LINDARAJA

## ANALISIS AMBIENTAL

Figura 3.1.2. (2). El Lote - Analisis Ambiental  
 Figure 3.1.2. (2). The Site

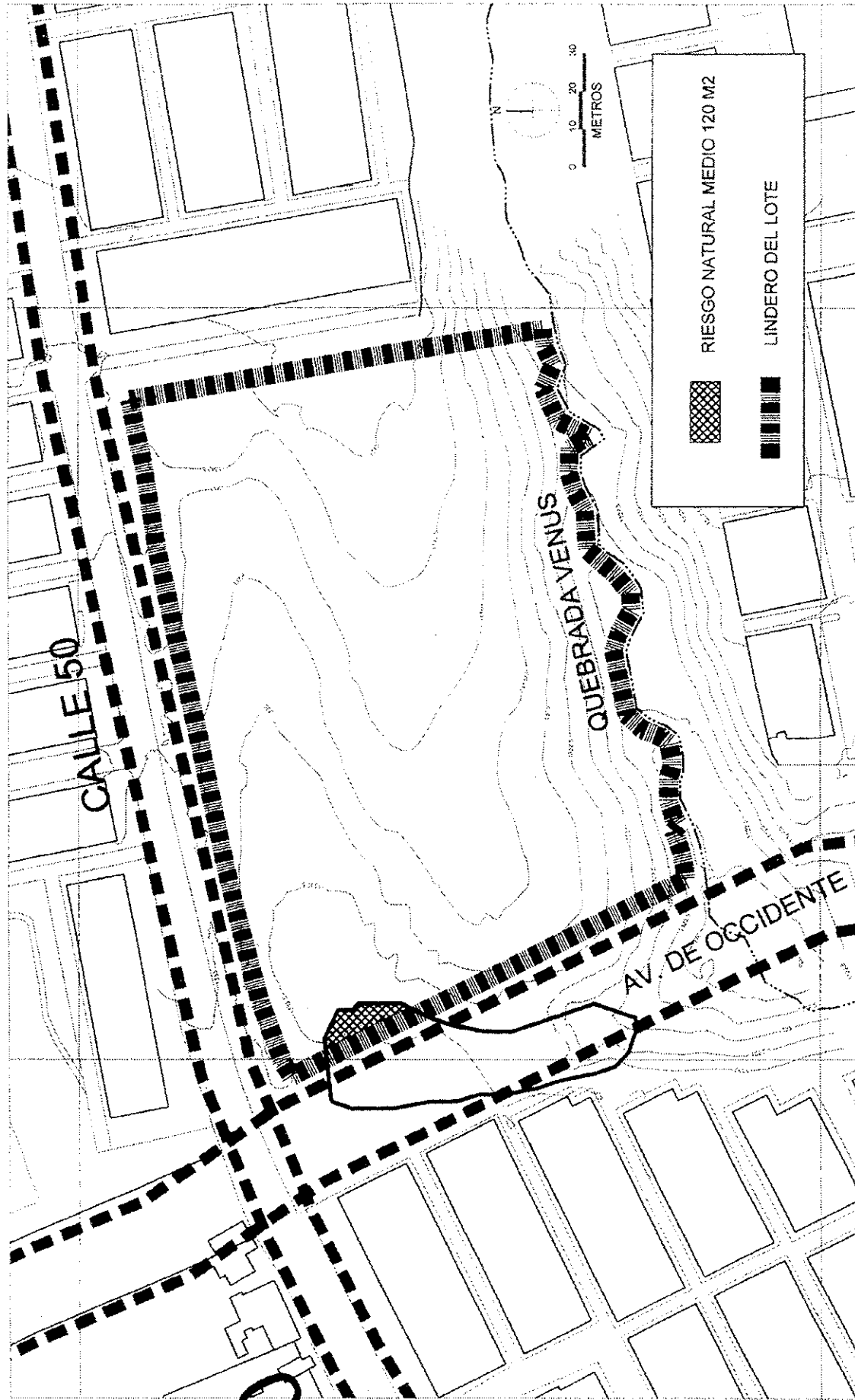
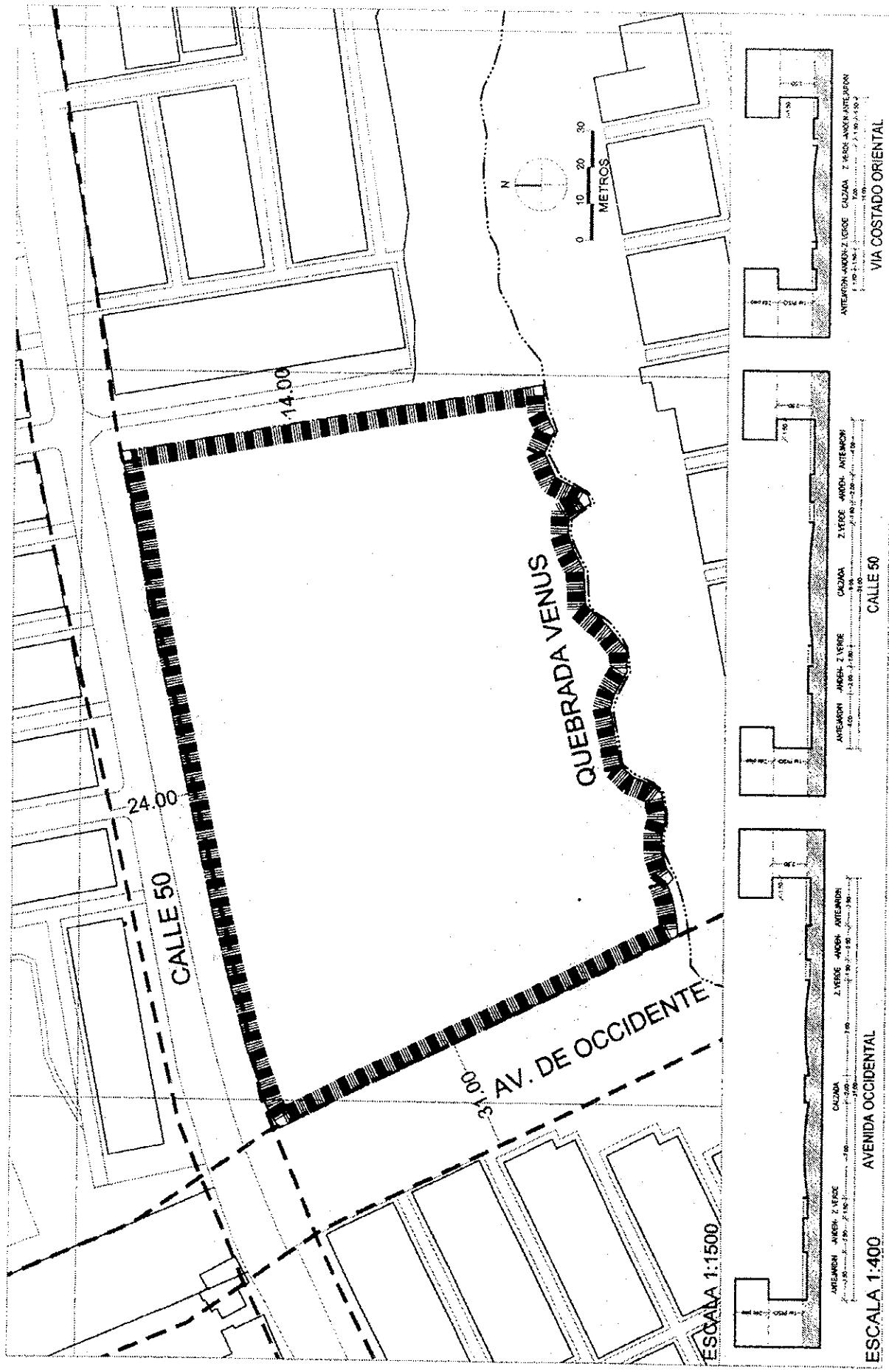


Figura 3.1.2. (3). El Lote - Zona de Riesgo  
 Figure 3.1.2. (3). The Site - Natural Hazards

# LOTE - LINDARAJA

## ZONA DE RIESGO



**LOTE - LINDARAJA**  
**AFECTACIONES VIALES**

Figura 3.1.4. El Lote - Afectaciones viales  
 Figure 3.1.4. The Site - Road planning Reserved Areas

# ACUERDO 10 DE 1999

USOS	PRINCIPAL	- Uso residencial - Uso mixto (actividades productivas)
COMPLEMENTARIO	<ul style="list-style-type: none"> <li>- Usos comerciales</li> <li>- Institucionales (población estudiantil)</li> <li>- Productivos (bajo impacto)</li> </ul>	
VIAS VOLADIZOS Y ALTURAS		<ul style="list-style-type: none"> <li>- Via de enlace: para plantearamientos urbanos nuevos</li> <li>- Via local: formando manzanas de 90 metros máximo de longitud</li> <li>- Via peatonal: desarrollo máximo 60 metros</li> </ul>
TIPOS DE VIVIENDA	<ul style="list-style-type: none"> <li>- Vivienda unifamiliar 1 piso Frente lote &gt; 6-8 metros Relación 1:2 Area lote 50 metros<sup>2</sup></li> <li>- Vivienda unifamiliar 2 pisos Frente lote &gt; 0-3.5 metros Relación 1:3 Area lote 36.75 metros<sup>2</sup></li> <li>- Vivienda bifamiliar 2 pisos Frente lote &gt; 6-8 metros Relación 1:2.5 Area lote 36.75 metros<sup>2</sup></li> </ul>	<ul style="list-style-type: none"> <li>* Puede cambiar a bifamiliar de 2 pisos.</li> <li>15% área neta urbanizable para mas de 2400 metros<sup>2</sup> (descontando las áreas del plan via) y áreas de protección)</li> <li>13% para conjunto cerrado</li> <li>6% para equipamiento colectivo municipal (puede ser mas de un globo de terreno)</li> <li>9% áreas comunes y áreas verdes</li> <li>8% áreas comunales verdes</li> <li>5% equipamiento colectivo</li> </ul>
CESION TIPO A		

Figura 3.1.6. Normas, licencias y permisos  
 Figure 3.1.6. Regulatory controls, codes and zoning  
 AGENCIA DE COOPERACION INTERNACIONAL DEL JAPON  
 PASO No.2: EL ESTUDIO - Preparación del plan  
 STEP No.2: THE STUDY - Preparation of the plan-