

Raquel Tardin

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Concrete Project Strategies
for Urban Territories



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Raquel Tardin
Graduate Programme in Urbanism (PROURB)
Federal University of Rio de Janeiro
Rio de Janeiro, Brazil
rtardin@ufrj.br

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To Rodrigo, Davi and Lina

Foreword

In the current panorama of urban growth and planning in many urban territories of Western societies, territorial open spaces, viewed as residual spaces of urban occupation, are reserved for eventual occupation. Open spaces have been viewed in this manner in the earlier stages of the compact city and especially now, in a time of the dispersed territories characterized by discontinuity, heterogeneity, and fragmentation.

The disciplinary perspectives of ecology, geography, and urbanism, but also public opinion, have for some time promoted the conservation and protection of the most valuable open spaces, and efforts have been made to remove such spaces from the real estate market. However, such positions, usually radical, are insufficient for territorial equilibrium and inevitably lead to the progressive isolation of valuable open spaces.

By contrast, understanding existing open spaces as protagonists of spatial planning can be an adequate starting point to realizing territorial equilibrium (in physical - spatial terms) through the articulation of open spaces with urban occupied spaces, where the open spaces would include spaces with important biophysical and visual values, and spaces that do not have these features but are otherwise useful, owing to their spatial position, in structuring the urban occupation of the territory.

With this as its principal objective, this book attempts to combine environmental, landscape architecture, and urbanistic approaches in the construction of the system of open spaces as one of the most relevant “layers” for renewed urban territories.

Initially developed as a doctoral thesis at Universidad Politécnica de Cataluña, the work considers the case study of a singular territory, consisting of Barra da Tijuca and Jacarepaguá in Rio de Janeiro. (This case study is not only attractive in a research sense but also daring because of its spatial size and because of the effort required to generate many original maps that were essential for the analysis.) Using the study area as a laboratory for analysis, reflection, and experimentation, the work subsequently establishes an objective singular method for the analysis of these spaces together with proposals of project strategies.

Once the open spaces resulting from contemporary urban growth and their urban dynamics are identified, their main attributes are analyzed and evaluated by

considering the role that the open spaces might eventually play in the urban context (relating to other territorial components). Such attributes relate to biophysical support, visual perception, and accessibility from the main roadway network. Other distinct attributes of open spaces that are analyzed are the qualities of the spaces in terms of planning (which facilitate or hinder their planning as open spaces) and the spatial situation or position of open spaces relative to territorial elements (e.g., other open spaces, infrastructure, and settlements). The structuring character of each open space is thus deduced for the proposed planning of the system of open spaces.

After the evaluation of these attributes, project principles for the planning of the system of open spaces are formulated. The principles relate to themes such as the designation of land use, the maintenance of spatial continuities, and the convenient “suturing” of open and occupied spaces. Additionally, project actions to be carried out on open spaces in the territorial scope are identified and defined to illustrate the use of established analysis categories and to construct a planning proposal for the system of open spaces that will guide the restructuring of the territory.

Finally, a brief presentation of international projects and achievements allows for the completion and understanding of a possible profile of the proposed planning as a whole, and indications for implementation and management are presented.

I consider that the work presented is *a notable theoretical and methodological contribution to the analysis and projects of territorial open spaces, decisive for the construction of new spatial planning and for the restructuring of territories*, and much more comprehensive than its specific geographic link. This was a consideration of the members of the group that evaluated the thesis in April 2005 and unanimously bestowed the highest qualification.

As the supervisor of the original Ph.D. thesis, it is a great pleasure for me that the author’s results are being published, not only because the author deserves the recognition of her work, but also because of the academic and professional interest that her book will generate in the field of landscape and spatial planning.

Barcelona, Spain

Antonio Font

Preface

I met Raquel Tardin in the beginning of 2004 in Barcelona at a bookstore café called Laie, a nice place where the aroma of coffee wafts through the bookshelves and tables of magazines and newspapers. The Landscape Observatory of Catalonia was being constructed at that time, and Raquel was interested in the functions and composition of this institution, which would open its doors in a few months. For my part, I wanted to know in more depth the content of the research that she was conducting and what was spoken of so well. I clearly remember that first meeting and all that followed because the exchange of information and points of view were so plentiful.

Raquel is an excellent professional who has as a virtue her strong belief in trans-disciplinarity (which is unfortunately not very common), which allows her to integrate ideas, concepts, and derived perspectives of other areas of knowledge with incredible ease, and it can only be attained with an open and curious mind like hers.

The research that Raquel was undertaking at the time of our first meeting later became the material of an excellent Ph.D. thesis completed at the Technical School of Architecture of Barcelona in April 2005. This thesis, which I had the privilege of reading and evaluating with the highest grade as a member of the examining board, is what the reader has in their hands today in the form of a book. Although there are several reasons why this work has interested me from the moment I first read it, I believe its greatest contribution is that it gives open space a title role in spatial planning and urban intervention.

Raquel proposed “reading” open spaces in a unique way to understand them as a system and as active agents of spatial planning, distinct from simple mute spectators that are passive and isolated in their expectation of protection or occupation. I believe that this is a perspective that is not just suggestive but also necessary, one that can give excellent results both for Rio de Janeiro, which the author examined in a case study, and many other territories. The author is also conscious of this aspect of her work and proposes a method that can easily be extrapolated and applied to other cases. In considering open spaces to play the role of the protagonist, they need to be well understood and defined to allow for concrete project strategies for the planning of their spatial system and the restructuring of the territory. Hence, the author presents an exhaustive list of attributes and indicators and describes their

relevance to fundamental aspects of the system of open spaces and its planning, such as urban, biophysical, visual, and social functions.

The perspective advocated by Raquel further interests me because it coincides with what we are carrying out at the Landscape Observatory of Catalonia, namely, landscape catalogs,¹ although they are obviously on another scale and more directed toward political interventions than physical interventions in the landscape. In coming to understand the current work, I could not avoid drawing a comparison between our approach and that proposed by the author. I found myself pleasantly surprised that, disregarding the differences in scales and objectives, there were many points of contact: the integral vision of landscape, the interdisciplinary and transdisciplinary approach, and, above all, the handling reserved for open spaces.

Additionally, these areas are considered priority agents in spatial planning. According to the European Landscape Convention, “Landscapes are an important element in the quality of life of populations, urban and rural areas, degraded and high quality territories, as well as special and everyday spaces.”

I sincerely believe that contributions such as the work in this book are fundamental to extending and spreading *a new culture in spatial planning and urban project design* and the careful management of natural resources based on innovative management of land that cannot be urbanized and of the landscape as a whole, and such contributions present a new method of territory administration and management based on dialogue and social participation. In this new desired context, open spaces—and landscapes—will play a key role in policies of spatial planning and in proposals of urban projects, and they will be included in specific policies whether urban, environmental, social, cultural, or economic.

Barcelona, Spain

Joan Nogué

¹ The landscape catalogs are documents of a technical nature that the Catalan laws for the protection, management, and planning of landscapes consider as tools in the planning and management of landscapes from the perspective of spatial and sectorial planning. The catalogs determine the types of landscapes of Catalonia, their values and conservation status, the goals of quality that must be met, and measures for achieving these. They are therefore extremely useful for implementing landscape policy, with the complicity and active participation of all social agents that take part in the territorial interventions through intensive public participation.

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I would like to thank my Ph.D. supervisor Prof. Antonio Font, for his earnestness, patience, and dedication in guiding my Ph.D. thesis (2005), the basis of this work. I also thank Prof. Carles Llop, Prof. Nuno Portas, and Prof. Álvaro Domingues for their attention, encouragement, and collaboration throughout the development of my thesis; Prof. Joaquim Sabaté, Prof. Joan Nogué, and Prof. Enric Battle for the contributions they made to the Ph.D. thesis project; and Prof. Lucia Costa for her constant support. I would like to thank the respondents for their participation and kindly giving their time; those who provided important documents for the development of the analysis; the Government of Brazil, Ministry of Education (Coordenação de Aperfeiçoamento de Pessoal de Nível Superior—Capes), for financing my research during part of the time that I required to fulfill my Ph.D. thesis; the graduate programme in urbanism (PROURB) for financing part of this book; my family, and specially my husband, Rodrigo, for all support given; and those who collaborated in the completion of my research but who I, unfairly, have omitted.

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Chapter 1

Introduction

This book proposes an interdisciplinary method of urbanistic intervention through the planning of the system of open spaces and demonstrates possible concrete project strategies for the restructuring of urban territories. Open spaces are considered to play a valued role in spatial planning on the basis that they are a system, with its own values, and the planning of the system of open spaces may have the potential to restructure the territory in terms of providing a new structure for urban occupation whether existing or yet to come.

It is important to make it clear that, when working on the broader scale of the territory, open spaces are those free from urban occupation. In the specific case of developing the proposed method, open space is a space for possible future transformation of the territory. These open spaces are free from settlement and roadway infrastructure. The territory is understood to be an artificialized landscape, as a place where nature and human construction coexist (and can be seen, interpreted, adapted and transformed over time) and have distinct spatial and functional structures.

The system of territorial open spaces, in these terms, can be represented by a set of elements. The elements are capable of establishing various open relationships with each other and the urban occupation, under mutual influences and relative autonomy. In other words, the elements receive and send influences between the interior and exterior of the system. As a system, the set of spaces is more than the sum of its parts, and is susceptible to mutations over time.

The proposed method involves the recognition of territorial open spaces and the analysis and evaluation of some of their most significant physical - spatial attributes and relationships that they establish with the urban occupation. In this context, this allows for a approach to determine the spaces that should remain free from urban occupation and the spaces that can be occupied, under certain conditions. The method thus guarantees the maintenance of essential dynamics of open spaces, which include dynamics related to the urban context, biophysical support, and visual perception of these spaces, as a basis for the structuring of urban occupation. As a final objective, the method focuses on strategies for planning the system of open spaces and conducting urban occupation as possible guidelines for the spatial planning of a concrete urban territory.

The method specifically proposes the planning of a system of open spaces as a project strategy, and considers the system as a possible restructuring element of the urban territory. It does this by focusing on the role of open spaces in non-consolidated urban occupation. This book takes a territorial unit in the western area of the city of Rio de Janeiro that includes the Pedra Branca and Tijuca massifs, the Atlantic Ocean, and Jacarepaguá lowlands as a case study for empirical investigation.

Although applied here to a specific territory, the proposed method may be applied to any other place, since it has broader scope than a specific geographic relationship.

1.1 Presentation

In recent decades, various authors (Boeri and Lanzani 1992; Ascher 1995; Corboz 1995; Dematteis 1995; Font et al. 1999, among others) have researched the transformations or mutation of cities, from the perspective of new forms of urban growth. These forms have developed a new model of a city facing changes in transport and information technologies and in the economic order. In this context, the territorial scale of urbanization reaches a point that it modifies the traditional downtown–suburb relation of a city, and shapes urban patches that occupy the territory unequally and discontinuously, thus forming an intricate network of relationships with increasingly complex spatial and functional realities.

In the case of walled cities, it was possible to clearly differentiate the urban fabric and territorial open space. Even as recently as the twentieth century, one could identify the parts of a territory and its structure in a more or less compact way, because cities had a more or less perceptible “end”.

Current urban territories, however, have complex formations (Figs. 1.1 and 1.2). They have a discontinuous and extended spatial structure, with compact urban areas mixed with scattered settlements and natural and rural areas connected by a network of enhanced roads. The mix of urban and rural areas conforms to a distinct urban reality in which the city has invaded rural areas. This mix offers a joint vision of both city and country in such a territory. In the context of mutual interference, the urban, natural, and rural areas have become one reality, namely the reality of urban territories. These territories are threatened by unmeasured and fragmented urban occupation. The territories have “holes”, or non-consolidated areas in the middle of existing urbanization, and urban fronts that advance to conquer non-occupied space.

In this reality, analysis of non-consolidated territorial units can suggest possible ways to achieve urban consolidation in a balanced form through action on open spaces. The approach supports the use of existing structures and avoids extensive occupation of the territory. In this way, disordered urban expansion and, among other problems, excessive soil impermeabilization and high energy consumption, which tend to result from urban sprawl, could be avoided.

Urban territories appear as mutant regions. There is thus a need for new concepts and instruments for their analysis and interpretation, and methods for intervening in their development. At the same time, there is also a need for project strategies of urban occupation that are more sensitive to the territorial resources and the needs of the people.

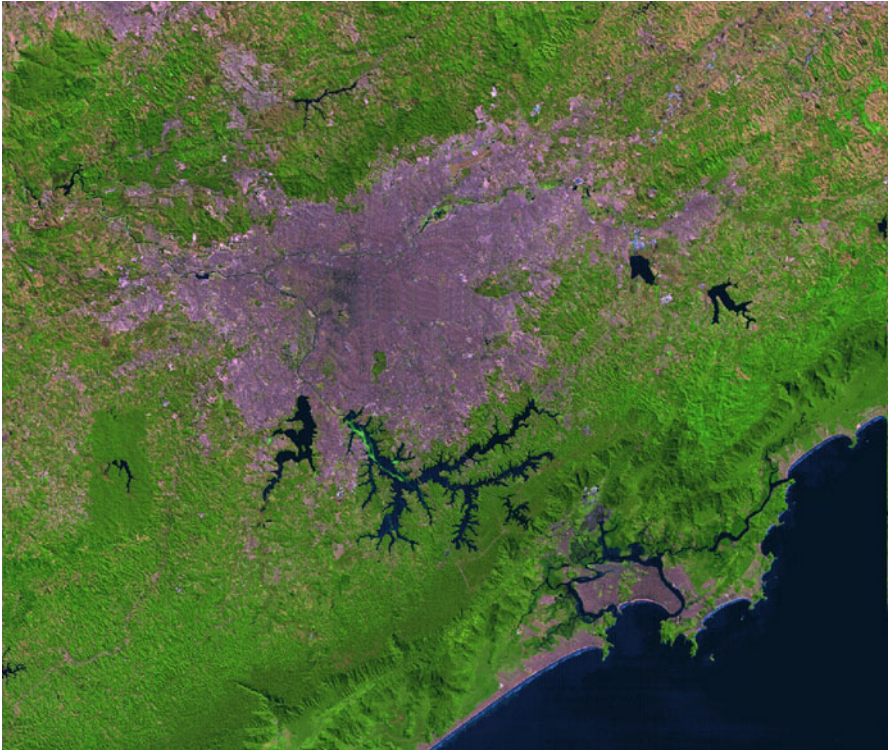


Fig. 1.1 São Paulo (2000) (Source: <http://www.inpe.br>. Accessed 25 June 2002)

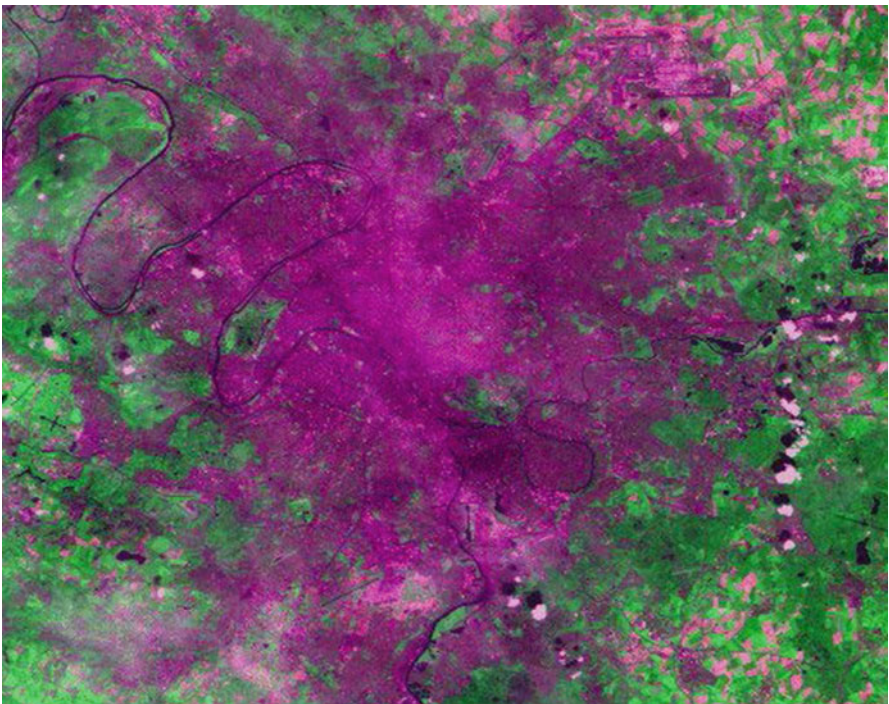


Fig. 1.2 Paris (2000) (Source: <http://www.inpe.br>. Accessed 25 June 2002)

The majority of metropolises have suffered and continue to suffer under growing urbanization based on the logic of extensive occupation (in terms of the spread of occupation). In such occupation, open space tends to be a residual space in the urban territorial structure. The proposal is to turn this perspective around and think positively about open spaces. In other words, the proposal focuses on the values of open spaces and how the permanence of these in a system may offer the possibility of acting in the “holes” of the territory, and creates the basis for possible territorial restructuring.

The goal is to change the basic thinking. Encouragement is given to treating open spaces in a system as more than isolated parts (e.g., parks and reserves), by considering that the system of open spaces through the maintenance of its dynamics can give new structure to urban occupation, and that open and occupied spaces are not separated but united and strongly interconnected.

Territorial open spaces, to this end, may cease simply being protected areas or areas of future occupation and may become areas that in a system are capable of restructuring the territory construction. In this way, open spaces are spaces of opportunity for intervention in the territory. This opportunity is in accordance with the recognition of the potential the open spaces offer to the comprehensive development of the dynamics of the territory. The balancing of collective needs and territorial resources, through the ordered manifestation of the urban context, provides the possibility of an urban territorial development that is in accordance with the necessities of each part of the territory and its community.

This proposal offers the possibility that open spaces play a central role in spatial planning, not being only non-buildable spaces or abstract patches of zoning. Open spaces may therefore be considered an active element, which contrasts with prevailing conceptions of open spaces, which are more protectionist or developmentalist. Specifically, the system of open spaces can be used to consolidate urban occupation in a manner that is coherent and complementary and connects open and occupied spaces in a balanced way; thus treating open spaces as essential resources for territorial restructuring and sustainability.¹

¹ The concept of a sustainable city recognizes that cities must respond to certain social, environmental, political, cultural, as well as, physical and economic objectives. It is a dynamic organism as complex as society itself and sensitive enough to react properly to changes. The sustainable city is a city with many facets and can be described as

- a fair city, where justice, food, shelter, education, health, and opportunities are distributed properly and where all people feel represented by their government;
- a beautiful city, where art, architecture, and landscape foster imagination and renew the spirit;
- a creative city, where open-mindedness and experimentation mobilize the full potential of its human resources and enable more rapid responsiveness to changes;
- a green city that minimize its environmental impact, where the relationship between built-up space and landscape is balanced and where infrastructure use resources efficiently and securely;
- a city that encourages contact, which brings public space into community life and assists the mobility of its inhabitants and where information is exchanged both personally and electronically;
- a compact and polycentric city, protecting the surrounding countryside, integrating communities, and optimizing their proximity;
- a diverse city, in which the degree of diversity of overlapping activities encourages, inspires, and promotes a vital and dynamic human community. (Rogers 2000, p. 168, translated from Spanish)

1.2 Contribution of the Proposed Method

Authors (Battle 2002; Font 2003; Sabaté 2003; Llop 2003, among others) have raised the issue of the active dimension of open spaces in the spatial planning of urban territories facing fragmentation. They have promoted the system of open spaces as a guide and central axis for spatial planning, which allows for the consideration of urban development from “the outside in”. This focus is based on the principles related to the modification of the passive role played by open spaces in the planning and transformation of these “empty spaces” into spaces that are full of meaning and are capable of restructuring the urban territory. This demonstrates that infrastructure or real-estate pressures are the only possible logic for urban development.

This approach aligns with already established theories, especially those related to landscape urbanism,² as important references to this work. In this sense, we stress that there is an ever greater need for guidelines that are capable of redirecting urban intervention according to landscape issues and that are capable of managing complexity according to the demands of the current territorial dynamics; these guidelines would need to consider plural strategic propositions, and have well-defined but flexible formalizations (Corner 2006).

In this direction, the objective is to provide concrete tools for planning the system of open spaces, as an opportunity to restructure urban territories and create combined open-space and urban occupation strategies. It represents the development of a practical approach that focuses on proposals for urban intervention that are more concrete than abstract.

In fact, the complexity of the subject of how the system of open spaces can affect the structure of the territory is reflected in the various heterogeneous approaches. Works that make ecological and socio-cultural assumptions are highlighted, although this is not an exhaustive selection.

The ecological approaches value the biophysical attributes of open spaces and adopt the conservation and recovery of natural processes, from urban ecology to landscape ecology, as guidelines for the maintenance of open spaces and for planning the system of open spaces and structuring the territory. References in this field are McHarg 1969; Forman 1995; Hough 1995; Odum and Sarmiento 1998; Burel and Baudry 1999, among others.

The socio-cultural approaches value the perception of landscape as a complex sensory experience, although visual perception prevails. Thus, one can see open spaces in the landscape as places for the construction of images and collective practices, covering their aesthetic, formal, social, and cultural dimensions as values for the maintenance of open spaces and for intervention in the territory. References in this field are Lynch 1976; Spirn 1998; Cosgrove 1984; Roger 2000, among others.

These approaches are complementary in the planning of the system of open spaces, regarding both the focus on the different component elements of these spaces and the different planning methodologies for a possible system. Some important

² In this sense, authors have made important theoretical and practical contributions in the field of landscape urbanism that are strong references; e.g., Charles Waldheim, James Corner, Alex Wall, Stan Allen, Chris Reed, Christopher Gray, and Peter Connolly.

approaches even include both aspects to collate socio-cultural and ecological values in the analysis of open spaces for planning the system (e.g., McHarg 1969).

When facing contemporary urban complexity and fragmentation that is the result of striving for a structured and sustainable territory, it seems prudent to analyze and evaluate open spaces not only in terms of their biophysical and socio-cultural attributes but also in terms of the roles they may play in fragmented urban contexts, which are related to the integration of urban occupation. Here open spaces are elements that can promote the relationship among other urban elements and processes (such as settlements and roadway infrastructure) in a spatial and functional sense, through possible physical, biophysical, visual, or social connections.

The relationships between open and occupied spaces may thus be seen as determinants for the maintenance of open spaces free from occupation, or their occupation under certain conditions, and as references for the structuring of urban occupation. This is due to the related dynamics that may develop, regardless of the biophysical values of the open spaces or the values assigned to the visual perception of the open spaces. From this viewpoint, the proposed method includes the urban context of open spaces as an important factor to be analyzed and considered for the permanence of these spaces, beyond the existing values related to the other attributes of the open spaces. The urban context and the attributes of the biophysical support and visual perception are then combined to guarantee the maintenance of essential dynamics of open spaces and, consequently, the spaces themselves as determinants of urban occupation. This allows the planning of the system and the restructuring of the territory with the system of open spaces being the backbone of urban occupation.

In this direction, one can question urban models that are entirely based on ecology. Such models are concerned about the protection of open spaces and/or mutual respect between open and occupied spaces, and do not consider the complementarity of existing phenomena in open spaces as part of a whole, in which open and occupied spaces are structurally interrelated. Thus, intervention in the open spaces should involve other variables, beyond ecological variables, and should allow the creation of new project possibilities and solutions for the restructuring of the territory.

For this purpose, the proposed method is an interdisciplinary approach that includes the following.

- *Strengthening of the concept of the system of open spaces as a guide for spatial planning* as opposed to thinking of open spaces as isolated protected pieces or spaces for further occupation.
- *Reinforcement of the relationship between planning and design concepts to create concrete project strategies* that plan the system of open spaces and restructure the urban territory.
- *Recognition of the complex and plural nature of territorial open spaces relating to their biophysical support, visual perception, and urban context*, as an important factor to be considered in planning the system of open spaces and for the structuring of urban occupation.
- *Emphasis of the importance of open spaces in the current urban context as elements that can integrate parts of the urban occupation*, thus encouraging the maintenance of open spaces free from occupation, or their occupation under certain conditions, beyond their biophysical and visual perception attributes.

- *Emphasis of the system of open spaces as an important factor in the structuring of urban occupation through the establishment of a close relationship between open spaces and urban occupation in the process of construction, where the system of open spaces may dictate where to occupy, where not to occupy, and how to occupy, as the case may be.*

An illustrative case for Latin America is presented. Most published work on this topic comes from Anglo-Saxon perspectives, and there is thus a gap related to a Latin-American point of view, and the present work can be regarded as having particular importance in this context.

1.3 Case Study of Rio de Janeiro

The choice of a case study in Latin America, especially in Rio de Janeiro, represents a personal concern for this area and the importance of the largest metropolises in this part of the American continent. The metropolises have much in common regarding the shaping of their territories; e.g., there are serious problems related to uncontrolled urbanization, which is linked to the presence of large reserves of open spaces and there being few resources for the conversion of this framework.³

To this is added the territorial dimensions of landscapes in the Americas. Whereas most European cities are compact within the scope of an administrative core, the Americas have vast areas in the process of urban occupation. These areas are defined by open spaces belonging to a wider scale of the territory. The dimensions of the open spaces are thus such that the spaces are functionally and spatially representative of territories with non-consolidated urban occupation. Here intervention in favor of consolidation would result in the “essential complement” of central nuclei that, in most cases, already have infrastructure that could be used in future consolidation, thus avoiding consumption of land farther away.

Within this reality and beyond the problems associated with urbanization and the reserves of open spaces, Rio de Janeiro is itself a worldwide symbol for the relevance of an unmistakable landscape. Rio de Janeiro is not only a city with extremely complex urban growth and planning, for which there is still a lack of analytical tools such as those proposed in this work, but also a city with a large amount of open space, which has affected and still does affect the spatial configuration of the territory and demonstrates the potential of open spaces within the dynamics of the growth of the metropolis.

Over the last few years, most actions⁴ of the public sector in Rio de Janeiro have considered public open spaces on a local scale and/or the recovery and revitalization

³ Latin American cities share many characteristics in their urban setting, despite the inherent differences in the place or type of influence they have; e.g., the irreversibility of the rural exodus, the presence of large rural and urban properties, changes in economic rhythms, the presence of areas of urban decay such as slums, high rates of poverty, and inequality in the income distribution and, pressures on urban growth and sprawl. (Santos 1982, translated from the original)

⁴ Examples of urban interventions can be found in the projects of Favela-Bairro, Rio-Cidade, and Rio-Orla.



Fig. 1.3 Situation of the study area in relation to Latin America and Brazil (Source: <http://parnaiba.ana.gov.br>, 2008)

of urban occupation, usually in areas with assured urban vitality and high density. This emphasizes the importance of the treatment and rehabilitation of public open spaces. However, these interventions respond primarily to the criterion of the juxtaposition of spaces from specific standpoints that contribute little to the integration of open spaces in a system on the scale of the territory. They therefore do not efficiently address specific processes of fragmentation and imbalance in the urban territory in a broader sense.

In the analysis presented in this book, the case study, which includes the Pedra Branca and Tijuca massifs, the Atlantic Ocean, and Jacarepaguá lowlands, in the western area of the city of Rio de Janeiro, is a specific territorial unit that is bounded by decisive elements that shape the geographic territory in its entirety, and that allows for the system of open spaces to be treated as a functional and spatial system (Figs. 1.3, 1.4 and 1.5).

According to Font et al. (1999), territorial units are linked to a physiographic unit and have a particular morphology and a specific system of spatial organization and functional organization. To this end, the territorial unit in the case study (also referred to as the study area in this book) has peculiarities that strengthen the analysis, especially with respect to the following.

- **Geographical position.** The territorial unit is situated in the center of the metropolis, relatively close to the traditional center, which allows prediction of its urban consolidation and amalgamation with the central city.



Fig. 1.4 Satellite photographs of the metropolitan region of Rio de Janeiro (Source: <http://www.cdbrasil.cnpm.embrapa.br>. Accessed 20 June 2002)

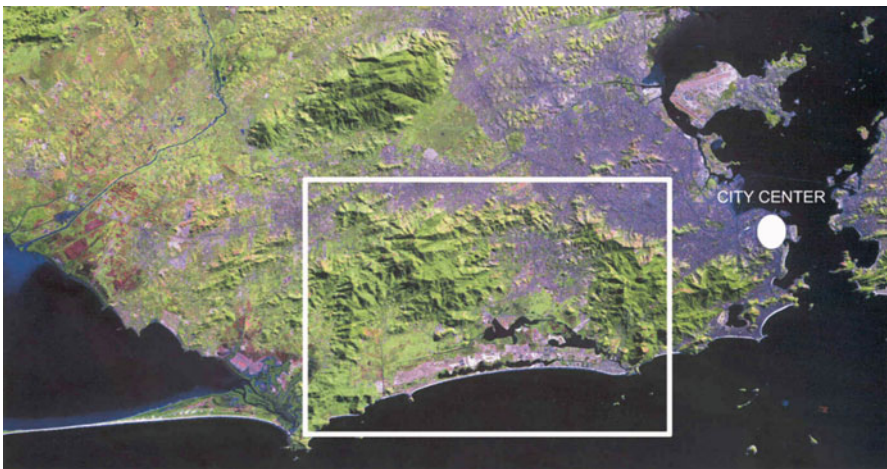


Fig. 1.5 Situation of the study area in relation to Rio de Janeiro (Source: SMAC 2000)

- **Physiography.** The territorial unit has geography well defined by massifs, plains, and the sea, which promotes understanding of the proposed system of open spaces and the different scales of the components. This configuration offers the opportunity to join open spaces on different scales in the same territorial unit, thus allowing the planning of the system of open spaces and restructuring of the territory. This strengthens the system of open spaces as a set of spaces related to each other and to the urban occupation.
- **Unique urban structure.** The spatial, morphological, and functional organization of the study area generally reflects the problems addressed in the book. The study area is a territorial unit undergoing the process of consolidation of urban occupation, and has large reserves of a wide variety of open spaces that are suffering from the establishment of new settlements and infrastructure. Additionally, the territorial unit has different spatial and functional characteristics and a rich history of formation and transformation over the years, resulting from urban development

plans that have encouraged the main urban trends of the twentieth century and intense formal and informal urban occupation. Furthermore, the most important facilities for the Olympic Games in 2016 will be developed in the territorial unit, which encourages the restructuring of this territory.

Because of its peculiarities, the study area is chosen as a challenging example of the application of the proposed interdisciplinary approach. Problems that are representative of many of the stresses and needs of open spaces within the urban dynamics of the territory are illustrated.

Nevertheless, the presented method is applicable to other territories. The case study constitutes only one of its possible applications. The case study will certainly have limitations and it is not meant to be illustrative of all possibilities of analysis and project proposals, which cover a multitude of aspects and related elements and functions. The intention is to contribute to the enrichment of spatial planning, in a theoretical and practical sense, by taking an interdisciplinary approach. In this way, the proposed method has a transversal focus that is intended to be adaptable in time and space.

1.4 Outline of the Proposed Method

The proposed method essentially focuses on the physical - spatial dimension of the system of open spaces and the distinct relationships that can be established among open spaces and between open spaces and urban occupation. Thus, the analysis includes, besides aspects genuinely related to architecture and planning, aspects related to biophysical support and visual perception. This allows the investigation of other possibilities of “constructing the city” that are more in line with the plural character of these spaces and can contribute to the restructuring of urban territories. For this purpose, instruments derived from nearby disciplines, such as spatial planning, urban design, landscape architecture, urbanism, geography, and ecology, are used. The method basically comprises the following.

- *Recognition of open spaces to be analyzed and their urban context and the roles they can play to structure urban occupation.* Analysis allows the identification and characterization of existing territorial open spaces and the urban dynamics in which they are inserted. It is observed that there are spatial and functional relationships among open spaces, settlements, infrastructure, and planning over time that allow the recognition of open spaces to be analyzed and the possible roles they can play in structuring elements and processes in fragmented urban context. Points of emphasis are the importance of open spaces in the structuring of the territorial unit, the consequences of urban occupation for open spaces and the manner in which the open spaces developed, and the current territorial situation of open spaces related to urban occupation, its elements, and processes. It is thus possible to recognize possible open spaces that could structure the fragmented urban context and encourage the maintenance of these spaces free from occupation, or their occupation under certain conditions, and as references for the structuring of occupation. These aspects are considered in three distinct periods,

which are characterized by different approaches to planning and building. The different approaches relate to, among other aspects, the ideology of the plans, the real-estate logic, and the appropriation of space by people. The periods are until 1940 as a stage of colonization, between 1940 and 1970 as a stage of subtraction, and between 1970 and 2000 as stage of fragmentation.

- *Analysis and evaluation of the attributes of open spaces in identifying possible spaces for project opportunity and their situation in the territory.* The goal is to initially consider territorial open spaces that are the most suitable to be preserved as unoccupied areas, or that can be occupied under certain conditions. Such spaces are identified according to their attributes relating to⁵ biophysical support, visual perception, accessibility, and links to planning rules. This evaluation provides possible *spaces of project opportunity*. These spaces are *anchor spaces*, *reference spaces*, and *other open spaces*. The spaces with the best evaluated attributes of biophysical support and visual perception are prioritized. They are designated *anchor spaces* if they have attributes of high/medium-high value, and *reference spaces* if they have attributes of medium/medium-low value. Finally, there are *other open spaces* that are without significant value. The *situation* of the *spaces of project opportunity* in the territory is determined according to the above evaluation and the urban dynamics in which the open spaces can be inserted by identifying the main continuities and discontinuities among the spaces and the characteristics of their borders, and by taking into account the possible roles they play relative to open spaces and to the structuring of urban occupation, as data for the planning of the system of open spaces and restructuring of the territory. This may indicate the importance of essential dynamics that the *spaces of project opportunity* have; these dynamics relate to the urban context, biophysical support, and visual perception. The preservation of such spaces as unoccupied areas, or their occupation under certain conditions, and their structuring character in the construction of the territory are reinforced as bases for final *project strategies*. Additionally, the possible assurances and threats of the *spaces of project opportunity* in the face of the possibility of their maintenance as open spaces or spaces designated for urban occupation are analyzed in relation to the final evaluation of the parameters of protection established through existing planning rules. This analysis determines the tendency toward occupation and the importance that territorial open spaces not yet protected have as elements in final *project strategies*.
- *Creation of concrete project strategies for planning the system of open spaces and restructuring the urban territory.* According to the previous analysis, it is of interest to identify possible *project strategies* that allow the planning of the system of open spaces and the restructuring of the territory by focusing on open and occupied spaces in terms of both planning and design concepts. On the one hand, *project principles* are proposed to determine project guidelines for open spaces. These *project principles* refer to the system of open spaces and the functional, spatial, and synergistic relationships among parts of the system and between the system and urban occupation to maintain or recreate the processes involved in the

⁵The values were high (H), medium-high (MH), medium (M), medium-low (ML), and low (L).

different dynamics of the open spaces; these processes are related to biophysical support, visual perception, and the urban context. The *project principles* can be applied to each of the spaces and they allow for the project of the system of open spaces to guide urban occupation. On the other hand, *project actions* are suggested as strategies for the structuring of the system and as guidelines for urban occupations. These *project actions* are established following the previous analysis of the *spaces of project opportunity*, their *situation* in the territory, the relationships they establish with the surrounding areas, occupied or not, and the structuring character that each open space has in the system and related to urban occupation. The *project actions* thus structure the system of open spaces and the urban occupation. As a result of this relational analysis, the *project actions* may indicate the possible roles that the open spaces could play in the planning of the system and, consequently, in the restructuring of the territory. These *actions* can be described as *adding*, *delimiting*, *connecting*, *adapting*, *articulating*, and *linking*. Also featured are the possible challenges of and the possible alternatives for the effective consolidation of the system of open spaces employing planning instruments.

It is important to highlight that this work does not include an evaluation of the immaterial values of open spaces in the considered territory, owing to this in not its main focus and the breadth of the research that would be required and the impossibility of accomplishing such a task without the support of a team. However, further, such evaluation could be added to analysis carried out with the purpose to incorporate spaces with immaterial value to the system of open spaces.

It should be noted that when taking a broad interdisciplinary approach as in this proposal, it is impossible to consider all possible relevant data, and as previously noted, this is not the intention. What is proposed is an investigation that reinforces disciplinary pluralism, more than a unidirectional vision, as a possible project path.

In accordance with the intended objectives, it is necessary to adopt quantitative and qualitative methods, even though the focus of the analysis is qualitative. To bring together spatial, formal, and functional features, it is in the interest of our analysis to determine the relation among the elements of the system of open spaces and between the system and urban occupation in accordance with morpho-topological logic.

Among the operational methods employed are the elaboration of detailed cartography, a field study including a photographic register of the area, bibliographical and iconographical research, and interviews.

1.4.1 Cartography and Scale of Analysis

The study area in this work has spatial area of 427.7 km². The cartography is defined by the limits of the Jacarepaguá lowlands, including the surrounds of the Tijuca and Pedra Branca massifs, bordered by two straights perpendicular to the ocean, at the eastern and western extremes of the plains.

The scale chosen for analysis is 1:25,000 because it fits the needs of the analysis, which should include scales ranging from the structure of relatively small open spaces to the territorial characteristics of larger surfaces. Thus, the scale 1:25,000,

between the scales of 1:50,000 (of more territorial character) and 1:10,000 (of more urban character), allows the manipulation of information that comes from different realities, thus enriching the final proposals.

In addition to define *project strategies*, the objective of this book is not to carry out a project for the case study but to develop a possible methodological approach. This purpose justifies possible cartographic imprecision. Despite this, the creation of maps (developed in their entirety by the author, see [Appendix 1](#)) was the most rigorous possible, with the intention of working, at all times, with official sources and primary information.

However, owing to the scale and themes involved, it was not always easy to obtain adequate information, particularly with regard to biophysical attributes. The scale of available maps (elaborated by state agencies) is 1:50,000. For many of the studied attributes, such as the hydrology, details do not exist on a smaller scale, but for vegetation, the detail is as good as 1:2,000. In this sense, the detailed data were compiled at scales of 1:2,000 and 1:10,000 and subsequently synthesized to a scale of 1:25,000. Original information was used for the remaining data. Cartographic information was collected for July 2003.

Cartography⁶ was a fundamental tool in the analysis of the study area as a territorial unit. It is used for the analysis of the urban context of the open spaces and the analysis of established spatial and functional relationships between open spaces and

⁶The cartography was developed from the following sources.

- City Hall of Rio de Janeiro:
 - Digital maps with original size of 1:10,000 for 1999 (via the Internet).
 - Digital maps with original size of 1:2,000 for 1997.
 - Information derived from the compact disc *Atlas Rio* (1998), mainly references to slums and irregular settlements in the study area, and an update according to a printed map with scale of 1:80,000 for 2001 produced by the Secretary of Housing of the City Hall of Rio de Janeiro (Secretaria de Habitação da Prefeitura do Rio de Janeiro).
 - Printed map of the city of Rio de Janeiro on a scale of 1:50,000 for 1999 and 2003.
 - Information derived from the compact disc *Zoneamento Urbano 99* relating to the classification of the existing territory.
 - Maps in PDF form derived from Secretary of Urbanism and Environment of the City Hall of Rio de Janeiro (Secretaria de Urbanismo e Meio Ambiente da Prefeitura da cidade do Rio de Janeiro (SMAC) (1998). *Estudo de impacto ambiental para o projeto de recuperação ambiental da Macrobacia de Jacarepaguá*. Rio de Janeiro: Secretaria de Urbanismo e Meio Ambiente da Prefeitura da cidade do Rio de Janeiro.)
- Center for Information and Data (Fundação CIDE), State of Rio de Janeiro:
 - Digital maps with original scale of 1:50,000 corresponding to pages 2,744-4 and 2,745-3 (Santa Cruz and Vila Militar, respectively) relating to the land use and vegetation, urban dynamics, and physical and environmental constraints.
 - Digital maps of the metropolitan region of Rio de Janeiro relating to the land use and vegetation on a scale of 1:200,000 for 1994.
- National Center for Soil Research of the Brazilian Agricultural Research Corporation (Centro Nacional de Pesquisa de Solos da Empresa Brasileira de Pesquisa Agropecuária; EMBRAPA):
 - Compact disc concerning the study and characterization of soils in the State of Rio de Janeiro, 2001.

the urban occupation, where one finds principal data on the physical attributes and existing land use. In the same way, through cartography it was possible to manage the principle data relating to the attributes of biophysical support and visual perception of open spaces for their analysis and evaluation. Additionally, the overlapping of maps as layers of information in each specific situation (McHarg 1969) allowed for the final evaluation of the attributes and their synthesis, and also the identification of *spaces of project opportunity* and the bases for the *project strategies*.

1.4.2 Iconography

Iconography⁷ was of great importance in the analysis of the urban context of the open spaces and the attributes of the visual perception of the territorial unit. With respect to the latter, photographic documentation was carried out to make a visual register of the area. For this purpose, the author traversed the main roads of the territorial unit, photographed the main sights, visited the tallest buildings and panoramic viewing points, and visited all existing parks and other relevantly sized open spaces to capture all possible viewpoints.

For the analysis of the urban context of open spaces, beyond the photographs obtained in the field study, historic photos taken from a select bibliography were used. Additionally, orthophotos on the scale of 1:8,000, which covered the entire study area, and aerial photographs that offered an overall view of the territorial unit were used.

The iconography is also an important resource for the elaboration of *project strategies*, mainly those that refer to alternative projects for the system of open spaces. For this purpose, extensive research was carried out looking for examples in magazines and books that were illustrative of what was intended to be shown in each of the *project strategies*.

1.4.3 Literature

Primary and secondary references were used, although the majority were primary, especially in relation to historic and current planning for the area. The general literature could be broken down into two categories. One category was more specifically related to the case study, and the other was more related to general theory, referring in

⁷The sources of photographic documentation (not taken by the author) are the following.

- Aerial photographs taken by the architect Rodrigo Rinaldi in 2001.
- Instituto Pereira Passos (IPP), City Hall of Rio de Janeiro:
 - Orthophotos with scale of 1:30,000, ENGEFOTO, flight 7/12/99.
 - Orthophotos with scale of 1:8,000 for 2000.

large part to urbanism, spatial planning, ecology, landscape ecology, landscape architecture, physical geography, and human and cultural geography, as will be shown throughout the book.

Through interpretation of the literature, it was possible to determine the principal concepts considered in the book, such as how to determine the disciplinary backgrounds that deal with the theme of the system of open spaces and spatial planning and how to determine the focus of the adopted approach. Likewise, the literature clarified other proposals for territorial intervention through the use of open spaces, which are complementary to those introduced in this book, resulting in an enriched dialogue.

The literature also clarified the plans and projects carried out in the study area and works that dealt with themes related to those that are approached in this work. These themes are specifically related to the territorial unit as a whole and its territorial situation, open spaces, existing plans, condition of settlements, and infrastructure, which were fundamental to the undertaken analysis.

1.4.4 Interviews

To obtain all necessary data for the analysis, especially data related to urban design projects that are planned in the study area by the public sector, interviews were held with the people responsible for the projects in December of 2001 and July of 2003 (see [Appendix 2](#)).

The interviews clarified the interests of and actions carried out by the public sector, regarding both the planning and management of open spaces and the planning and management of the study area as a whole, according to each administrative region. For this purpose, interviews were held with those responsible for the main parks, with those responsible for the projects that City Hall undertakes in the study area, and with public administrators.

There is also a need to understand the social and cultural relations between the local population and open spaces, and interviews were thus held with those responsible for the existing residents associations in distinct parts of the territorial unit. To obtain a general idea of the social and cultural context of the area, owing to the size of the study area and the large number of associations within, only associations recognized by City Hall were consulted in an effort to represent each part of the territorial unit (i.e., Barra da Tijuca, Recreio, Vargem Grande, Vargem Pequena, and Jacarepaguá).

In total, 19 interviews were held, each lasting approximately 1 h, with representatives of the public sector and the local community. In general, the interviews, all recorded, were held in a semi-structured way, leaving enough time for the interviewee to talk about other aspects that they deemed relevant to the proposed theme. The procedure for the interviews provided valuable material for the book, since it allowed for consideration of the relation of physical - spatial characteristics, which was the focus of the analysis, with the social and cultural realities of the open spaces in the study area.

1.5 Content of the Book

Following this general introduction, Chap. 2 compiles previous contributions on the structuring of a territory through the planning of the system of open spaces. The concepts used in the book are made explicit, and the attributes of biophysical support and the visual perception of open spaces, as well as the relationships established between open and occupied spaces in a fragmented urban context, are recognized as project resources. Later, an approach to contribute to the sustainability of the territory is formulated.

Chapter 3 turns to the characterization of the territorial unit, as an introduction to the case study, by describing its spatial situation in the territory, relief and climate, hydrography, infrastructure (i.e., roadways, urban services and public transportation), vegetation, urban land use, and population characteristics.

Chapter 4 concerns the recognition of open spaces to be analyzed and their urban context and the roles they can play in structuring urban occupation. This is done through the identification and characterization of territorial open spaces and the urban dynamics where they are inserted, especially the spatial and functional relationships established between open spaces, settlements, infrastructure, and planning over time that allow the recognition of the open spaces to be analyzed and the possible roles they can play in structuring elements and processes in fragmented urban context. The relationships are thus considered important to the planning of the system of open spaces and the restructuring of the territory.

Chapter 5 covers the analysis and evaluation of the attributes of open spaces for identification of possible spaces having *project opportunity* and their *situation* in the territory. Open spaces are analyzed and evaluated with the objective of determining the spaces that are most suitable to be preserved as unoccupied areas and those that can be occupied under certain conditions, according to their attributes (i.e., biophysical support, visual perception, accessibility, and links to planning rules). Also pointed out are the *spaces of project opportunity*, considering the urban dynamics in which the open spaces are inserted, their *situation* in the territory, and the possibility of occupation related to planning rules, as bases for *project strategies*.

Finally, Chap. 6 proposes concrete *project strategies* for planning the system of open spaces and restructuring the urban territory. According to preliminary analysis and evaluation and following the spatial and functional relationships of the open spaces related to their surrounding areas, occupied or not, *project principles* and *project actions* are indicated as *project strategies* that focus on the open spaces. Additionally, an approach for using planning instruments and the introduction of flexibility in planning are proposed, thus allowing the consolidation of the system of open spaces.

Chapter 2

Conceptual Questions

This chapter analyzes theoretical contributions that serve as a basis for the development of the proposed method.

It is first shown how the system of open spaces has been strategically used in territories throughout history, considering distinct aspects of the growth of cities, and the current tendencies for systems of open spaces. The objective is to recognize the disciplinary background related to the system of open spaces and the structuring of territory, to offer criticism and to present the proposed method in this context.

The concepts of territory, artificial landscape and territorial open spaces are then defined. Later, the attributes of biophysical support and those of the visual perception of open spaces, as well as the relationships established between open and occupied spaces in a fragmented urban context, are recognized as project resources. One can thus create project concepts for the system of open spaces and urban occupation, considering that open and occupied spaces are directly interconnected in the system, as a structuring element of the urban territory. Later, an approach to contribute to the sustainability of the territory is formulated.

2.1 Disciplinary Background

The idea of the system of open spaces, as a guideline for spatial planning, appeared at the end of the nineteenth century, through the work of Frederik Law Olmstead in The Boston Park System (1887) (Fig. 2.1). The system was based on the conversion of Back Bay marshland into a public park, and expanded into a series of parks connected by paths culminating in the Emerald Necklace (1887).

With this proposal, Olmsted aimed to integrate the city with the countryside as parts of the same project, using the system of open spaces. In this way, the open space in the system acquired a new dimension, beyond simply being public parks, because the parks were connected by parkways. These parkways, beyond connecting parks, contributed to a new concept in the design of roadways, allowed better

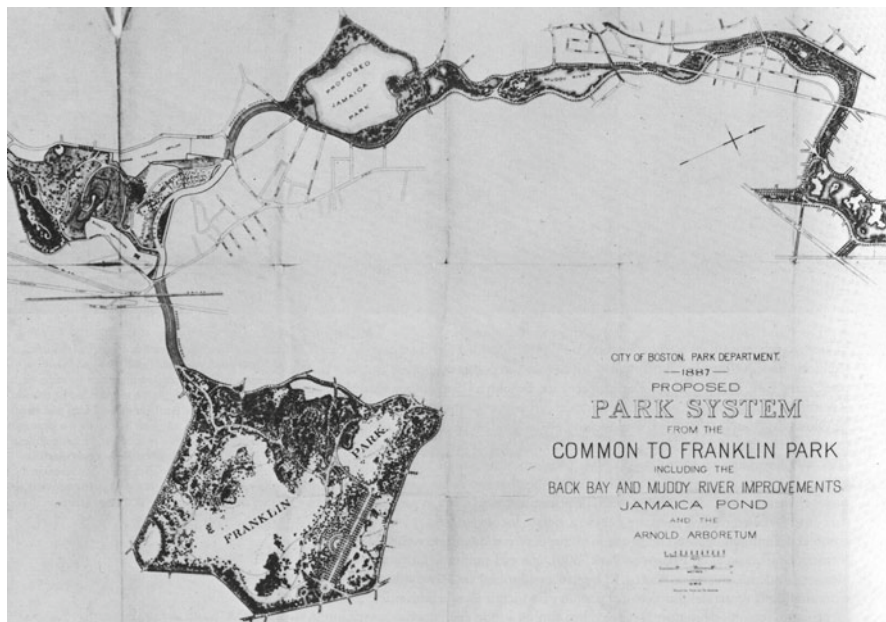


Fig. 2.1 Boston Park System (1887) (Source: <http://www.archives.gov>. Accessed 12 May 2008)

enjoyment of the landscape, and took the form of tree-lined streets, panoramic paths or elements of landscape continuity (Jellicoe and Jellicoe 1995).

These ideas, which were applied at the beginning of the twentieth century in other cities such as Chicago (1909) and New York (1928), demonstrated the desire to introduce nature into cities for public enjoyment by connecting built-up areas with open spaces through a continuous system of parkways, while also beautifying urban areas. The proposals took advantage of simultaneous projects relating to open spaces and roadways and their respective consolidations as guidelines for the construction of a city.

Afterwards, facing the growth of industrial cities, Howard proposed garden cities as an alternative for spatial planning. The project of garden cities sought to avoid urban densification, contamination, social problems, and the abrupt separation of city and countryside. Howard proposed new urban nuclei away from the large traditional city centers and endowed with great operational autonomy, having industries, agriculture and public facilities, and a design that integrated the city and nature in a harmonic form through a system of open spaces (Hall 1996).

In this context, as a city approaches its limits, another newer city emerges next to it, and the cities are separated from one another by their own green belts (Hall 1996). The cities are connected through various types of infrastructure, and the idea is to guarantee the planned occupation of the territory, incorporating respect for nature, although the fundamental issues are more social or aesthetic than ecological.



Fig. 2.2 Le Corbusier’s proposal for Rio de Janeiro (1929) (Source: <http://www.fondationlecorbusier.asso.fr>. Accessed 12 May 2008)

Also with the aim of planning the growth of cities and establishing new cities, Le Corbusier pioneered the Modernist Movement of urbanism, which places importance in the system of open spaces, as an alternative to the dense and “dirty” standards of the industrial city. In *Ville Radieuse* (1935), his famous unrealized city, settlements and open spaces occupied distinct spaces, and at the same time, from a functional point of view, land use was specific and not mixed. The city of the Modernist Movement incorporated open spaces, although in an abstract way, as an idealized place and as a “background” for buildings.

In this model, open space appears (1) as a green carpet, either as an accompaniment to roadways (Chandigarh’s green linear open spaces, 1950) or as a surface marked by buildings, and (2) as reservations (e.g., natural or agricultural spaces) having landscape characteristics unique to the territory. Neither of the applications of open space considers open spaces as structuring elements, and instead, the applications reinforce the remoteness of open spaces from the spatial conformation of the city, which was based on the guidance of settlements and roads (Jellicoe and Jellicoe 1995). Other examples of this concept are the plans for Brasília (1960) and Le Corbusier’s plans for Rio de Janeiro (1929) (Fig. 2.2).

In an attempt to plan the growth of cities, which have grown at a dizzying pace, some urban areas have been the object of general spatial planning, which typically considers the system of open spaces to be important.

The garden city and its logic of location were incorporated into Abercrombie’s plans for Greater London (1943), together with the prediction of beltways and green

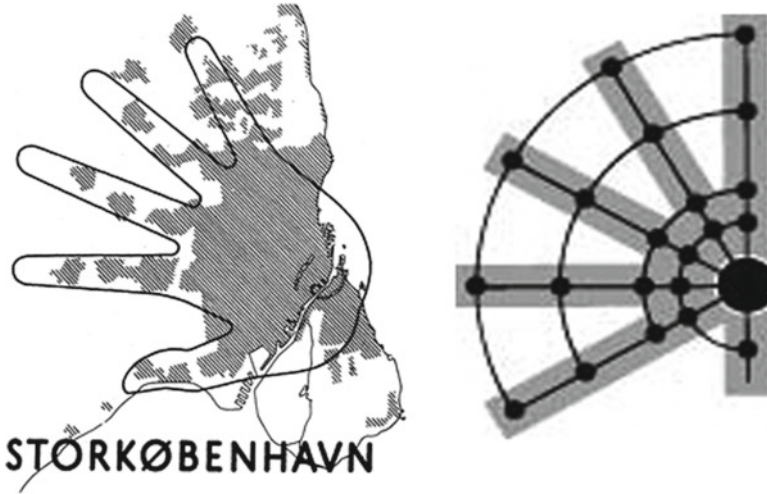


Fig. 2.3 Copenhagen Finger Plan (1947) (Source: <http://www.regjeringen.no>. Accessed 12 May 2008)

belts that separated more or less concentric zones, at the same time isolating the new cities from the historic city center (Hall 1996). As an American concept, green belts and green wedges were also used in the Regional Plan of New York. The green belts comprising rural spaces worked as a break for urban expansion, and the green wedges penetrated the cities and established a more direct link between urban occupation and open spaces.

In this spirit, interest in nature has resulted in alternatives to the introduction of open spaces in urban centers in northern European countries. In the Copenhagen Finger Plan (1947) (Fig. 2.3), “green fingers” following the natural topography invaded the city and allowed for respectful contact between occupied and open spaces, and at the same time, the fingers were the key element in planning the development of new areas. The main objective of the plan was to slow the city’s growth and concentrate the urban occupation around these axes. The same scheme appeared in the Regional Plan of Stockholm (1967), which sought to link the construction of the city to the system of open spaces (Jellicoe and Jellicoe 1995).

However, the explosion of cities, starting in the 1970s, had several impacts: the loss of quality of life in urban centers, the general tendency of the degradation of open spaces and intense uncontrolled growth, which resulted in urban dispersion and fragmentation throughout territories.

Responses to such rapid urban growth began as early as the 1960s, with works oriented towards the collective quality of life provided by public urban open spaces and the value placed on landscapes.¹ Additionally, starting in the 1970s, ecological

¹ The works of Lynch (1960) in *The Image of the City*, of Jacobs (1961) in *The Death and Life of Great American Cities*, and Alexander (1977) in *A Pattern Language - Towns, Buildings, Construction*, are fundamental contributions that call great attention to the relation between settlements, roadways and open spaces in cities.

concerns were raised in, for example, the works of McHarg (1969), the National Environment Policy Act (NEPA) was passed into law in the United States (1969), concepts of ecological planning, landscape ecology and green infrastructure were established in Holland and United States, and other initiatives that sought better integration of the distinct instances of landscape were developed.

In this sense, some works related to landscape urbanism in the last decade have considered the landscape as the basis for the planning and design of territories in a comprehensive manner, where the “natural” and “artificial” realities are thought of as being interrelated in efforts to find alternatives to present problems of urban complexity (Corner 2006).

Governments began to place importance on sustainability at the United Nations Conference on the Human Environment (Stockholm, 1972) and the United Nations Conference on Environment and Development, often referred to as the Rio Summit (Rio de Janeiro, 1992), which tried to consolidate ideas about sustainable urban development, a theme that has been the subject of many conferences since [e.g., Kyoto Protocol (Kyoto, 1998) and Rio + 10 (Johannesburg, 2002)]. The summits have considered sustainable urban development to have three basic components—ecology, economy, and social necessities—resulting in the so-called Agendas for sustainable development.

The search for more sustainable urban parameters in planning urban territories is reflected in many plans, and proposals for systems of open spaces given in many of the plans are representative of a planning mechanism that tries to structure urban occupation and respect for territorial resources.

One can perceive the above tendency in some of the planning proposals that emerged in the 1990s for cities such as Berlin (Fig. 2.4), Paris (Fig. 2.5) and Barcelona (Fig. 2.6). In these plans, the system of open spaces is composed of a series of morphological elements that both rescue past styles and provide new solutions (e.g., green wedges, green corridors, greenways, ecological networks, and biological corridors), while complying to the distinct functions that guarantee the sustainability of the landscape and a closer relationship between open and occupied spaces.

These approaches are important references, in a global context, in the search for solutions to restructure the urban territory and reconcile urban development with a plan to conserve resources, which is fundamental to providing quality of life in cities.

Far from the romantic proposals of closeness with nature of the nineteenth century, and in the way of the proposals that recognize the system of open spaces as structuring element of the territory, the proposed approach claims a central role for the open spaces, in which the system can integrate the pieces of the fragmented urban territory and be planned ahead of time in relation to the future proposals of urban occupation as a guideline, offering resources on distinct scales and instances for the restructuring of the urban territories. In other words, the planning of the system of open spaces can consider the management of both open and occupied spaces and, at the same time, offer concrete project strategies for structuring the system and the urban occupation.



Fig. 2.4 Plan for Berlin and Brandenburg (1998) (Source: <http://www.mlur.brandenburg.de>. Accessed 12 May 2004)



Fig. 2.5 Paris Green Plan (1995) (Source: Conseil Régional d'Île-de-France 1995)

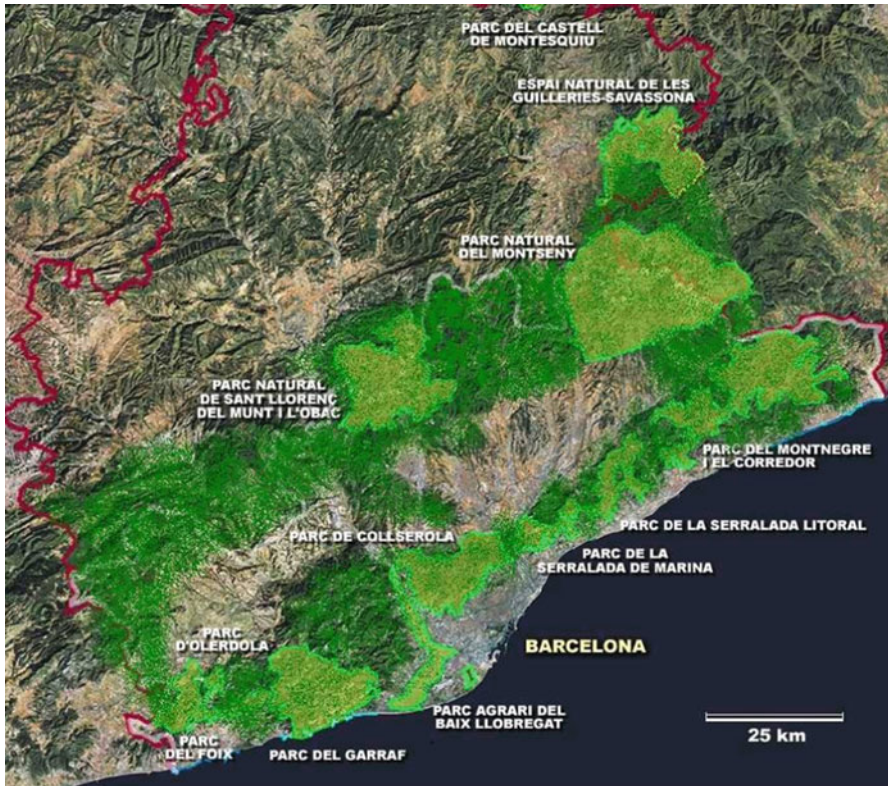


Fig. 2.6 Barcelona Green Ring (1999) (Source: <http://www.diba.cat/parcsn/parcs>. Accessed 12 May 2004)

2.2 Territory, Artificialized Landscapes and Territorial Open Spaces

There is no consensus on the concepts of territory, landscape or open space, or even an exact definition of what they represent, given that they can contain different phenomena. Many references derived especially from urbanism, spatial planning, landscape architecture, geography and ecology, define the concepts in different ways. Territory, landscape, and open space, in their plurality, have various connotations, and each highlights the most adequate characteristics for the analysis that one wishes to perform, which allows us to say that they are, mainly, instrumental concepts.

One could say that the territory corresponds to the marks of man, which can be called artificial (contradictorily in opposition to natural, because man is part of nature), and that it is the human product or a *human artifice* over nature. Thus, the

territory, which was once the territory of nature, becomes, on a large scale, the territory of man, where the artifice itself coexists with the “artificialized” nature² (Folch 2003).

The territory as an artificialized landscape implies the idea of inhabited space, or space adapted to the necessities of humans and their intentions for transformation. This space, besides its physical configuration, the processes that are established on it and its possible visual perception, involves human reading, as an interpretation of the physical support that enables action upon it (Cosgrove 1984).

In other words, the territory is considered as an artifact constructed by man, upon what was first nature, and the landscape is addressed as an introduction of human interpretation of this artifact. The result of this union, territory + landscape (or the artificialized landscape), would encompass the territory’s spatial construction, its use, its visual perception by man, and interpretation, in a figurative sense, with its own meaning, for each place and for each community. Through the analysis of the artificialized landscape, one can recognize the community practices on it and their intentions of action, in a continuous process, in which the spatial reality involves the witnessing of the past and indications for a future transformation.

The territory as an artificialized landscape would bring together a spatial dimension and a functional dimension, relative to its natural and artificial attributes, which would include its visual perception. The interpretation of the spatial reality of the artificialized landscape and of the functional relations established in it allows for the comprehension of some of the logical bases of its construction that remain in its structure.³ At the same time, the intended interpretation of the artificialized landscape, given the project’s intentions, allows for the transformation of its existing logical bases resulting in the concept of the artificialized landscape as a transformable object where physical space, function and intention converge.

The artificialized landscape can have different possible formalizations, although, finally, all result in an occupied, transformed and colonized territory. In urban territories, the landscape is that adapted to the necessities of humans (e.g., to live, produce, feed, and move) that spatially involve the essential elements that satisfy

² Some authors distinguish nature and artifacts relating to nature as biotic and abiotic resources (living and non-living organisms), which do not need external energy for their development, and artifacts as the anthropogenic environment (urban occupation) and the anthropic environment (exploration of the environment), which need external energy for their development (Bolós 1992).

³ The landscape [as a causal system] is the formal outcome of different physical and biological relationships, a simultaneous consequence of a process and a geological structure, and the result of the actions of elements of the climate, biological occupation and the relationships between different energy flows. In areas heavily occupied by humans, the landscape is largely an artifact, since the natural area has been cleared and plowed, parceled, built on and even irreversibly altered from its most basic natural conditions. In these situations, the landscape is often figuratively compared to a palimpsest, in the sense that it can track and interpret the traces of various historical periods and different human interventions. The landscape has materialized different solutions that different generations, applying different technical specifications, have been given the right to occupy and use. (Zoido 2002, p. 24, translated from the original)

these necessities. Landscape, in this way, is seen through built and unbuilt elements, human mobility, the exploration of the land and its resources that bring together various components of the physical structure: the settlements, infrastructure, and open spaces (Font et al. 1999, among others).

Open spaces have a great probability for transformation in the process of landscape construction. They make up the most flexible component of the territorial structure, whether functionally or spatially. They are also the most fragile places and one of the most promising, taking into account the possibility of restructuring the territory, since they can take on important roles, for example, as places where the ecosystems are, as places that allow the visual perception of the landscape and as places for human occupation.

As places where ecosystems are, open spaces bring together biophysical elements and processes responsible for the ecological quality of the territory, through relationships established between living beings and the inorganic environment (McHarg 1969; Odum and Sarmiento 1998, among others). In this sense, the biophysical elements embody the result, positive or negative, from the causes and consequences of interactions between the natural and artificial processes that are developed in an area, which can involve the vegetation, water, soil structure, and climate.

As places that allow the visual perception of the landscape, open spaces are the visible part of the territory, which allows the establishment of relations between the territorial elements and the creation of an image of the place, through the possibility of recognition and preservation of its specific characteristics and, consequently, of its visual quality. The characteristics of a landscape give it a spatial character, which varies from place to place, and can be identified according to formal components, originating from both natural and artificial processes (Lynch 1960; González 1981; Bolós 1992; Zoido 2002, among others).

As places for human occupation, open spaces provide the opportunity for the integration of the fragmented territory and the structuring of urban occupation. There is the possibility for the conscious management of the physical components of the territory in its construction, which should be proposed respectably and coherently with the dynamics of open spaces as a basis for the structuring of urban occupation. In this sense, management of the territory construction may be interested in maintaining the resources of the territory and highlighting the importance of open spaces in a system as a guide for spatial planning and restructuring of the territory (Battle 2002; Font 2003; Sabaté 2003; Llop 2003, among others).

In this sense, on a broader scale of the territory, open spaces can have distinct characters, being rural spaces, water spaces, forest spaces, major unoccupied urban areas or other areas, according to their spatial characteristics (e.g., size, position, and type of elements) and functional characteristics (e.g., type of functions that are carried out in each space and the repercussion of development).

The analysis of territorial open spaces thus falls on non-occupied surfaces, protected or not by law, of public or private realm, covered or not by vegetation, which can represent opportunities for the restructuring of the territory. The importance of the analyses of these surfaces is that, on the one hand, the surfaces are generally areas whose structuring value is not recognized by the planners (with the exception

of those already protected and having an unquestionable value ensured by law) and, on the other hand, the surfaces are made up of areas threatened by urban occupation. At the same time, it is believed that the surfaces should remain free from occupation, according to their attributes and the relationships they establish with their surroundings, and that they can form a system, being restructuring elements of the territory.

2.3 System of Open Spaces and Resources for Project Strategies

2.3.1 Open Spaces in a System

The spatial system referred to in this book is represented by a set of elements on distinct scales. There are various relationships between the elements themselves and between the elements and their surroundings, and the elements can be under mutual influence and have relative autonomy. In other words, the elements are able to receive and transmit effects from their interior to their exterior, and vice versa. In the system, the elements and relationships make up the whole, and their dynamics affect the general structure, without one element or relationship being dominant. However, not every dynamic has the same repercussion on the whole, and the repercussions vary according to scale. Considering the scale as a fraction of the total space, the larger the scale of the phenomenon, the greater the repercussions tend to be in the system. As a system, the set of open spaces is more than the sum of the parts (Santos 2002).⁴

For the planning of a system, it is important to recognize the constituting elements and the relationships that are established between them and their immediate surroundings. According to Forman (1995), the composition of a system of territorial open spaces can be viewed as a mosaic of ecosystems and the system brings

⁴A system is defined by a node, a periphery and the energy through which the pioneering features developed and located in the center can be projected on the periphery, which will thereby be modified by them. It is only from this scheme that we will be able to systematically capture the articulations of the space and understand its nature. This should make defining each piece of land possible, in an exact and special way. Each spatial system and its corresponding locations appear then as a result of the interaction between relationships; the analysis will be so much more rigorous as we are capable of avoiding the confrontations between simple variables that most of the time lead to causative analysis or to cause-and-effect relationships that artificially isolate certain variables and prevent covering the totality of the interactions. Whenever one system substitutes another, it is because the spatial system is always the consequence of the projection of one or more historic systems. Since the space contains characteristics of the different corresponding ages, this focus should allow for a more careful and more systematic interpretation of the remnants and affiliations. (Santos 2002, p. 79, translated from the original)

together continuous and non-continuous spaces that can be defined by patches, corridors and matrices, according to the following criteria.

- Patches are fragments, or pieces of the mosaic that have homogenous characteristics and can acquire distinct formats, elongated or wide, with straight or curved limits.
- Corridors are defined as linear elements that differ from their surroundings and cross an area. They can be of three basic types.
 - Trough corridors are strips with vegetation that is shorter than that of the adjacent matrices.
 - Wooden strips are corridors with vegetation that is taller than that of the adjacent matrices.
 - Stream and river corridors are strips with vegetation that can be taller or shorter than that of surrounding matrices and that contain a channel of flowing water.
- Matrices represent ecosystems that occupy extensive areas and they include patches and corridors. They are very connected and control the dynamics of the regional landscape. A matrix has three basic attributes: area, connectivity and control of the dynamics.

Each element of the system contains a margin, which is the border that separates the element from the adjacent elements. Two combined margins generate a *boundary zone*, which can be between open spaces or between open and occupied spaces.

The scales of the elements of the system vary, and the continuity of scale also varies. Among the elements of the system of open spaces, one distinguishes those that are continuous and those that are non-continuous. The continuous elements are connected to each other, such as in the case of water. The non-continuous elements are separated by portions of the territory that impede their direct connection and the elements are “satellite” pieces of the continuous system. The continuous or non-continuous nature of elements can help or hinder the development of flow in the system, where flows, especially energetic flows, are important to the correct operation of the system. Without these flows, there is no system, and it is thus critical that there is element continuity. Otherwise, the components themselves would be stagnant or, at most, juxtaposed. However, all pieces, connected or not, big or small, are important parts of the whole and can play a role in maintaining the processes that occur in open spaces, whether the processes are related to nature itself or to the human artifacts and experience.

On the other hand, open spaces, continuous or not, have spatial relationships with their subsoil, their borders and their surroundings. The effects of phenomena that occur in the subsoil reach the surface (e.g., when groundwater comes to the surface or a plant sprouts), and phenomena at the surface affect the subsoil (e.g., the impermeabilization of soil hindering the flow of water). Likewise, everything that happens at the borders and in the surroundings directly affects the open spaces; e.g., the consequences of urban occupation on open spaces related to the interference of processes, natural or not.

Together, the processes in the system make up an integrated framework, with relationships between the system's own elements and the surroundings. This means that the processes of the system, on a broader scale, are shaped by general and local interactions between elements and processes, which are reflected in each piece of the open system, and can influence the flow within the system with different intensities.

A spatial system of open spaces is a dynamic whole that varies with time (Santos 2002); e.g., one can observe how urban occupation affects the spaces; how water moves and affects surrounding areas; and how the climate and vegetation are affected. Over time, the open spaces can become occupied, areas with water can become dry, and explored areas can become abandoned. Additionally, the changes are not linear and occur simultaneously, in different directions and for different aspects. Thus, the system is not a system of a single time but the layering of different ages of the system, in which the permanencies and modifications throughout the years are mingled together. The recognition of these "times" of the system allows for the identification of problems, potentialities and currently existing symbioses between open spaces and their surroundings, whose analysis into certain categories can provide strategic information about spatial/functional relationships between open spaces and their surroundings for the planning of the system and the restructuring of the territory.

2.3.2 Nature as a Project Resource

According to the ecological method of McHarg (1969), each open space, in accordance with its biotic and abiotic elements, has essential ecological characteristics for the maintenance and/or recovery of its natural processes and for the ecological quality of the territory. Thus, the elements and processes of nature need to be respected in the process of urban occupation and can be incorporated by it, and appropriate limits to urban occupation can be established (Figs. 2.7 and 2.8).

Among the natural elements of open spaces, the presence of vegetation in current territories is of unquestionable importance to the distinct functions that it fulfills, such as the diversity of the landscape and wildlife, the stability of the soil structure, the maintenance of water flows, beneficial effects on the climate, reduction of air pollution, and recreational, relaxation and educational uses (McHarg 1969; Hough 1995; Turner 1998, among others).

Places with vegetation, or those without vegetation but that can recover with development of the ecosystem, deserve that attention be paid to their natural elements and processes in the maintenance of the ecological quality of the territory.

Agriculture, which is often directly related to the identity of a place, usually occupies spaces that frequently suffer from the pressure of urbanization, particularly when production conditions are not profitable. However, encouraging agriculture in a territory is an opportunity for recreation, environmental education, the creation of jobs, production and trade conditions for small-scale urban production, and low-cost maintenance of open spaces. Additionally, when cultivations are adequate, conditions are best for the maintenance of the ecological balance of the open space and its surroundings (Hough 1995; Turner 1998, among others).



Fig. 2.7 Nature:Amazon rain forest (Source: <http://www.fmc.am.gov.br>. Accessed 10 July 2008)



Fig. 2.8 Nature:Agricultural landscape (Source: <http://www.flickr.com>. Accessed 10 July 2008)

The water network, among other factors, supplies water to a territory, offers leisure opportunities, enables the development of agriculture, the functioning of cities, provides hygiene and improves human health, and generates its own ecosystems. Beyond this, water is a factor that, together with slope, has associated risks, mainly related to runoff, which promotes flooding, the accumulation of water and sediment, and drainage problems. Thus, “water places”, on the surface or subterranean, affect the functioning of ecological flows and the territory as a whole, and their maintenance is essential for the development of natural processes.

Likewise, observations of the relief and soil conditions are important to the maintenance of natural processes. The stability of soil is a reference for the possibility of the fixation of vegetation, which reduces the interference of earth movement in river and allows safe urban occupation.

In general, the contributions of biophysical elements in the system of open spaces reveal both the possibility of preserving and/or recovering natural processes and the opportunity to promote interconnection between ecology and urban occupation in the process of territory construction. Here it is considered that biophysical elements and processes are important factors in decision making relating to structure urban interventions, rather than simply an attribute considered afterwards.

2.3.3 Visual Perception as a Project Resource

The perception of the landscape can have great importance in the planning of a system of open spaces. Perception is an essential element for the maintenance and/or recovery of the visual quality of an area, and it has repercussions on the quality of life of the population and the preservation of natural and artificial heritage (Zoido 2002). Additionally, the perception of the landscape can be considered an important factor to be taken into account as a guideline for the structuring of urban occupation (Figs. 2.9 and 2.10).

Open spaces can be elements of the visual structure of an area and give the area unique characteristics. The maintenance of open spaces tends to favor the visual diversity of an area and can enhance the value of elements that have remained after a long period of artificialization. According to McHarg (1969), such maintenance means increasing the value of what remains as an element of the physical identity of a place, and it is a collective work carried out by accident or design. The maintenance of open spaces is the result of voluntary or involuntary conservation of significant elements that characterize the place, and it allows the open spaces to be shared by the community. In this sense, scenic elements, areas with visual prominence, the scenic background, and open spaces of historic and cultural interest are important visual content of the landscape. This content makes a place unique, with the singular elements determining the particularity, diversity and visual quality of the place.

Scenic elements give character to a place. They allow for the coverage of its physical structure and highlight the more significant attributes (e.g., unique forms of



Fig. 2.9 Singular scenic background:Rio de Janeiro (2000) (Photo: Rodrigo Anda)



Fig. 2.10 Singular scenic background:Morocco (2004) (Photo: Author)

the relief, hydrography and vegetation). These elements work as references and to mark the place, and they are part of the territorial identity and the visual potential of the landscape (McHarg 1969).

The scenic background allows the visualization of the character of a place in a generic way. The background is the integration of significant elements into large



Fig. 2.11 Fragmented territory. Barra da Tijuca in Rio de Janeiro (Photo: Author 2003)

features of the geography, and it reveals the landscape scenery, totally or partially. The scenic background thus allows visual connections to be established between basic elements (Bolós 1992).

Areas with visual prominence are perceived to have individuality and can be used to guide movement along roadways and to link points between visual sequences. Additionally, they are special spaces that can be recognized as a collective asset, which should be shared with the whole community (Lynch 1976; Spirn 1998).

Open spaces of historic and cultural interest are usually witnesses to the transformation of a place. They are typically remnants of urban development, and it is important to conserve some of their more representative features as part of the identity of a place (McHarg 1969).

Preserving and/or recovering significant physical features of non-occupied spaces can therefore be a reference for the planning of the system of open spaces and for the structuring of urban occupation, and would guarantee the maintenance of the visual quality of the territory and strengthen of the identity of the territory.

2.3.4 Urban Context as a Project Resource

In analyzing the urban reality of large cities of today as extended, transformed and fragmented cities, one can see that the logic of roadway connections, new forms of construction in the territory (in many cases driven by strong real-estate speculation), and outdated spatial planning with respect to the monitoring of urban changes, have a tendency towards dispersion without proper attention to the resources of the territory.

In many cases, one can observe that, as result of several centuries of human occupation, the current conformation of many urban areas has significant imbalances between its elements and processes resulting in fragmented territories. The fragmentation of territories affects open and occupied spaces, with there being negative consequences for both and also for the human experience of the landscape. Recognizing the origins of the fragmentation of the urban territory and consequently their processes and elements (e.g., open spaces, settlements and infrastructure, and especially roadways) can offer a perspective on the roles that open spaces can play to reverse this reality. In this context, looking at the open spaces as possible integrating elements of parts of urban occupation can encourage the maintenance of these spaces free from occupation, or their occupation under certain conditions, and as references for occupation structuring (Fig. 2.11).

In terms of settlements, one can observe factors contributing to the fragmentation of the territory; e.g., the dispersion of settlements with increased accessibility, the excessive consumption of soil, and the construction of “closed” settlements inside “walls”. There is also improper land use in certain places and monofunctional settlements, which depend on other city centers, creating the need for displacement. In this process of fragmentation, the “closed” settlements do not relate to their surroundings in a direct way, and the settlements may have excluded and/or conflicting functions. On the other hand, settlements can occupy areas much larger than the land upon which buildings are constructed, and with the development of greater infrastructure, the settlements thus have a disproportionate effect on the environment; e.g., decrease reduction of agricultural and natural spaces and soil impermeabilization. Additionally, the process of fragmentation can result, in some cases, in the deterioration of urban centers that lack sanitation, public urban spaces, collective facilities and adequate transportation; have an unhealthy environment; have poorly planned buildings; and are affected by overpopulation and the degradation of building heritage. These factors combine to segment a territory (Boeri and Lanzani 1992; Ascher 1995; Corboz 1995; Font et al. 1999, among others).

In terms of the roadway network, a project normally considers traffic flow and tends to be more related to technical and economic issues, which, in many cases, contribute to the fragmentation of urban territories. Roadways, on a broader scale of the territory, are built to connect places in a quicker and shorter manner. Roadways are usually not conceived with consideration of communication between people, open spaces and settlements, or the possibility of incorporating settlements, nature, visual perception and social use in one design (Lynch 1966; McHarg 1969). In particular, highways and expressways are designed like channels with walls at their margins, which do not allow direct connections with the surroundings. In this context, it is common for the territorial roadway infrastructure to cross areas of vegetation or settlements, thus separating the areas into parts, modifying topography and water courses, and separating people. Moreover, there is roadway infrastructure that is in decay, is not maintained or is obsolete, and contributes little to urban efficiency.

In terms of territorial open spaces, their spatial configurations are largely modified by the large occupation of a territory, through the construction of patterns of settlements and roadway infrastructure that contribute to fragmentation. This fragmentation can be seen through biophysical modifications such as the removal of vegetation, changes made to water flow and topography, the presence of monocultures (which tend to produce impoverished soils), water pollution and silting, and soil contamination. These consequences can generate many problems, such as elevated risks of landslide, soil erosion, and flooding. In this way, the visual perception of the open spaces, as part of the identity of the territory, is also affected owing to the loss of important visual features that give a special character to each landscape. On the other hand, the fragmentation of open spaces is, in part, because of the anthropic perspective of planning in the twentieth century, where open spaces were, in general, reserved for later occupation or enjoyed environmental protection, as separated “portions” of land.

In this context, it is important to highlight that the system of open spaces, which can act in the “gaps” of a territory, assumes further importance in the structure of urban occupation. Open spaces, protected or renewed, can reverse the process of fragmentation caused by settlements and roadways, introduce nature and visual perceptions, and benefit social uses and economic activities, establishing new urban dynamics. Thus, the permanence of open spaces can be valued regardless of the current biophysical attributes or visual perception values of the open spaces. In this case, the importance of the permanence of spaces free from occupation in the urban context, or their occupation under certain conditions, relates to their role in integrating elements and processes in the urban occupation, irrespective of whether they have biophysical and/or visual perception values. There are thus alternative guidelines for creating open and occupied spaces to restructure a territory by forming new spatial and functional connections.

2.3.5 Contribution to Sustainability of the Territory

The concept of sustainability has emerged in the last few decades to guide the respectful consumption of territorial resources, and to maintain their functions and equitable distribution spatially and temporally (Rogers 2000; Folch 2003a, among others).

Sustainability is an eloquent paradigm for the transformation of increasingly fragmented territories by random and scattered urban growth, in which, frequently, one can see the spatial and functional disintegration of open spaces. Sustainability itself may be an unreachable goal, an impossible myth or a series of unsolvable contradictions, but it allows for the creation of possible alternatives, or at least healthy illusions, that instigate a proactive attitude in project proposals and are not just descriptions of the reality of urban territories.

The search for a system of open spaces as a possible guideline to spatial planning tends to reflect principles of sustainable action, concerning the maintenance of open spaces and the possibility of developing a new structure for urban occupation. Examples are conserving the heterogeneity of open spaces, guaranteeing the integrity of human and natural processes, in a spatial and functional sense, and promoting physical, biophysical, visual, and social cohesion of the territory (McHarg 1969; Hough 1995; Zoido 2002, among others).

The maintenance of the heterogeneity of open spaces can be translated into, among other factors, the preservation of the diversity of biophysical elements, the more significant visual elements, social variety, functional and typological variety of settlements and alternative mobility. In principle, maintaining the heterogeneity of open spaces leads to the individualization of each portion of the territory, with the reinforcement of its own characteristics against homogenization, trivialization, and segregation of the differences that devastate our urban territories today.

Ensuring the integrity of human and natural processes, in a spatial and functional sense, provides mainly the possibility of development of biophysical processes, visual perception possibilities, and access and social interaction. This is done

through the designation of land use and activities according to the resources and fundamental characteristics of the open spaces and the intentions of people using the open spaces.

The promotion of physical, biophysical, visual, and social cohesion of the territory reveals the relationships between open spaces and urban occupation. Open spaces are favored as places of integration, which relate the distinct instances of the landscape and promote aggregation in the face of fragmentation. Indeed, the promotion of cohesion presents the system of open spaces as an alternative for possible integration among the components of a territory and the community of that territory.

Chapter 3

Characterization of the Territorial Unit

The purpose of the general characterization of the territorial unit is to define the main aspects of a study area, which will be important for subsequent analyses. The characterization is an approximation of the area rather than a detailed study, and it comprises an introduction to the area and its territorial situation and the relief, climate, hydrography, infrastructure (i.e., roadways, urban services, and public transportation), vegetation, urban land use, and population characteristics.

3.1 Case Study and Its Territorial Situation

The metropolis of Rio de Janeiro comprises different territorial units with open spaces (i.e., “reserves”) that are under pressure from the advance of urban occupation.

The Metropolitan Region of Rio de Janeiro (Região Metropolitana do Rio de Janeiro; RMRJ) (Figs. 3.1, 3.2, 3.3 and 3.4) is located in the State of Rio de Janeiro and currently has 10,872,768 inhabitants.¹ RMRJ has an area of 5,693 km² and comprises 19 municipalities. Its main city is Rio de Janeiro. Open spaces play an important role in defining the landscape of RMRJ, since more than two-thirds of the territory is unoccupied. Open spaces are thus important to the urban structure, as well as having unquestionable biophysical and visual values.²

¹ Source: Instituto Brasileiro de Geografia e Estatística; IBGE. <http://www.ibge.gov.br>. Accessed 10 August 2003.

² The geographical configuration of Rio de Janeiro and its surrounding area corresponds to a particular relief and hydrography. The massifs, plains, and water are constant patterns of the geography, constituting the main axes for the main territorial relationships between the settlements and the roadway infrastructure.

The peculiarity of the coastline, somewhere between the open sea and a bay, defined the first occupation of land, which was more protected in its interior, resulting in the present location of the traditional center of the metropolis. On the other hand, the accumulated water on the plains near the sea, the lagoons, and the mangroves was, throughout history and today, one of the main obstacles to the construction of settlements and infrastructure, giving rise to a necessary transformation

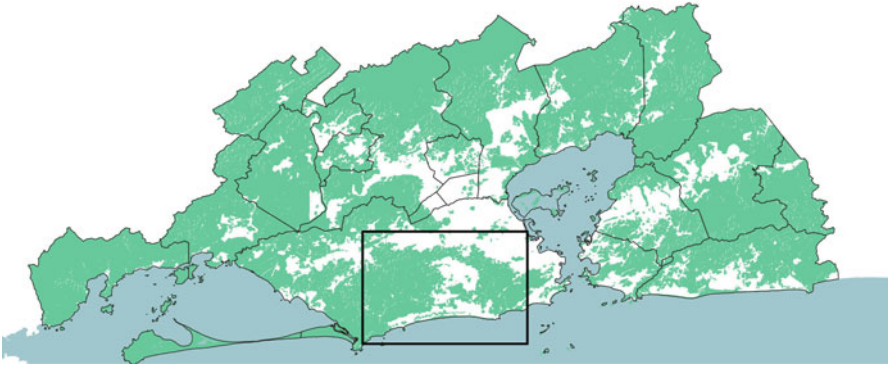


Fig. 3.1 Vegetal layer. Metropolitan region of Rio de Janeiro (Adaptation of the map of RMRJ (1994), Fundação CIDE)

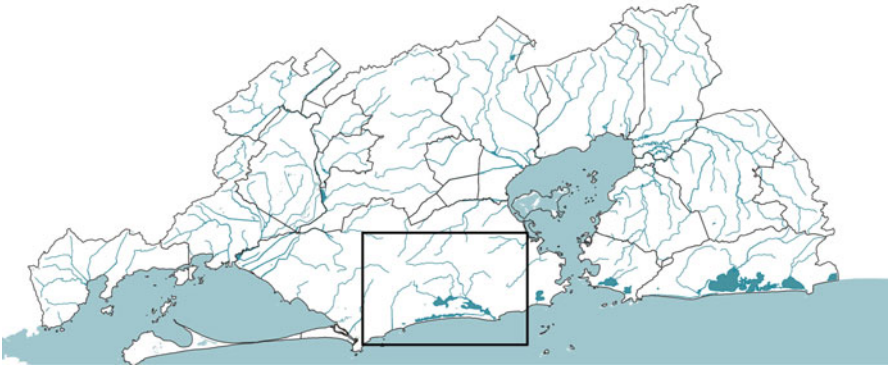


Fig. 3.2 Water layer. Metropolitan region of Rio de Janeiro (Adaptation of the map of RMRJ (1994), Fundação CIDE)

The occupation of the territory is generally distributed radially from the metropolis's traditional center. Many areas have important rural and natural spaces, either at the extremities of urban occupation or between areas of urban occupation, together with other open spaces.³

of the landscape through the filling of the land and the modification of waterways to make urban consolidation possible (Amador 1992).

³The observation of the current occupation of the area, from the perspective of roadway infrastructure and settlements that colonized rural and natural spaces, allows us to determine axes of the urban structure that are not yet consolidated, noting accessibility aspects and the main activities that support occupation (Abreu 1992; Amador 1992; Lobato 1992, among others).



Fig. 3.3 Urban occupation layer. Metropolitan region of Rio de Janeiro (Adaptation of the map of RMRJ (1994), Fundação CIDE)

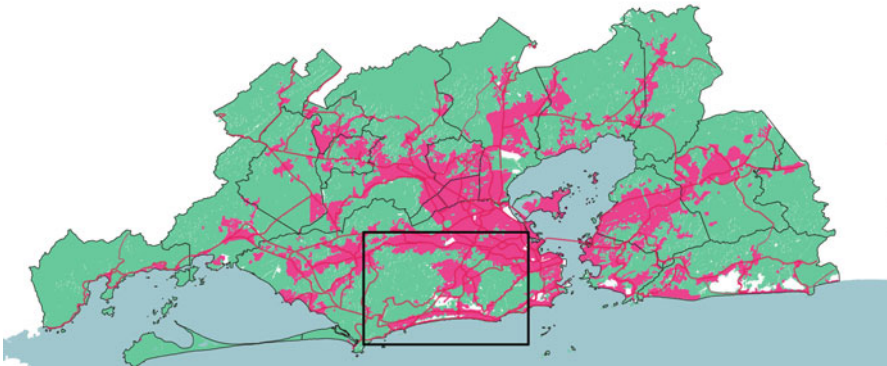


Fig. 3.4 General composition. Metropolitan region of Rio de Janeiro (Adaptation of the map of RMRJ (1994), Fundação CIDE)

The axes include the following.

- Fluminense lowlands. The traditional center of the metropolis, as well as the southern and northern zones of the central city, are fully consolidated areas. Historically, from the central city, there has been an urban continuum directed towards neighboring cities, where the axes of the roads Presidente Dutra (the main connection between Rio de Janeiro and São Paulo) and Washington Luís, next to the railway and lower-scale roads, are the main guiding axes for the occupation of the great plains of the Fluminense lowlands. This area is characterized, primarily, by industrial activity.
- The Niterói-Manilha axis and the oceanic part of Niterói. To the east, urban occupation largely follows the course of the Niterói-Manilha road, which are aligned with industry and the coastline, from the city of Niterói to the city of Maricá, having great tourism value.
- The Avenida Brasil and Jacarepaguá lowlands axes. In the western zone of the central city, there is occupation of land around Avenida Brasil and the railway, by industry, and around the Jacarepaguá lowlands, between the Pedra Branca and Tijuca massifs, largely through the expansion of the tertiary sector and the construction of houses, and mainly in areas nearer the sea.

Some of the region's territorial units lack a consolidated urban setting but are within the administrative boundaries of the central city. In the city of Rio de Janeiro, which has 5,851,914 inhabitants, 63.06%⁴ of the area of 1,255 km² is unoccupied; thus, the distribution of urban occupation is very scattered, with there being areas of greater urban density, areas with isolated buildings or small groups of buildings, and large areas of open spaces within the buildable limits. Large areas of open spaces are found in the west of the city.

The case study considers an area encompassing the Jacarepaguá lowlands, the Pedra Branca and Tijuca massifs, and the Atlantic Ocean, and having a population of 743,634 inhabitants. From an administrative standpoint, the study area corresponds almost in its entirety to Planning Area 4 (AP4), which covers the administrative regions of Jacarepaguá (VI RA), Barra da Tijuca (XXIV RA), and Cidade de Deus (XXXIV). These regions cover the neighborhoods⁵ of VI RA (Jacarepaguá, Anil, Gardênia Azul, Cidade de Deus, Curicica, Freguesia, Pechincha, Taquara, Praça Seca, and Tanque) with 575,992 inhabitants; XXIV RA (Joá, Barra da Tijuca, Itanhangá, Camorim, Vargem Grande, Vargem Pequena, Recreio, and Grumari) with 129,632 inhabitants; and XXXIV RA (Cidade de Deus) with 38,010 inhabitants. The territorial unit's western limits are the neighborhoods of Guaratiba and Campo Grande; its northern limits are the neighborhoods of Bangu, Realengo, and Madureira; and its eastern limits are the neighborhoods of Méier, Vila Isabel, Tijuca, and São Conrado.

The study area corresponds to 24% of the municipal territory, and 65%⁶ of the study area is open spaces. These open spaces are important to the spatial structure of the central city, in addition to be important to the biophysical characterization and configuration of the area's most significant visual elements.

The Pedra Branca and Tijuca massifs are the two most important natural areas of preservation in the city of Rio de Janeiro (and are considered by UNESCO as biosphere reserves⁷); they also affect the urban structure, since they are the most important internal geographical structures and define, with other hills and the sea, the plains that shape the physiography and sustain most of the important urban zones of the city. Among them, one can find, besides the territorial unit, a southern zone and central zone, which occupy the plains of the eastern section of the Tijuca massif (areas with urban services and housing for the richest stratum of the population); a northern zone, which occupies the lowlands of Inhaúma and Irajá, in the northern section of the Tijuca massif (suburban areas characterized by housing and industry); and a western zone, which occupies the lowlands of Bangu, Santa Cruz, and

⁴Source: SMAC 2000.

⁵Source: Prefeitura da cidade do Rio de Janeiro (1998). *Anuário Estatístico da Cidade do Rio de Janeiro*. Rio de Janeiro: Instituto Pereira Passos.

⁶Source: SMAC 2000.

⁷The massifs are part of the Consórcio Mata Atlântica Brasil biosphere reserve (1992), which includes Atlantic Forest in several Brazilian states, including Rio de Janeiro.



Fig. 3.5 View towards part of the study area (2003) (Photo: Author)

Guaratiba, in the northern and western sections of the Pedra Branca massif (with each area having different functional characteristics, ranging from industrial activity in Avenida Brasil to farming activity in Guaratiba).

A series of public and private interests affect the occupation of the territorial unit, since it is an area suitable for urban development and tourism. In addition, there are natural attractions with roadway connections to the rest of the territory, there are metropolitan facilities, and the territorial unit is relatively close to the traditional center of Rio de Janeiro (Villaça 1998).

Since the mid-1980s, the study area has become increasingly important as a new central area of Rio de Janeiro and as a housing alternative outside the more congested centers. The area has good roadway infrastructure, which has attracted the headquarters of large companies and tertiary activities, and there is presently growing real-estate activity, in terms of both residential centers and large commercial centers (Villaça 1998). Additionally, there are illegal settlements that convey a sense of precariousness and urban poverty.

The construction that has taken place in the territorial unit since the 1970s has strengthened bonds to the central, northern, and southern zones, and augmented growth in the industrial, residential, commercial, and service sectors. Basically, the structure of the territorial unit is determined by the highway Avenida das Américas, which runs parallel to the sea and connects the southern and western zones, and the highway Avenida Ayrton Senna and the expressway Linha Amarela, which strengthen connections with the northern zone of Rio de Janeiro.

The territorial unit had rural origins before being the specific object of a modernist urban plan designed by Lucio Costa (1969). Later, it underwent dynamic urban development. The territorial unit today thus has a complex urban organization; the unit has traditional forms of roadway infrastructure and buildings (Fig. 3.5), is witnessing new forms of growth that are usually closed and introverted (e.g., commercial centers and low-density houses in closed spaces connected by highways and expressways), and is witnessing the fast emergence of illegal urbanized areas (Fig. 3.6). Marked social contrasts, resulting from a very unequal income distribution and a public system that is deficient in terms of healthcare, education, transportation, and sanitation, are reflected by the presence of slums next to luxurious houses in closed spaces (condominiums).

Generally speaking, the case study considers both the singularities of urban occupation and the characteristics of the population, focusing on the different features of Barra da Tijuca and Jacarepaguá (Fig. 3.7). Barra da Tijuca is a coastal



Fig. 3.6 Aerial photo of the study area (2001) (Photo: Rodrigo Rinaldi)



Fig. 3.7 Locations of Barra da Tijuca and Jacarepaguá (Source: Ortophotos mosaic, Instituto Pereira Passos 2000)

region to the south of the massifs, coinciding with the northern section of the lagoons in the middle of the plains. This is where most important services centers are concentrated, and where we find dynamic real estate expansion and the wealthiest population. Jacarepaguá, in the interior, lies on the plains from the lagoons to where the two massifs meet. It is structured according to the industrial suburbs of the city, and it

tends to grow according to changes in this initial structure and has a poorer population, as discussed latter.

Open spaces in the territorial unit can be classified as forests and mangroves, many of which are protected by planning; extensive open spaces that are not yet protected and that have a certain “amorphous” quality (in that they have ill-defined spatial form and there is a tendency towards the degradation of their biophysical value); and open spaces of more modest dimensions that are fragments of urbanization. In general, these spaces have great visual and biophysical qualities, are very fragile in terms of withstanding urban occupation, and are under the constant threat of urban expansion and serious environmental problems, ranging from water contamination to the erosion of slopes and the loss of vegetation.

To a certain extent, the open spaces are configured according to a rationale of protection and isolation, the speculative reservation of land, or agricultural exploration, or they are simply remnants of the construction of settlements and roadways. The protected open spaces, in this setting, not only have biophysical importance but also control urban occupation within the study area. Among the protected open spaces, the most important are the Pedra Branca, Tijuca, and Marapendi parks.

It is considered that thorough analysis of the situation and internal particularities of the territorial unit may assist the planning of the system of open spaces as an integrated whole and a restructuring element of the territory.

3.2 Biophysical Support

3.2.1 *Relief and Climate*

The physiographical configuration of the area has the shape of an amphitheater and is a two-component structure (Figs. 3.8 and 3.9).

- Slopes and rocky formations of the massifs are located in the western (Pedra Branca Massif) and eastern (Tijuca Massif) zones, and have the sea at their extremities. The massifs become smoother in the northern zone, where they meet.
- Large central plains are bordered by the massifs. They are of Quaternary formation and have a “triangular” shape. They comprise hills, lagoons and canals, and end where they meet the sea.

The massifs are a series of mountains and valleys. Among the mountains of the massifs that face the study area are those belonging to the Pedra Branca massif (Serra do Engenho Velho, Serra do Barata, Serra do Nogueira, Serra do Rio Pequeno, Serra do Quilombo, Serra do Caçambê, Serra do Alto do Peri, Serra de Santa Bárbara, Serra do Rio da Prata, Serra Geral de Guaratiba, and Serra do Grumari) and the those belonging to the Tijuca massif (Serra do Inácio Dias, Serra dos Pretos Forros, Serra dos Três Rios, and part of Serra da Carioca). The mountains are all difficult to access, and are usually very exposed to the sun and rain. They are visible from the plains. The highest peaks of the mountains are Pico da Pedra Branca (1,025 m), Morro da



Fig. 3.8 Map of the relief



Fig. 3.9 Profiles of the relief (*a*, *b*, and *c*, respectively) (Source: Author)

Bandeira (964 m), Pedra do Ponto (938 m), Morro Santa Bárbara (857 m), Pedra do Quilombo (735 m), Pico do Sacarrão (714 m), Morro dos Caboclos (696 m), Toca Grande (577 m), Santo Antônio da Bica (482 m), and Morro da Boa Vista (456 m) on the Pedra Branca massif; and Pico da Tijuca (1,022 m), Bico do Papagaio (989 m), Morro da Cocanha (982 m), Pedra da Gávea (842 m), Pedra Bonita (696 m), Pretos Forros (482 m), and Morro do Inácio Dias (449 m) on the Tijuca massif. Most of the highest points are accessible via trails through areas of forest.

The lowest points of the relief are the gullies between mountains. The gullies are areas of confluence for the waters that run down the massifs, and are generally radially distributed around peaks.

The plains can be virtually divided into three areas⁸: a coastal area; an intermediary area, close to the lagoons and their canals; and the northern vertex of the plains. In the first area, the terrain has small undulations, generated by marine processes or wind sedimentation; in the second, the surface is flatter; and in the third, the land is almost perfectly horizontal, having a gradual decline toward the coastline.

The hills are thus important elements of the landscape of the plains, and they include Pedra da Panela, Morro da Freguesia, Pedra de Itaúna, Morro do Amorim, Morro do Cantagalo, Morro do Portelo, and Pontal de Sernambetiba.

The study area has a micro-climate typical of a tropical coastal region. The area has high temperatures, and a rainy season and a dry season as the most important seasons of the year. Additionally, there are climatic variations related to latitude, proximity of the ocean, topography, and intermittent cold fronts.

Generally, the most intense period of rainfall is in summer (from December to March), and the least intense period is in winter, with July being the driest month and January the wettest. The average yearly temperature is 23.5 °C. The yearly average evaporation is 700 mm, and the relative humidity is 88% in summer and 65% in winter, which makes for a very damp climate for most of the year (SMAC 1998).

⁸ Source: Centro Nacional de Pesquisa de Solos da Empresa Brasileira de Pesquisa Agropecuária (EMBRAPA) (2001). *Estudo e caracterização dos solos*. Rio de Janeiro: Centro Nacional de Pesquisa de Solos da Empresa Brasileira de Pesquisa Agropecuária.



Fig. 3.10 View of part of the study area (Marapendi lagoon and the beach) (2003) (Photo: Author)

3.2.2 Hydrography

The hydrography of the study area belongs to the ambit of the Jacarepaguá basin, which is located on the plains and empties into the ocean. The waterways tend to be permanent and run radially from the massifs to the sea or the plains. On the plains, waterways flow as rivers and streams, form lagoons and islands, and enter canals. Water affects the configuration of the territorial unit, and the largest surface and underground retentions are widely distributed from the sea to the lagoons in the middle of the plains. The hydrography mainly comprises the following (Figs. 3.10 and 3.11).

- A coastline runs along the open waters of the Atlantic Ocean. There is usually strong wave movement along approximately 20 km of beaches.
- Lagoonal surfaces are represented by Lagoa de Jacarepaguá, Lagoa da Tijuca (and Camorim), Lagoa de Marapendi, and Lagoinha. The lagoons are the byproduct of sandbanks; i.e., the accumulation of sediments that form bars along the coast that enclose a portion of water. They predominantly receive superficial water, but also underground water, in addition to exchanging fresh water with saline marine water (SMAC 1998).

The lagoons of Jacarepaguá and Tijuca, having a central position and large dimensions (the two lagoons have a total area of 9.3 km² and total length of 13 km), function as a divider of fresh and saline water, receiving and distributing water that runs down the slopes of the massifs and water that comes from the sea. Additionally, they divide the region into two well-defined parts. This is reflected in the formation of the two administrative regions of Barra da Tijuca and Jacarepaguá. The most important islands in the lagoons are Ilha da Gigóia, Ilha Primeira, Ilha dos Pescadores, Ilha do Ribeiro, and Ilha Pombeba.

Lagoa de Marapendi, running parallel to the sea in the southern-most section of the plains, has an elongated shape, surface area of approximately 3.5 km², length of 10 km, and width of 350 m. It is connected to the lagoons of Jacarepaguá and Tijuca.

Lagoinha completes the lagoonal framework. It is located within Chico Mendes Park, has low levels of salinity, and is connected to Lagoa de Marapendi.

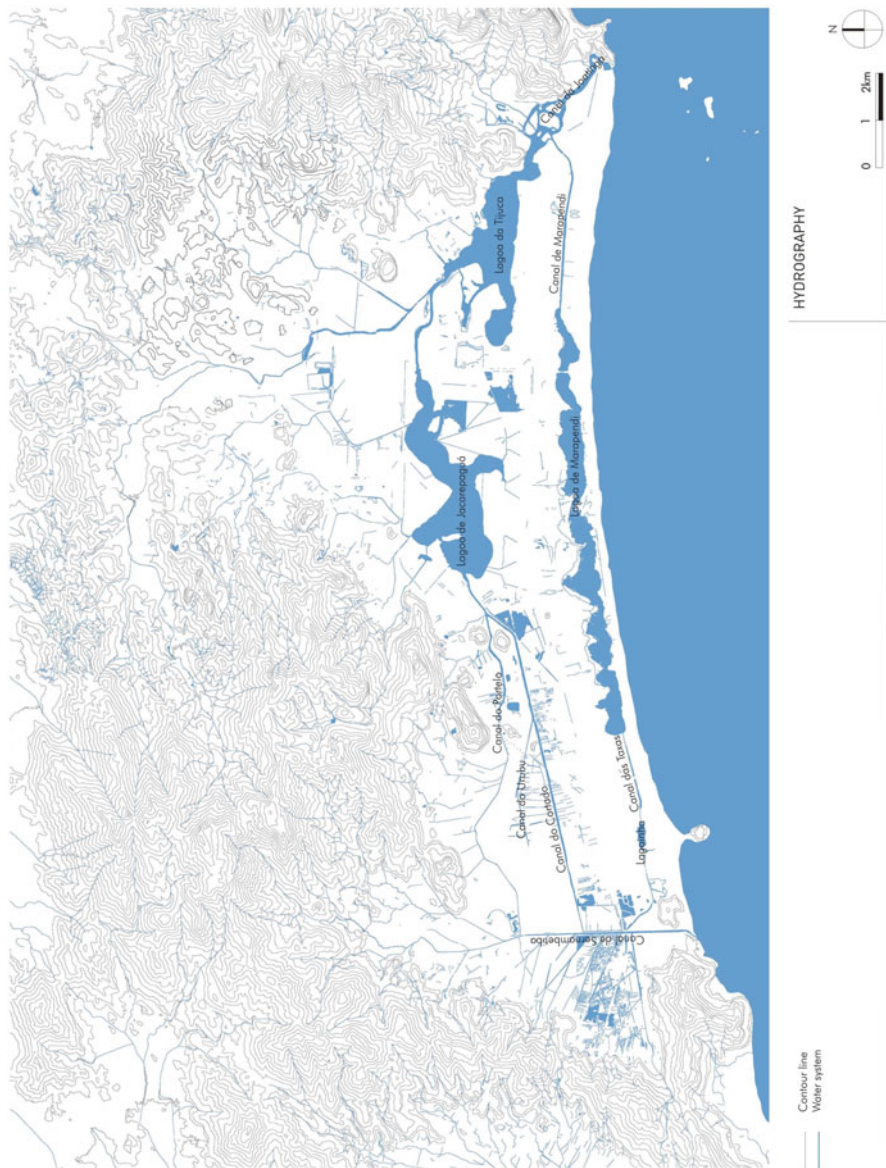


Fig. 3.11 Map of the hydrography

- Lagoonal canals include Canal da Joatinga to the far east and Canal de Sernambetiba to the extreme west, with both running perpendicular to the lagoons; Canal do Portelo, Canal do Urubu, and Canal do Cortado to the west, arranged longitudinally; and Canal de Marapendi and the Canal das Taxas, which pass through Lagoa de Marapendi longitudinally. The canals are mostly artificial. They were built to improve the drainage of the area between the lagoons and the sea, which is low in altitude and witnesses great accumulation of superficial and underground water. On the plains, Canal de Sernambetiba and Canal da Joatinga are the main drainage routes to the sea.
- Rivers flow along the valleys of the Jacarepaguá lowlands. The rivers shape the territory from the massifs, and follow the topography to the lagoons, before finally flowing into the sea. The courses of the rivers delimit two zones on the plains: one superior and one inferior to the lagoons of Tijuca and Jacarepaguá. In both zones, the continuous courses of transversal and radial waters are prevalent. Generally, the riverbeds are narrow and of small dimensions.

3.2.3 Vegetation

The physiography of the area, along with the hydrographical characteristics and characteristics of the soil and climate, determine the existence of a wide diversity of vegetation communities of inestimable ecological value. These communities exist in the sea, lagoons, damp and floodable areas, rivers, and mountains.⁹

Among the areas of vegetation in the study area, we highlight the following¹⁰ (Figs. 3.12 and 3.13).

- Atlantic forest is dense forest that is little modified or completely recovered, usually found at the highest altitudes of the massifs. Such areas of Atlantic forest are those remaining from the anthropic activities or that have recovered. They are forest reserves of great ecological value and a significant part of the natural heritage of the city. The tree height varies, with trees taller than 30 m composing the upper arboreal stratum.
- Secondary Atlantic forest includes various arboreal strata and species that were later introduced in the original forest. Such forest is found in the greater part of the area of the massifs. There are also isolated instances on the plains, where in

⁹ Sources: Secretaria de Urbanismo e Meio Ambiente da Prefeitura da cidade do Rio de Janeiro (SMAC) (2000). *Mapeamento e Caracterização do uso das terras e cobertura vegetal no município do Rio de Janeiro entre os anos de 1984 e 1999*. Rio de Janeiro: Secretaria de Urbanismo e Meio Ambiente da Prefeitura da cidade do Rio de Janeiro; Estado do Rio de Janeiro (1999). *Mapa de usos do solo e cobertura vegetal* (pp. 2744–4 and 2745–3) (scale: 1:50.000). Rio de Janeiro: Fundação CIDE; Prefeitura da cidade do Rio de Janeiro (1997). *Mapeamento digital da cidade do Rio de Janeiro* (scale: 1:2.000). Rio de Janeiro: Instituto Pereira Passos.

¹⁰ Areas of vegetal communities described as marshland, cultivated land, and garden vegetation were separated from the original categories in SMAC (2000), at a scale of 1:2000, according to the digital cartography of Prefeitura da cidade do Rio de Janeiro (1997).

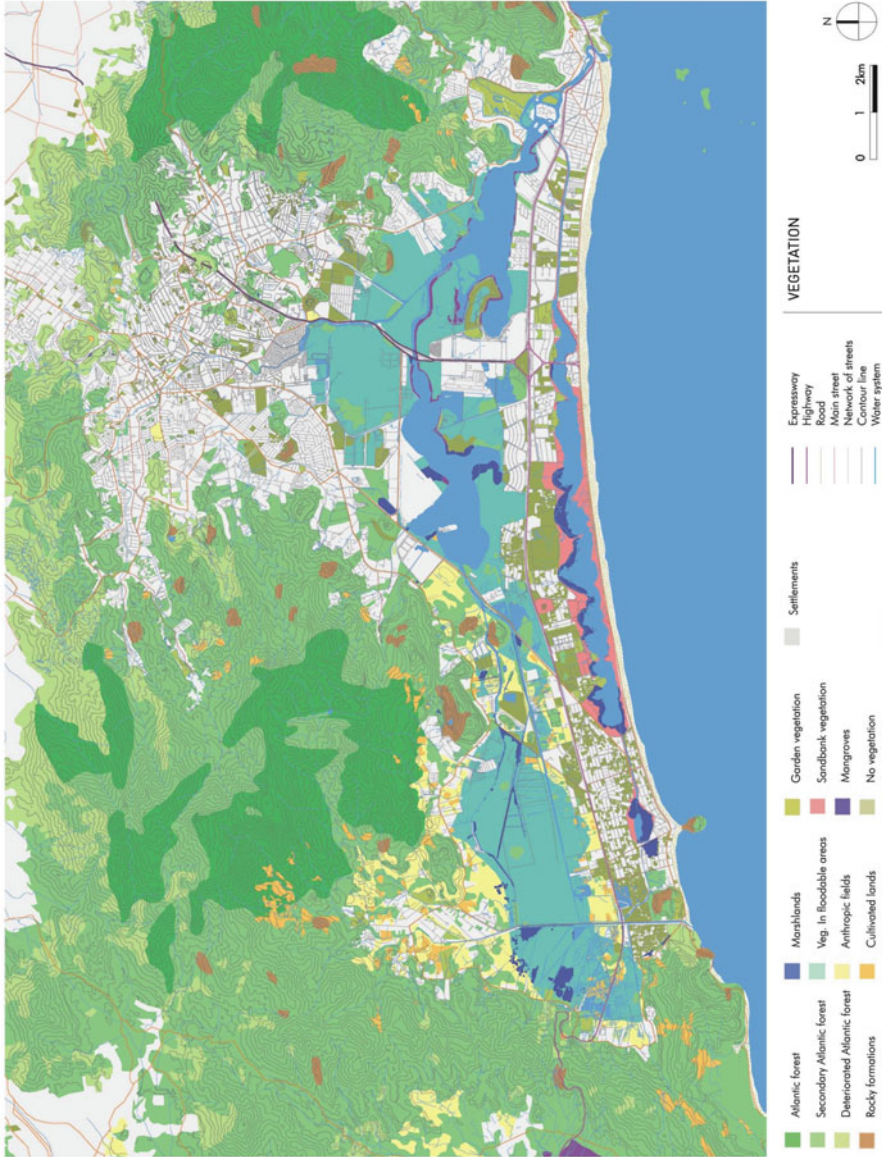


Fig. 3.12 Map of vegetation



Fig. 3.13 View of part of the study area (2003) (Sernambetiba fields) (Photo: Author)

many cases the forest is accompanied by a rocky outcrop. In most cases, areas of secondary Atlantic forest constitute the limits between the massifs and urban areas, and they are important reservoirs of the biotic environment.

- Deteriorated Atlantic forest is distributed in deforested areas. Such forest is found on some slopes of the massifs and is in an advanced state of degradation relative to original forest. It is mainly located in the upper parts of the eastern section of the Pedra Branca massif, and to the west of the Tijuca massif.
- Mangrove is a type of vegetal community that is present around the lagoons, and the vegetation is of shrub-tree stature. Mangroves are currently found in reduced areas, such as the relatively narrow strips on the margins of the Tijuca and Jacarepaguá lagoons, and in some areas of the Marapendi lagoon. The mangroves have very particular and fragile ecosystems that are adapted to the high salinity and movement of the water.
- Marshland is a permanently humid area, with vegetation of herbaceous stature. Marshland is a very fragile ecosystem and, owing to intensive anthropization, it is generally reduced to the margins of the canals and rivers, or scattered amidst other flooded areas next to the Pedra Branca massif, to the west of the plains.
- Vegetation in floodable areas develops in flooded soils or in soils that are susceptible to flooding, and generally has herbaceous stature. The degree of humidity varies according to drainage, proximity to subterranean water, presence of embankments, and rain. According to water levels, there are variations in the vegetation. Such vegetation is found around the Tijuca and Jacarepaguá lagoons and their main canals, to the west of the territorial unit, as a consequence of the low altitude of the plains.
- Sandbank vegetation is an ecosystem that is typical along the coast, growing in arenaceous soils and having a relatively dense shrub-tree and herbaceous stature. It is found over a large area in the inferior section of the plains, next to Marapendi lagoon and its canals. The area of sandbank vegetation is home to fauna and flora that are adapted to high temperature, wind, and soil poor in nutrients.
- Anthropic fields are generally areas of vegetation of small stature, such as short and tall grasses, or forests in the process of regeneration. Most of these areas are found in the western part of the plains and in the southern section of the Pedra Branca massif.
- Cultivated land is land used for agriculture, predominantly flower and banana cultivation. Such land is concentrated in the western zone of the territorial unit and is directly related to the conditions of the relief. Banana cultivation is more

concentrated on the slopes of the Pedra Branca massif, and other cultivation is concentrated on the plains.

- Garden vegetation is tree-shrub and shrub-herbaceous plant vegetation grown in parks or other areas for the purposes of recreation and ornamentation. Gardens are spread throughout the plains.

3.3 Infrastructure and Urban Land Use

3.3.1 *Infrastructure: Roadways, Urban Services and Public Transportation*

The spatial organization of the roadway network is closely related to the territorial geography, mainly with the relief of the terrain and distribution of water. The roadway network has different scales of roadways and connections, and different locations, sections, and capacities for vehicle flow. The three levels of the roadway network are the main roadway network within the city and its region, the secondary roadway network that connects the study area to its surroundings, and the general network of streets connecting the secondary roadway network to neighborhoods (Fig. 3.14).

The main roadway network to the city and its region comprises highways and an expressway, which run parallel to the coast line and between the sea and the lagoons (the highway Avenida das Américas (Fig. 3.15), and perpendicular to the coastline, between the lagoons, the highway Avenida Ayrton Senna and the expressway Linha Amarela) (Fig. 3.16). The main access points to both roads are tunnels passing through the Tijuca massif. The roads converge at a roundabout, called Trevo das Palmeiras.

The expressway has the same cross-section throughout Linha Amarela, with two central arteries, having three lanes in each direction. The flow capacity is practically homogeneous, with small variations in some sections related to traffic demands.

The highways allow direct movement, practically without interruption, which reduces travel time. At the same time, this “canal” of express movement, according to its morphology, does not have many points of contact with its surroundings; specifically, the points of contact are restricted to the roads feeding the highway.

The highway Avenida Ayrton Senna is also very homogeneous, with there being few variations in the number of lanes: two central arteries, with three or four lanes, and two lateral arteries, with two or three lanes. Although a highway prioritizes the fast flow of traffic like the expressway, it has a more “open” character; i.e., it is more related to its surroundings, and it is in direct contact with adjacent buildings. However, because of its width, its two lateral lanes are not particularly connected to one another. Over the past few years, as an initiative of the public sector, bike paths were created in the lateral and central arteries to promote the use of bicycles as an alternative means of transportation, although with little success.

The results of interviews conducted have indicated the great dependence of the population on the use of automobiles in the study area, as the area is a place where travel distances are long, and the roads are not inviting to pedestrians and public

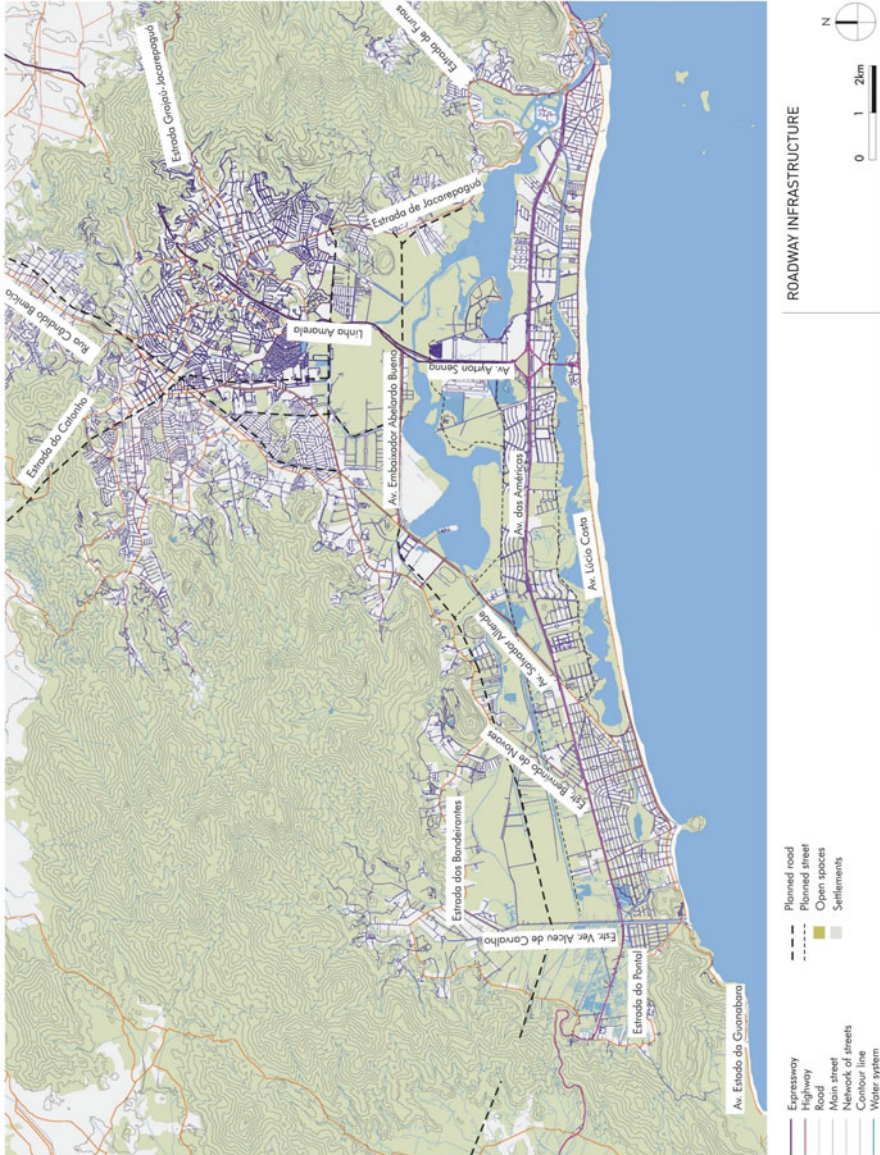


Fig. 3.14 Map of roadway infrastructure



Fig. 3.15 Avenida das Américas highway (2003) (Photo: Author)



Fig. 3.16 Linha Amarela expressway (2003) (Photo: Author)

transportation is deficient. The highway Avenida das Américas is similar to the highway Avenida Ayrton Senna, although Avenida das Américas varies more along its route. The most noticeable variations are

- The transformation of the highway from two central arteries with two or three lanes each and also two lateral arteries, to two arteries with six lanes each (beginning at Avenida Salvador Allende); and
- The transformation of the highway from two arteries with six lanes each to a two-way road (after the road Vereador Alceu de Carvalho).

The traffic flow on Avenida das Américas is 116,843 vehicles/day¹¹ in its first section, 61,441 vehicles/day in its second section, and only 7,959 vehicles/day in its third section. The situation is similar for public transportation, with traffic flow being higher in the first section (7,051 vehicles/day), slightly lower in the second section (6,813 vehicles/day), and drastically lower in the third section (1,528 vehicles/day).

It is worth noting that Avenida das Américas, which begins as a highway and ends as a road of more modest dimensions, is not entirely consolidated. Its last section coincides with the part of the territorial unit where urban occupation is scarcer.

The morphological considerations of Avenida das Américas, including projects for the implementation of bike paths and its poor acceptance by the population, coincide with those of Avenida Ayrton Senna.

The secondary roadway network, which connects the study area to its surroundings, has arteries that intersect the plains and that run along the margins of the massifs. There are

- Roadways that circumvent the massifs, namely Estrada dos Bandeirantes, Estrada de Jacarepaguá, Estrada do Pontal, and Avenida Estado da Guanabara;
- Roadways that traverse the massifs, namely Estrada dos Teixeiras, Estrada do Catonho, Estrada de Furnas, Estrada do Joá, Estrada Grajaú-Jacarepaguá, and Rua Cândido Benício;
- Diagonal roadways, namely Avenida Salvador Allende; and
- Longitudinal roadways, namely Avenida Lúcio Costa, Avenida Embaixador Abelardo Bueno, Estrada da Boiúna, Estrada do Cafundá, Estrada do Rio Grande, Estrada do Tindiba, and Estrada do Pau Ferro.

The secondary roadways are usually homogeneous throughout their course. Nevertheless, we can identify two types of road sections:

- Two-way sections, with two lanes in each direction; and
- Two-way sections, with one lane in each direction.

The volume of traffic tends to vary according to the surroundings of the roadways and the degree of urbanization. In the case of Estrada dos Bandeirantes, for instance, in the most urbanized neighborhoods, the average flow is 57,136 vehicles/day, whereas the flow drops to 6,115 vehicles/day in less urbanized neighborhoods. Likewise, the average flow of public transportation is 9,305 vehicles/day in more urbanized neighborhoods, and around 1,188 vehicles/day in other neighborhoods.

¹¹ Data are for October 2000, from the Secretary of Transport of the City Hall of Rio de Janeiro.

The roadways in the secondary roadway network differ from the highways and expressway mainly in terms of their width and their design being more focused on local travel, allowing the presence of pedestrians and bicycles. This implies lower speed limits and greater proximity to settlements at their margins.

The general network of streets connecting the secondary roadway network and neighborhoods has a smaller capacity for supporting traffic and usually narrower sections than the previously mentioned roadways (although some streets have capacity that is greater than the traffic demand). The general network of streets is composed of the main streets of neighborhoods and the general streets. Some streets are not yet completely urbanized, although the public sector has been encouraging improvement works and the creation of bike paths. Among the most important streets are Avenida Zilke Machado, Avenida Gláucio Gil, and Avenida Alfredo Balthazar da Silveira in Recreio dos Bandeirantes; Avenida Olegário Maciel and Avenida Rodolfo Amoedo in Jardim Oceânico; Rua André Rocha in Taquara; Rua Edgar Werneck and Geremário Dantas in Freguesia; and Estrada Benvindo de Novaes and Vereador Alceu de Carvalho in Vargem Pequena and Vargem Grande (Fig. 3.17).

Roadways planned but not yet constructed include the following.

- State and Municipal roadways, to be constructed according to the Highway Department of the State of Rio de Janeiro (Departamento de Estradas e Rodagens do Estado do Rio de Janeiro; DER),¹² including RJ-075, RJ-089, RJ-091, RJ-240, and RJ-120.
- Streets, to be constructed according to the provisions of Decree 3046, including street numbers 2, 4, and 7 as part of alignment project (PA) 8997 and the Via Parque as part of alignment project (PA) 9822.

Roads for which proposals are in the process of definition and/or approval include the following.¹³

- Highway ring. The highway ring of the city of Rio de Janeiro is a project of the Secretary of Transport of the City Hall of Rio de Janeiro (Secretaria de Transporte do Município do Rio de Janeiro), and it aims to connect the main perimeter roads of the city and improve access from the southern zone to the western zone. In the case study, the highway ring specifically affects the Avenida das Américas, the Avenida Ayrton Senna, and the expressway Linha Amarela, and follows the implementation of already approved roads and streets, such as RJ-091, RJ-075, and Via 5. The project is so far comprises some preliminary proposals.
- Modifications of and improvements to roads constructed for the Pan-American Games (2007). Modifications are planned for the Estrada dos Bandeirantes, and improvements for Avenida Ayrton Senna. Additionally, bike paths will be constructed to expand the existing network. (Note that currently other initiatives in this sense are been carried out by the government for the Olympic Games in 2016).

¹² According to information to July 2003.

¹³ Information from interviews conducted with the professionals responsible for the projects and from material published by the responsible departments of the City Hall of Rio de Janeiro.



Fig. 3.17 Example of a main road (2003) (Photo: Author)

In short, the roadway network of the territorial unit is well distributed and connected with other parts of the city and the region, characterizing the good accessibility of the area. However, there are traffic bottlenecks along the main routes of the main roadway network in tunnels that pass through the massifs, which compromise general mobility in the study area.

In terms of infrastructure services, rapid urban growth in the study area has not been accompanied by the development of adequate networks of water supply and sewage processing. Additionally, there are many problems of drainage owing to the very low topography (even lower than sea level) in some areas. Likewise, there is insufficient electricity distribution, especially in areas of the massifs that are most difficult to access, and illegal connections are frequently made to the power grid, most being in areas of illegal occupation.

Many of the water-treatment stations are privately owned, and most residues are stored in cesspools, or directly passed to the lagoons and waterways, which magnifies contamination and gives rise to serious biophysical issues. Additionally, there are illegal connections that send residual waters directly to the rainwater network, making the waterways open-air sewers.

This deficiency of the infrastructure of services, which is one of the biggest problems in the study area, has been the subject of public-sector initiatives over the last few years; e.g., the establishment of a marine outfall system, which is yet to be completed.

There are also problems relating to the insufficient collection of solid waste in the study area, with solid waste being transferred to existing open spaces and affecting

the soil and water in the territorial unit. Trash contributes to the contamination of water and to the proliferation of diseases and other problems. There is no efficient policy for the collection and selective recycling of trash.

Most public transportation relies on buses and vans. The Alvorada terminal is the main bus terminal in the territorial unit and it is located at the roundabout where Avenida das Américas and Avenida Ayrton Senna converge. Condominiums (residential areas inhabited by the upper class) have private collective transportation services. In general, the needs of the population for public transportation are not being met. New projects have been started with the aim of providing light rail, a subway, and special lanes for buses. Among them, the projects for public transportation that are in the process of definition and/or approval¹⁴ are the subway lines 4 and 6. Line number 4 will connect Barra da Tijuca and the southern zone by a surface route along Avenida das Américas and a tunnel; and line number 6 will connect Barra da Tijuca and the northern zone by a surface route along Avenida Ayrton Senna (Note that currently other initiatives in this sense are being carried out by the government for the Olympic games in 2016).

In such a territorial unit where car travel is prevalent, it is important to improve public transportation and promote alternative means of transportation, such as bicycles and light rail, for travel within the unit, and maritime transportation for external access. Improving public transportation will entail significant environmental and social improvements, in as much as it will lower levels of contamination and democratize the transportation network by offering more equitable conditions for people's displacement and access to places, in an area where social inequalities are very marked.

3.3.2 *Urban Land Use*

Observation of urban land use in the study area (Fig. 3.18) reveals that, in general, commerce and services are distributed over the most populous areas, both close to the sea and in inland areas, especially near the main local centers and around the main roadways. The path of Avenida das Américas, from the Tijuca massif to the convergence with Avenida Ayrton Senna, is the main axis of commerce and services in Barra da Tijuca (Figs. 3.19 and 3.20). The main constructions of the tertiary sector along this section are commercial centers and large leisure and entertainment structures, which extend to Avenida Ayrton Senna and form a pool of commerce and services. Barra Shopping and Downtown Mall are representative of commercial centralities¹⁵ in the study area. In Jacarepaguá, commerce and services are more scattered, although there are great concentrations near the centers of Taquara and Freguesia. Between these two centers, Rua Geremário Dantas is the main axis of commerce and services.

¹⁴ Information from interviews conducted with the professionals responsible for the projects and from material published by the responsible departments of the City Hall of Rio de Janeiro.

¹⁵ We understand "centralities" to be parts of settlements with large attraction potential that were consolidated in the urban evolution of the place with the polarizing of certain activities; e.g., commerce.

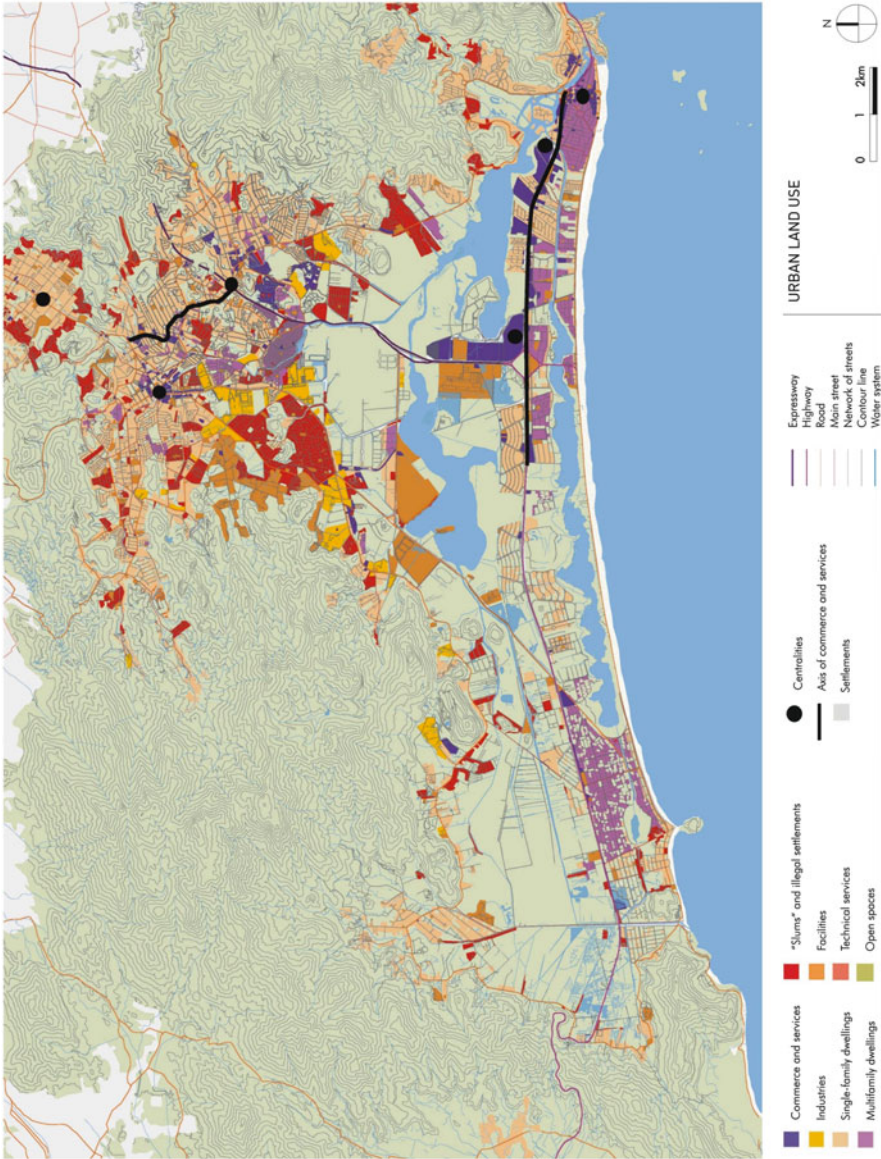


Fig. 3.18 Map of urban land use



Fig. 3.19 Aerial view of the margins of the Tijuca lagoon (2001) (Photo: Rodrigo Rinaldi)



Fig. 3.20 Aerial view of part of Barra da Tijuca (2001) (Photo: Rodrigo Rinaldi)

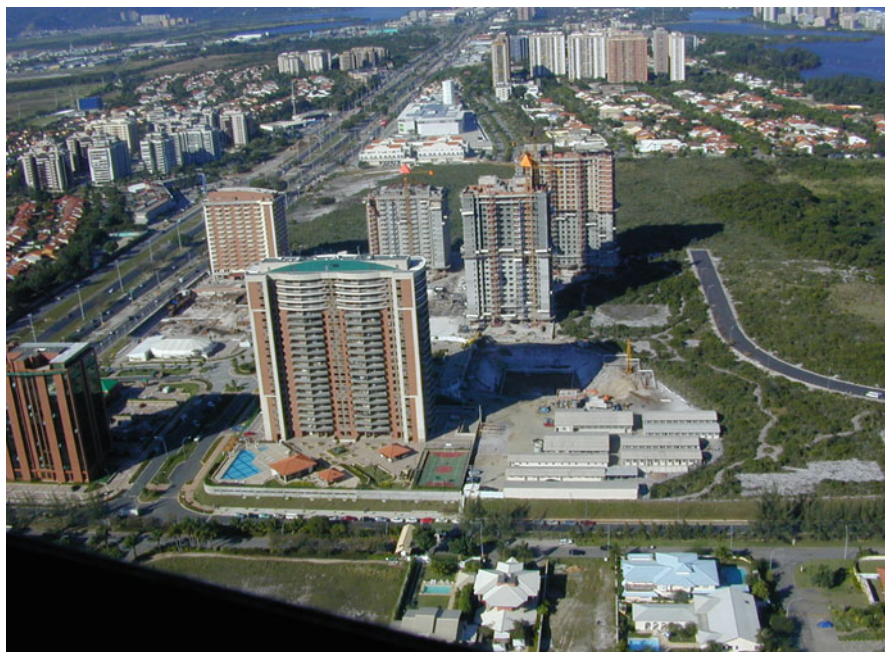


Fig. 3.21 Aerial view of part of Barra da Tijuca (2001) (Photo: Rodrigo Rinaldi)

Industry is especially concentrated in Jacarepaguá, where there is an industrial zone. Additionally, there is industry on the margins of the Pedra Branca massif, in Vargem Pequena. This activity largely includes the production of pharmaceutical products and beverages, and trash recycling.

The clear zoning of tertiary and industrial sectors reflects the pro-visions of planning. There is a tendency toward establishing areas specific to sectors throughout the territorial unit, which leads to there being few urban areas having mixed uses and a subsequent lack of functional autonomy for the constructed nuclei.

Residential areas near the sea, in the interior of the plains, and on the margins of the massifs occupy much of the settlements in the territorial unit. In Barra da Tijuca, multifamily dwellings form blocks, clearly seen near the sea and in some intermediate spaces, and there are more multifamily dwellings than single-family dwellings (Fig. 3.21). In Jacarepaguá, by contrast, single-family dwellings are prevalent, with few concentrations of multifamily dwellings, which are mainly located between the two centers mentioned above, Taquara and Freguesia.

To the west of the plains, single-family dwellings are more scattered, which is characteristic of an area that is less occupied, although there is a trend towards the conversion of agricultural open spaces to areas of urban occupation (Bicalho 1992).¹⁶

¹⁶Urban conversion is intense to the west of the lowlands, in contact with Serra de Guaratiba, at the foot of the massifs. The small farms are in an advanced process of transformation into residences, countryside headquarters for schools and companies, having the presence of a few horse farms. (Bicalho 1992, p. 308, translated from the original)



Fig. 3.22 Riocentro (2001) (Photo: Rodrigo Rinaldi)

There are single-family dwellings on the margins of the massifs and, increasingly, in the interior of the massif areas.

Slums (favelas) and other illegal settlements are distributed heterogeneously throughout the study area, although they are concentrated and proliferating in Jacarepaguá. The informal urbanization of favelas is scattered over the plains and mountains. Favelas usually occupy undervalued places in real-estate terms, or those areas that are difficult to occupy owing to the relief of terrain or water conditions. In the mountains, they are found on land that is inadequate for construction, especially on steep sections, where they paradoxically coexist with single-family luxury dwellings (Lobato 1992).

Smaller public facilities, such as schools, churches, and libraries, are distributed throughout the entire study area, although they are in insufficient numbers to the west of the plains and in Jacarepaguá. There are greater concentrations of metropolitan facilities around the lagoons, on Avenida Ayrton Senna, and on the western margin of the Pedra Branca massif. On the margins of the massif, there are hospitals, which take advantage of the natural resources in the area. It is worth noting the metropolitan facilities of the convention center Riocentro (Fig. 3.22), the Nelson Piquet racing track, and the airport, on the margins of the lagoons of Jacarepaguá and Tijuca. These facilities, located at the center of the territorial unit, have their central positions emphasized, and they serve as a point of attraction of people in both Barra da Tijuca and Jacarepaguá. At the same time, along with other commercial and service centers of the metropolis, the facilities denote the geographical centrality of the territorial unit in relation to the metropolis as a functional center.

3.4 Characteristics of the Population

Most of the 743,634 inhabitants of the territorial unit (80%) are concentrated in Jacarepaguá. In the administrative region of Jacarepaguá, the neighborhoods of Jacarepaguá, Taquara, Freguesia, and Praça Seca are the most populated, accounting for 60% of the population. In the administrative region of Barra da Tijuca, the neighborhoods of Barra da Tijuca and Grumari have the largest populations, accounting for 63% and 17% of the total, respectively.¹⁷

The geometric rates of yearly growth also vary according to the administrative region. Barra da Tijuca has a yearly growth rate of 6.58%, whereas Jacarepaguá has a rate of 2.13%, and Cidade de Deus has a negative growth rate of 0.06%. Thus, there is a strong trend of urban growth in Barra da Tijuca relative to other parts of the territorial unit.

Much of the study area has very low population density, with there being an average of 10 inhabitants/hectare in Barra da Tijuca and 46 inhabitants/hectare in Jacarepaguá. The highest densities, varying from 103 to 268 inhabitants/hectare, are for slums and the most populous neighborhood of Jacarepaguá.

The construction density varies (Fig. 3.23). The density of construction is 792.91 m²/ha in Jacarepaguá and 468.83 m²/ha in Barra da Tijuca. The density statistically illustrates what is observed for urban occupation. In the context of low construction density and from a quantitative viewpoint, it is not justifiable to occupy more open spaces as the first alternative to urban development. It is worth noting, however, that there has been strong pressure for construction in the territorial unit; the building of new dwellings exponentially increased from 924 dwellings in 1990 to 28,707 dwellings in 2000.

In terms of the profile of residents, the study area has a large young population (25% of the total) and productive population (15–60 years old; 67% of the total), whereas older people make up only 8% of the population. These data can be explained by the chronology of development of the urban fabric; there has been relatively recent urban development (since the 1970s) and, because of its specific characteristics, the study area has not attracted an older population.

The average years of schooling (for heads of families) slightly differ in the administrative regions of Barra da Tijuca and Jacarepaguá; the average is 10.91 years in Barra da Tijuca and 8.33 years in Jacarepaguá, whereas it drops to 5.03 years in Cidade de Deus. The data for Cidade de Deus are similar to the data for slums in the study area.

There is a fundamental difference in the income levels of the inhabitants among the administrative regions. Barra da Tijuca has the highest income levels, with nearly 85% of residents having an income exceeding three times the minimum wage.¹⁸

¹⁷To identify the characteristics of the population in the case study, data included in Prefeitura da cidade do Rio de Janeiro (1998). *Anuário Estatístico da Cidade do Rio de Janeiro*. Rio de Janeiro: Instituto Pereira Passos, and published data from the Instituto Brasileiro de Geografia e Estatística (IBGE) (Brazilian Institute of Geography and Statistics), (<http://www.ibge.gov.br>. Accessed 20 August 2000) were analyzed.

¹⁸The minimum wage in 2003 was about USD 80/month.

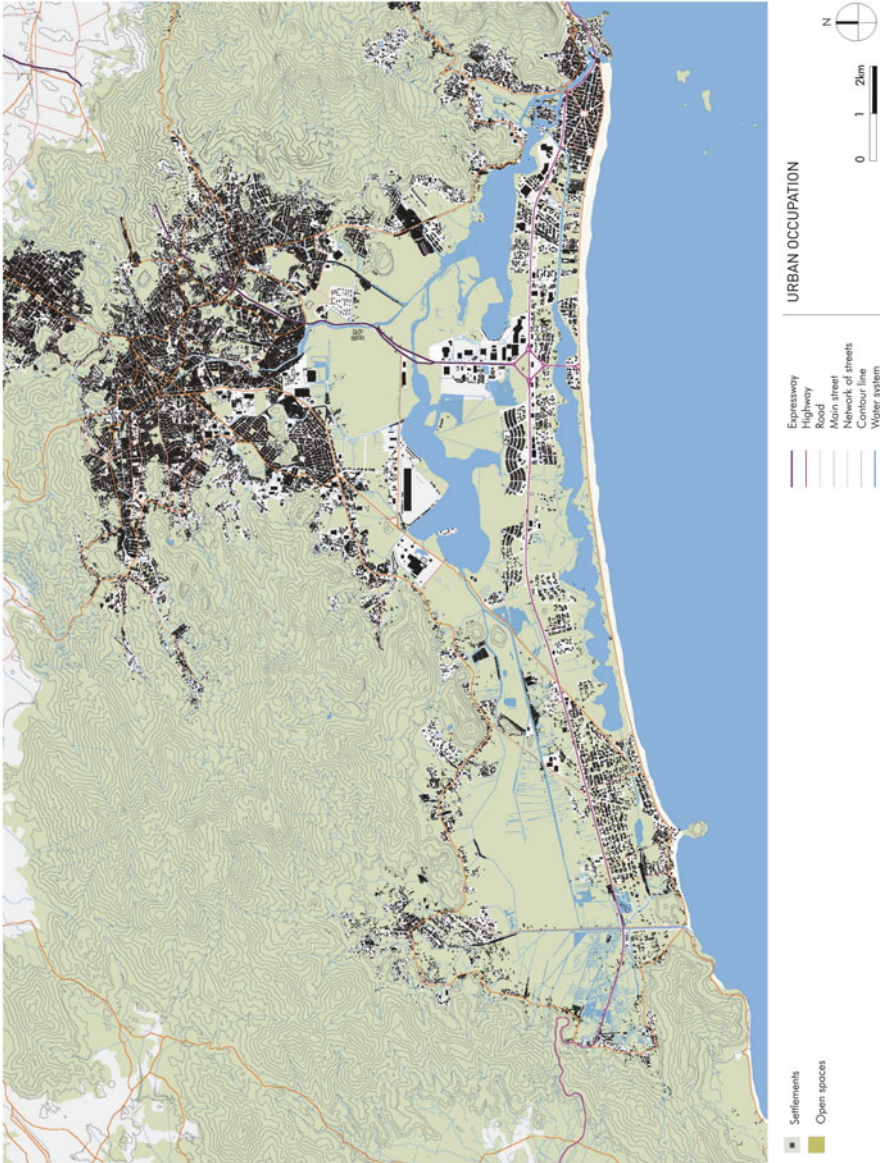


Fig. 3.23 Map of urban occupation

In Jacarepaguá, only 50% of residents have this income, whereas in Cidade de Deus, the figure drops to 30%. Tertiary activity and real estate are the important sectors of the local economy, followed by industrial activity. Agriculture and livestock are the least represented in general terms, and tourism is an expanding activity.

The above data illustrate the economic inequalities present in the study area. The data also confirm the existence of slums as the nuclei of poverty, which in part characterizes the social segregation of the local community. In this context, social inequality, with an imbalanced distribution of opportunities for development, tends to worsen the urban insecurity that has developed even further over the last few years, with there being an increase in crime rates in inverse relation to surveillance and social control capabilities.

In interviews conducted, the discourse reflects the social inequality, with different social strata hardly speaking with one another and often having divergent needs and goals. However, these discourses converge for certain aspects, which may have a direct or indirect relation to open spaces. Examples are the common desire to use water in a sustainable way and to have better sanitation conditions; the provision for the adequate use of protected open spaces, which are often unmanaged; the need for efficient public transportation; greater efficiency in trash collection; more public security; and the prohibition of illegal urban occupation and invasion of open spaces, be they protected or not. In general, the community is sensitive to the need for bio-physical protection and to the main visual elements that characterize the area. This is one of the main concerns of various non-governmental organizations in the city.

Chapter 4

Recognition of Open Spaces and Their Urban Context: Open Spaces to Be Analyzed and Roles that They Can Play in Structuring Urban Occupation

The present analysis allows the identification and characterization of territorial open spaces and the urban dynamics of which they are part to recognize the origins of the fragmentation of the urban territory and consequently their processes and elements (e.g., open spaces, settlements and infrastructure, and especially roadways) that can offer a perspective on the open spaces to be analyzed and the roles that they can play to reverse this reality and structure the urban occupation. Thus, the analyses consider the spatial and functional relationships established among open spaces, settlements, infrastructure, and planning over time as key factors in the planning of the system of open spaces and the restructuring of the territory. The bases of the analyses are as follows.

- The importance of open spaces in the structuring of the territorial unit, in terms of the plans for the study area and the urban occupation itself.
- The consequences for open spaces due to the expansion of urban occupation and the manner of expansion, in terms of the implementation of settlements and roadway infrastructure.
- The current open spaces to be analyzed and their territorial situation related to the elements and processes of urban occupation, from which it is possible to recognize the potential of open spaces in structuring urban occupation and benefiting urban integration, along with natural and visual processes. This can encourage the maintenance of these spaces free from occupation, or their occupation under certain conditions, and as references for the structuring of settlements and roadways.

There are three periods of events in this analysis. The periods clearly differ in terms of the interpretation and construction of the territory. They are characterized by different methods of planning and building, which is reflected in different ideologies of planning, real-estate logic, and appropriation of space by people. The three periods are as follows.

- Stage 1: Colonization (until 1940) is characterized by the rural use of the study area and by the beginning of its occupation.

- Stage 2: Subtraction (1940–1970) is characterized by suburban growth and the occupation of more open spaces.
- Stage 3: Fragmentation (1970–2000) is characterized by the introduction of new forms of urban growth and the fragmentation of the urban context and consequently open spaces.

4.1 Stage 1: Colonization (Until 1940)

The configuration of the investigated territory in this period underwent fundamental change, from centuries of being a rural region to the beginning of urbanization through the expansion of the city of Rio de Janeiro (the capital of Brazil from the eighteenth century) away from its traditional center (Figs. 4.1 and 4.2).

Until the 1940s, the study area had a strictly rural character, and it was difficult access by land owing to the presence of massifs. In general, it was immune to the growth of Rio de Janeiro, which was directed toward the suburban lands of the northern zone of the city, by means of industrial development around the railway that has been in operation since the late nineteenth century. The railway penetrated the mountains and allowed the occupation of the plains. The territorial unit, along with the western zone, was until then a rural area of the city, being an area of weak urbanization and important production of foodstuffs to supply the already consolidated central zone (Abreu 1987) (Figs. 4.3 and 4.4).

4.1.1 Planning

In the 1930s, the first master plan of Rio de Janeiro was drawn up by the French urbanist Alfred Agache. The plan encompassed areas close to the center of the city,

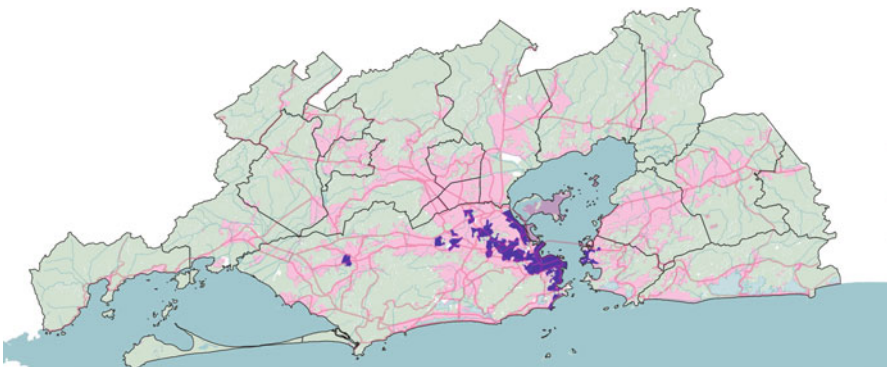


Fig. 4.1 Metropolitan region of Rio de Janeiro—urban occupation in 1922 (Adaptation of map of RMRJ in 1922) (Source: Villaça 1998)

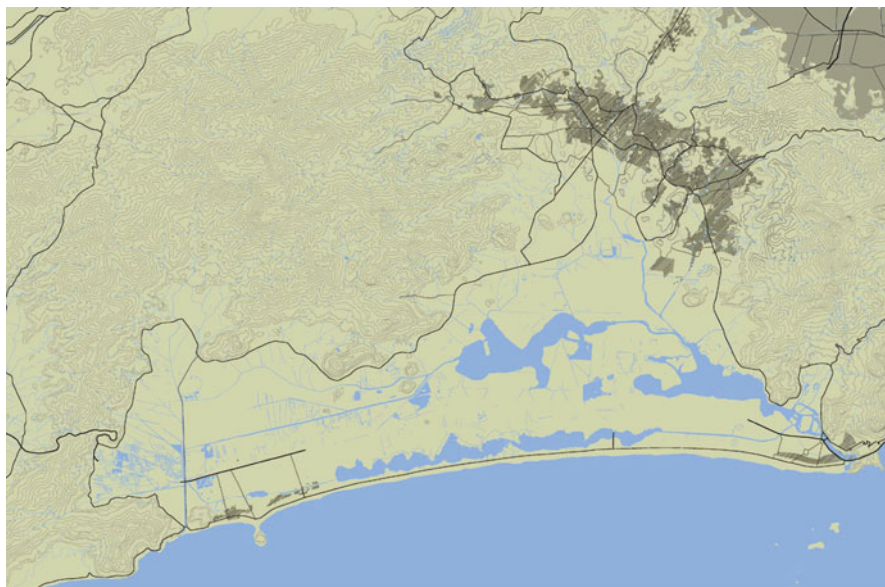


Fig. 4.2 Urban occupation scheme of the study area until 1940 (Source: Author)



Fig. 4.3 View of Barra da Tijuca from Joá Road in the 1950s (Source: <http://farm2.static.flickr.com>. Accessed 10 July 2008)



Fig. 4.4 View of Recreio dos Bandeirantes from Pontal in the 1950s (Source: <http://br.geocities.com>. Accessed 10 July 2008)

without reaching the western zone, although it predicted the relation of the city with the west, including the study area.

For the territorial unit, the plan proposed the creation of Tijuca National Park, on the Tijuca massif, and also “farther” open spaces as reservations that could be important to the future of the city. These reservations included the surroundings of the lagoons on the Jacarepaguá lowlands.¹

The plan was based on principles of urban embellishment and hygiene, and it entailed a territorial policy for open spaces that could be extended to cities near Rio de Janeiro.

... once again we insist on the need, by public authorities, for the vigorous enforcement of a territorial policy of open spaces, for the establishment of an exclusive budget to this end, and for not forgetting to express topographically the program and the projects envisioned in this regard, along with general plans for the circulation network and means of transportation. These last works of urbanization are presented with all their importance inasmuch as, as said before, numerous private interests are attached to it. It is in the name of general interest that public authorities should conduct their actions, upholding and sustaining open lands and indispensable gardens, not only for the beauty and luxury they provide, but also for the hygiene of

¹ A specific part of the planning of the area was the creation in 1932 of the biological reserve of Goethea in Restiga de Itapeba, which is the oldest reserve in Brazil enacted at the municipal level.

the city, for the development, and life of its inhabitants. Every project of improvement or extension must be deemed incomplete if it is not followed by the acquisition of the lands indispensable for its respiration. (Agache 1930, p. 211, translated from the original)

The Agache Plan considered open spaces as indispensable for urban development, and the multiplication of protected open spaces to be advisable in the face of expansion of the city. The plan highlighted the importance of open spaces (e.g., parks, fields for leisure activities, and forest areas) according to the benefits they might bring, physical as well as mental, and it insisted that they be interconnected.

To provide useful effects, these verdant spaces must be connected among themselves by avenues with trees, which, every time they are used in that fashion, will not be considered mere roads, but true promenades free from the flows of greater circulation, or spacious enough to be protected from the excesses of noise, dust, and dangers. Hence, we come to the construction of one or several parkways not only connecting the parks among themselves but equally leading to the exterior woods and promenades, as well as to the greater spaces of the rural zone destined for cultivation or breeding—reservoirs of fresh air indispensable for the breathing of the great masses. (Agache 1930, p. 205)

4.1.2 Roadway Infrastructure

At the time of stage 1, access to the study area was through the mountains. Attempting to overcome the limits posed by the physiographic features, pathways were built where the irregularities of the relief allowed. The pathways followed the valleys, crossing water bodies at the most inhospitable sites, and promoting cuts in the relief, mainly in the Tijuca massif, with the opening of the pathways of Covanca, Tijuca, and Furnas (Abreu 1992).

Rural pathways were formed between the massifs, following their margins and running to the north of the plains. The pathways formed a radial network of routes from three main points: Largo da Freguesia, Largo da Taquara, and Largo do Tanque. Coincidentally, these three places, years later, became the most important centers of Jacarepaguá.

Invasion of the study area by the French in the seventeenth century demonstrated the need for greater attention to be paid to its occupation, and authorities built pathways called Caminho da Grota Funda, which ran parallel to the sea through the entire area, from the Tijuca massif to Guaratiba. These pathways would later be the basis for the design of Avenida das Américas, one of the main traffic axes of the territorial unit (Costa 2002). Other pathways were also established in this area, such as Avenida Litorânea, running next to the coastline, and another perpendicular to it, running towards the interior.

The design of the pathways allowed the structuring of agricultural production and the transporting of produce to centers of consumption. From the main pathways on the plains, other pathways were established, opening the way to the massifs while adapting to the poor conditions of the slopes. Additionally, important drainage works were performed, resulting in the artificial hydrographic canals mentioned previously (Nogueira 1956). On the margins of the canals and next to some

rivers and streams, in the flooded areas to the west of the plains, pathways were established parallel to the routes towards the massifs that crossed the area, and they composed the traffic network that allowed the use of the area as predominantly an agricultural space.

4.1.3 Settlements

Until the 1940s, occupation built up around farmhouses and churches on rural properties, while there were a few isolated buildings on the margins of the pathways and near the sea.

The beginning of the occupation of the area, at the end of the 1930s, saw the creation of a new urban front, incipient to this day but providing new leisure, recreation and housing opportunities in a place of abundant nature; the area is an immense extension of beaches combined with mountains. In this context, the population that most benefited from the area and its leisure opportunities was the one living in the suburbs of the northern zone of the city, since the population living in the (economically most favored) southern and central zones already had beaches and mountains at hand (such as Copacabana beach and the Tijuca massif forest) (Pinheiro and Pinheiro 2001).

The growth of neighborhoods around train stations in the northern zone of the city gave rise to the beginning of the urban occupation of the Jacarepaguá plains, to the north of the territorial unit where the massifs meet. Here the network of pathways was the most important structure of urbanization. These small nuclei began to develop with a marked suburban aspect, similar to the other suburbs distributed around the railway.

There was only little urbanization near the sea, such as the settlements Tijuamar and Jardim Oceânico to the east and Recreio dos Bandeirantes to the west. The design attributed to Jardim Oceânico was similar to urbanization within the garden city model. In the design, there is a central square from which there radiates longitudinal routes, running parallel to the sea, transversal and diagonal, supported by a pathway that would become Avenida das Américas and a pathway running along the coastline. The settlements were bathing resorts, and the lack of infrastructure in the area hindered permanent residence; residences in many cases served as second homes.

4.1.4 Open Spaces

The lands in the study area were donated in the sixteenth century by Salvador Corrêa de Sá to his sons Gonçalo and Martin Corrêa de Sá. They had an agricultural character and were later characterized as a collection of large properties, up to 21 km² in size. The most evident subdivision of these large properties began in the 1930s, when the urban occupation of the area began (Fridman 1999).

At the beginning of the twentieth century, the agricultural properties were worked by their owners or hired workers. Many of the landowners did not live in the area, preferring more central and consolidated areas in the city. The lands around Estrada dos Bandeirantes were already more subdivided, and they were the original coffee and sugarcane plantations, and areas of livestock farming (Nogueira 1956).²

Until the 1940s, the study area was predominantly open spaces, comprising agricultural and natural spaces. The character and occupation of the area were generally defined by the spatial formation of the open spaces.

In stage 1, the opening of pathways, the occupation by agriculture, and the logging of wood were major modifying factors of the vegetation, specifically on the Tijuca massif. Additionally, erosion due to the creation of routes and deforestation caused movement of the land. All this resulted in, among other problems, a reduction of diversity in the ecosystems and a reduction of the water supply. Already in the nineteenth century, the Tijuca massif was an object of reforestation in an attempt to reverse the deforestation that had begun to compromise the water supply of the city (Abreu 1992).

The opening of canals was the first great modification of the hydrography of the area. Canals connected the lagoons themselves and the lagoons and the sea. Additionally, they provided drainage of the entire area of flooded plains. Furthermore, the canals allowed the draining of swamps, which transformed the extensive marshlands, which were initially unsuitable for cultivation, into productive agricultural land. This affected the profiles of the plantations, which were able to extend to areas until then uncultivated (Nogueira 1956). The layout of canals and main rivers and streams controlled, to some degree, the design of the rural areas, the effect of which can still be seen. There are characteristic canal markings running parallel and perpendicular to the sea, distributed in the shape of a comb in the extreme west, where the marks connect to streams of water flowing down the massifs.

The rationale of colonization was thus a combination of adaptation to local natural conditions and modification of local natural conditions.

4.2 Stage 2: Subtraction (1940–1970)

The period of subtraction corresponds to the suburbanization of the study area. At this time, the previous logic of open spaces, as a guiding principle of the settlements and of the implementation of infrastructure, began to be replaced by the artifices of urbanization over the physical barriers presented by the geography of the territorial unit.

² Since the 16th century, this region, occupied by large territorial concessions, was economically dedicated to livestock and sugarcane mills. In the 18th century, the activities expanded with the introduction of coffee plantations, which had their apogee and decadence during the 19th century. (Friedman 1999, p. 130, translated from the original)

Before the military coup of 1964 that instituted a dictatorial regime in Brazil, the country (particularly in the 1950s) had an atmosphere of development lead by the expansion of industry, great optimism shared by the population, and large initiatives in different areas. Some of the initiatives were clearly urbanistic, such as the creation of Brasília (1960). In Rio de Janeiro, specifically, these urbanistic actions were reflected in spatial planning, the occupation of the city, and large projects of infrastructure (Abreu 1987).

The decades from 1940 to 1960 were marked by the expansion of the city away from its administrative boundaries, with the growth of suburban areas around the routes Avenida Brasil (1946), Presidente Dutra (1951), and Washington Luís. The last two routes led towards the cities of São Paulo and Petrópolis, respectively. Avenida Brasil constituted a kind of roadway belt of the city in its northern section, providing an alternative to the connection between Rio de Janeiro and its metropolitan area that, along with the other routes mentioned, allowed urban expansion in these directions (Abreu 1987).

In 1960, Brasília replaced Rio de Janeiro as the capital of the country, with Rio de Janeiro becoming the city-state of Guanabara. As a consequence, the city lost political power, while the desire for industrialization and the creation of service centers, as driving forces of the local economy, strengthened.

The pressure of urban growth in the study area thus increased. The study area was, at that time, considered the area of the city most adequate for expansion because of its availability of wide open spaces and because of its position between the northern, southern, and western zones of the city, thus being a place that would unify the city and provide possible connections with the metropolitan region (Fig. 4.5).

4.2.1 Planning

One of the first attempts at planning in the study area was made by the public sector, through the Plan for Guidelines for Arterial Roadways on the Jacarepaguá Plains (Plano de Diretrizes para as Vias Arteriais na Planície de Jacarepaguá) (1950). This plan included the provision for a traffic network for the area and the reservation of parks for the preservation of lagoonal ecosystems. The plan intended to avoid uncontrolled occupation around the lagoons through the creation of the Jacarepaguá Biological Reserve, which enclosed all the lagoons in the territorial unit and the Itapeba sandbank.

In the 1960s, there were proposals for urban development in the city-state that made urban directives until the year 2000, and which originated from the Doxiadis Plan (1965). In its conception, this plan considered the city and its metropolitan region. One of its main ideas was the division of the city into a series of autonomous communities, interconnected by expressways. Additionally, the plan foresaw the provision of more housing, transportation, and sanitation (Leme 1999). In the case of the study area, the plan considered the need for the creation of a new business center, which would be located somewhere between the territorial unit and the rest of the western zone of the city.

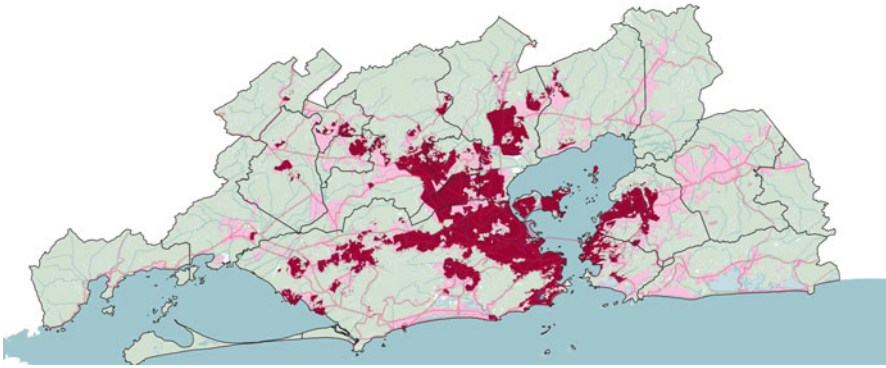


Fig. 4.5 Metropolitan region of Rio de Janeiro—urban occupation in 1958 (Adaptation of map of RMRJ in 1958) (Source: Villaça 1998)

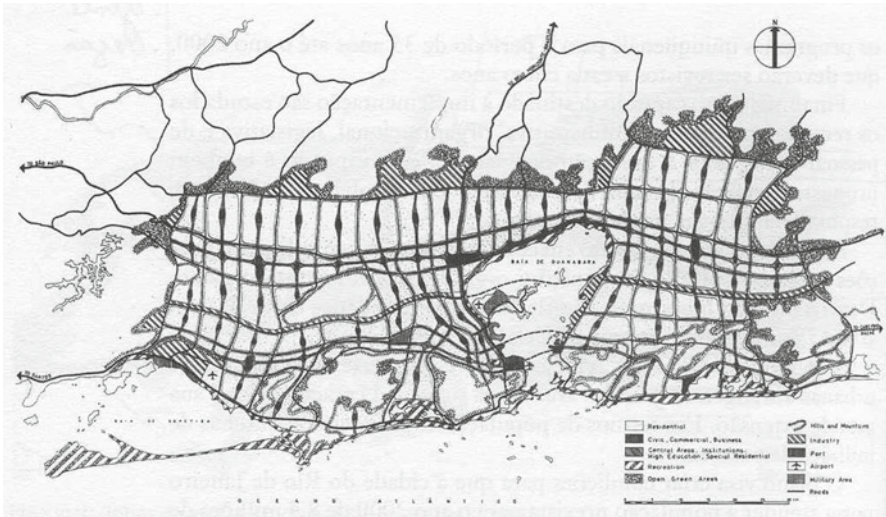


Fig. 4.6 Doxiadis Plan (1965) (Source: Constantinos and Emma Doxiadis Foundation)

Open spaces in the Doxiadis Plan (Figs. 4.6 and 4.7) were considered to be spaces for recreation and leisure, and except for the large geographical elements, such as the massifs, sea, and lagoons, which were to be preserved and protected, the open spaces were considered a compartmented space among the communities divided by the expressways. In other words, the criterion of scattered occupation throughout the territory was being followed, and open spaces were enclosed as intermediate surfaces.

The prevailing line of reasoning was that of extensive urban occupation, in which the role of open spaces was less valued as a structuring element of the territory.



Fig. 4.7 Doxiadis Plan (1965) (Source: Constantinos and Emma Doxiadis Foundation)

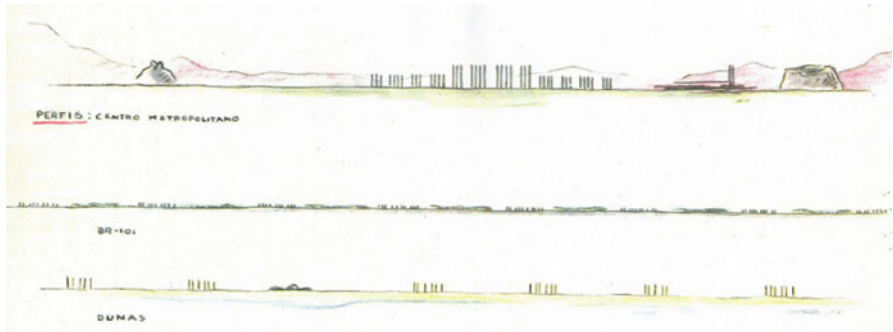


Fig. 4.8 Piloto Plan (1969) (Source: www.vitruvius.com.br. Accessed 10 May 2010)

In this sense, the functional and spatial aspects of open spaces were not considered as possible determinants of urban occupation. It is worth noting that, at that time, the parameters of ecology or the landscape in a broad sense were not major concerns in spatial planning. Thus, the developmental thinking on which the plan was based, practiced over the years, would entail the need for a more sensitive approach to the landscape, mainly owing to the deterioration of the ecology and visual quality resulting from urban growth.

At the end of the 1960s, the Pilot Plan (1969) was established (Figs. 4.8 and 4.9) to regulate the urbanization of the plains. Led by Lucio Costa and based on the principles of the Modernist Movement, such as the design principles of contemporary Brasília, this plan had the singular purpose of trying to regulate urban occupation in relation to guidelines dictated by open spaces, working to preserve the existing natural formations as much as possible.

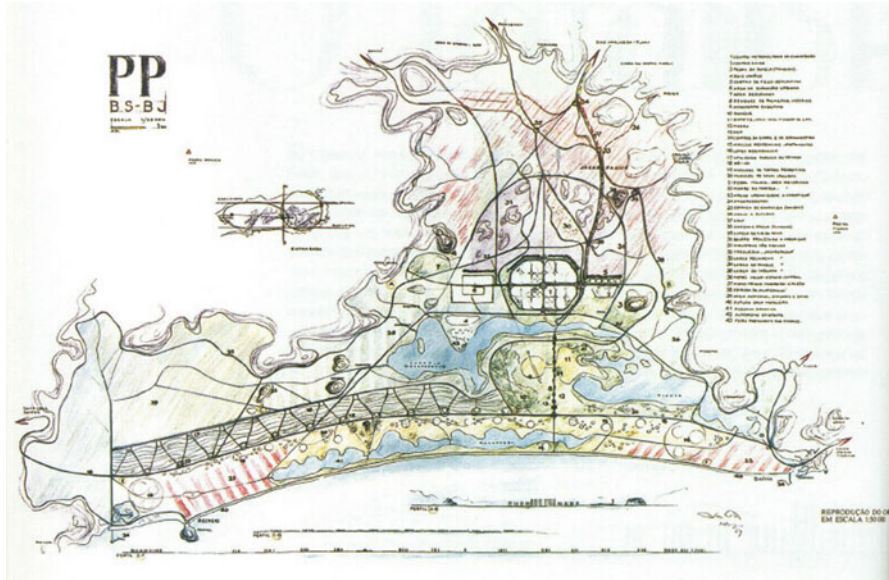


Fig. 4.9 Piloto Plan (1969) (Source: www.vitruvius.com.br. Accessed 10 May 2010)

The Pilot Plan, contrary to the Doxiadis Plan, established connections with consideration of the visual perception of the landscape, to the point of being, of itself, conditioning of the spatial planning, even though the ecology, just as in the other plan, was still not a guideline for such planning.

In the context of the plan, settlements were considered as a series of buildings superposed on the green surface of the open space, distributed as isolated towers or horizontal complexes of low density (according to strict zoning). These settlements were related to commercial and service centers and interconnected by walkways. Generally, the plan adhered to the concept of nature as scenery over which the buildings “landed”.

In the plan, the routes conceived for the exclusive use of automobiles and with a hierarchical structure would be shaped by the sea, massifs, lagoons, and hills of the plains. The plan also foresaw the creation of strips of protected land through linear open spaces around the busiest roadway infrastructure. The implementation of Avenida das Américas and Via 11 (Avenida Ayrton Senna), running perpendicular to each other, would join the entire area with the rest of the city. To the north of this intersection, the future metropolitan center of Rio de Janeiro would be developed.

The open space would serve as a basis for the design of the routes. In fact, the main routes followed the design of old existing pathways in the study area and were designed for fast motorized traffic flow with as few interruptions as possible. It is worth noting the prediction of Via Parque, which would encircle the lagoons of Jacarepaguá and Tijuca on their southern margins, with large extensions of open spaces around.

The plan proposed, in general, longitudinal urbanization on the basis of the topography of the plains, between the lagoons and the sea, directly connected to the roadway infrastructure and the main service and commercial centers (each at the extremities of the plains, near the sea). The lagoons would serve as a background, with few connections to the sea. The coastline would be free from buildings, except where Avenida das Américas and Via 11 (Avenida Ayrton Senna) meet, where there could be buildings in the form of towers and some facilities of lower height for collective use, distributed along the beach. The massifs were the final aspect of the entire complex. Margins of the plains to the west of the territorial unit would maintain their existing rural character.

This plan was the idealization of a large park with buildings in some areas, the purpose of which was to preserve and protect the original natural environment amid urban occupation. Among the areas to be preserved were Marapendi and the Tijuca and Jacarepaguá lagoons, their margins and canals, and Barra woods.

In the proposal, however, although the open and occupied spaces maintained respectful relations with each other, they remained juxtaposed, not intermingled, and to a degree separated from each other. The open spaces were, above all, spaces to be contemplated and not necessarily to be references for the structuring of urban occupation according to the integrity of their elements and processes. One can then see an existing abstraction between the formalizations of the territory and the open spaces, expressed, for instance, through geometrical complexes of residences and towers that, in many cases, were disposed over the green surface as a homogeneous whole.

4.2.2 Roadway Infrastructure

In this period, significant modifications were made to the traffic network of the territorial unit, which directly transformed the structure of the territory and generated tensions that determined the future of open spaces in the study area.

Encouraging the occupation of the study area was a goal set by the government. To that end, it was important to establish connections of direct access to the southern and central zones, then the most consolidated areas of the city. Such intention made clear the idea of transforming the rural character of the area, where there was significant agricultural production, into a commercial and industrial center, as well as creating a new real-estate market.

The construction of Elevado das Bandeiras (comprising several tunnels and 1.3 km of bridges and shaped by the slopes of the Tijuca massif over the ocean) and the Lagoa–Barra highway, which were concluded at the end of the 1970s, improved access to areas near the sea. The routes connected the southern zone to Barra da Tijuca, and they ended at the highway Avenida das Américas, running parallel to the sea. At the same time, Via 11 and Avenida Alvorada were built, running perpendicular to Avenida das Américas, which consolidated the Barra–Jacarepaguá connection and created new opportunities to improve the access to Jacarepaguá through the northern zone of the city (Fig. 4.10).



Fig. 4.10 Urban occupation scheme of the case study until 1970 (Detail: Avenida das Américas, Ayrton Senna and tunnel) (Source: Author)

Because of the very low relief of the terrain, it was necessary to implement extensive embankments along the entirety of Avenida das Américas and Via 11. At the same time, there were improvements in the urbanization of the routes in the secondary roadway network, with the implementation of pavement and service infrastructure.

The construction of infrastructure was clearly concentrated toward the sea, for this area promised greater development in terms of luxury houses, which demanded the presence of the sea and ample views, modern commercial and service centers, and tourism. Tourism had been increasing considerably because of the expanded use of the area for leisure activities, which was favored by a climate that allowed open-air activities for most of the year.

Both of the more prominent routes, Avenida das Américas and Via 11, were proposed by the Pilot Plan and passed through areas where old pathways crossed; the routes run parallel and perpendicular to the sea, respectively. The routes increased accessibility to the area, differentiating internal access, related to the more immediate surroundings of the territorial unit, and external access of longer reach. Consequently, internal access was provided by the pathways to the massifs, which were paved little by little, and pathways on the margins of the flooded areas to the west of the plains, which were few and difficult to travel on and currently serve mainly as access to areas of livestock.

The more prominent routes, as a product of notable works such as tunnels, viaducts, and embankments, thus changed the original design of the transit network

of the territorial unit. On the one hand, a clear hierarchy among the roadway infrastructure was established, which as a whole marked the beginning of a change in the character of the territorial unit from a more rural area to an area of urban expansion. On the other hand, these routes established new physical relations in the territory, and were realized by works that superposed the relief of the terrain, water, and soil, in contrast to the pathways of the previous stage, which, in one way or another, were adapted to the obstacles facing their construction.

4.2.3 Settlements

The reduction of open spaces, which was stable in the 1950s owing to poor access to the area, intensified in the 1960s with the addition of roadway infrastructure. Such infrastructure allowed the continuity of the suburban expansion of Jacarepaguá and expansion in areas close to the sea.

The intensification of settlements was thus encouraged in the two most important existing concentrations: Barra da Tijuca and Jacarepaguá. In Barra da Tijuca, the initial nuclei (i.e., *Recreio dos Bandeirantes* and *Jardim Oceânico/Tijucamar*) expanded, and others were created. The existing nuclei followed the margins of the Tijuca massif, *Estrada de Jacarepaguá*, the alignment of *Avenida das Américas*, the route then called *Avenida Sernambetiba*, and the margins of water bodies (mainly the Tijuca lagoon, the *Marapendi canal*, and the sea). Until then, residential use in the form of weekend houses was the most common land use during this growth, although there was also commercial use. However, Barra da Tijuca still reflected an almost rural way of life. In Jacarepaguá, the increments in suburban neighborhoods tended to follow *Estrada dos Bandeirantes* and advanced towards the massifs.

On the one hand, the residential buildings of Barra da Tijuca sold the idea of the quality of life that could be enjoyed there. They were connected to the modern image of the Pilot Plan, environmental preservation, being next to nature, low building density, and the promise of commercial and service enterprises. This area was compared to a brand new “southern zone”, which was an extension of the coastal settlements of Copacabana, but with a different way of life from the latter, inasmuch as Copacabana already had high building density, urban insecurity, noise, contamination, few open spaces, and buildings that formed a true concrete barrier facing the sea, all characteristic of disordered occupation (Leitão 1999) (Figs. 4.11 and 4.12).

On the other hand, Jacarepaguá could be distinguished as an area on the margins, literally, of the advancement of the urban model adopted close to the sea, being consolidated as an area destined for the housing of the poorer population. An expressive sample of this reality was the settlements, promoted by the public sector, of residential complexes for the population expelled from the slums of the southern zone of the city (many of which were burned down) and resettled in “remote” places far from the centers of high purchasing power, where the price of land was low and where the complexes would not be an obstacle to real-estate enterprises. An example of this practice is the neighborhood of *Cidade de Deus*, in the center of the territorial unit.



Fig. 4.11 Barra da Tijuca in the 1970s (Source: <http://farm1.static.flickr.com>. Accessed 10 July 2008)

4.2.4 *Open Spaces*

The improvements to the roadway infrastructure increased urban occupation, and there was an increase in the real-estate value of open spaces that were between occupation and preservation. At the same time, the routes and settlements affected the relief of the terrain and the water network of the territorial unit.

Viaducts and tunnels constituted significant interventions on the relief of open spaces. On the one hand, the tunnels represented the possibility of intervention on the terrain and its vegetation at specific points. On the other hand, viaducts overcame obstacles of the relief and water, and affected the open spaces at the contact



Fig. 4.12 Barra da Tijuca in the 1980s (Source: <http://br.geocities.com>. Accessed 10 July 2008)

points between two linked parts. In both cases, compared with the case of shifting land through altering the relief to make new roads, the impact tended to be more concentrated and less extensive.

The consolidation of the roadway network, through the construction of embankments and the laying of pavement, made important changes to the water network of the territorial unit and its correlated ecosystems, mainly with regard to the separation of the lagoons and floodable areas, which were “above and below” Avenida das Américas. Additionally, the waterways of the territorial unit that were in the way of planned routes were canalized or crossed by bridges, which changed and, in many cases, reduced their beds.

Nevertheless, the construction of viaducts, highways, and the expressway enhanced the views of the area, as travelers could view the wild outlook of the open spaces back then. Although the open spaces were being urbanized, they still retained some of the fundamental characteristics of their original formation, with regard to the presence of the massifs, lagoons, and extensive rural areas.

Industrial occupation, which began in the 1970s in Jacarepaguá (Abreu 1987) and continues without strict rules regarding industrial waste, played a key role in the contamination of water and air in the territorial unit (Costa 2002). Additionally, more intense occupation affected vegetation in the area, mainly through the reduction of sandbank areas and areas of forest on the massifs, which suffered with the

disordered development of settlements in Jacarepaguá and new constructions in Barra. Settlements both in the dunes and on the massifs affected the relief of the area, contributing to the disappearance, over time, of the existing dunes and promoting the movement of land in the irregular topography of the mountains, thus increasing the risk of erosion.

Since the 1970s, occupations have fragmented the agricultural fields and pastures and thus induced greater subdivision of the properties for residential ends (Fridman 1999). The presence of larger roadways next to open spaces, protected or not, represented a danger to elements of great visual and natural value, whose likely occupation would lead to the creation of other roadway infrastructure to cater to the functional needs of the new settlements. This tended to cause more ruptures in the territory as the process continued with the consumption and impermeabilization of open spaces. At the same time, the occupation of open spaces tended to reduce the connections between the sea and mountains and between one massif and the other.

4.3 Stage 3: Fragmentation (1970–2000)

The third stage is characterized by intense urban development of the territorial unit and by incorporation of new forms of urban growth, which drastically affected the configuration of open spaces and their spatial and functional relationships with the infrastructure and settlements. There was intense urban development towards the massifs and increasing construction density in the area during this period.

The 1970s were marked by the Brazilian economy becoming progressively more dynamic and by two main movements of metropolitan expansion in Rio. On the one hand, urbanization advanced towards the municipalities on the Fluminense lowlands, starting in the northern zone of the city (urban growth marked especially by industrial activity, the presence of potent roadway infrastructure, and continuous and disordered urban occupation with the development of vast areas of slums). On the other hand, the occupation of the western zone of the city continued through the access made possible by Avenida Brasil and the railway (Abreu 1987). In this context, the metropolitan growth of the 1970s increased in the 1980s and 1990s, with the occupation of the coast towards the east and west of the metropolis, made possible by the construction of the Rio–Niterói bridge (1974).

In the early 1970s, contradictory tendencies in the occupation of the metropolis were consolidated, spatially as well as functionally. One was the direction of occupation on the Fluminense lowlands, marked by the absence of infrastructure and facilities and unplanned urban occupation and the presence of a poorer population. Another was the direction of occupation on the Jacarepaguá lowlands, mainly in Barra da Tijuca, marked by the Pilot Plan attracting a wealthier population, where the construction of infrastructure and facilities was stimulated and where there was increased real-estate speculation (Abreu 1987). The difference between Barra da Tijuca and the rest of the metropolis was such that, in 1988, a plebiscite was proposed for its emancipation as a new municipality in the State of Rio de Janeiro, although unsuccessfully (Fig. 4.13).

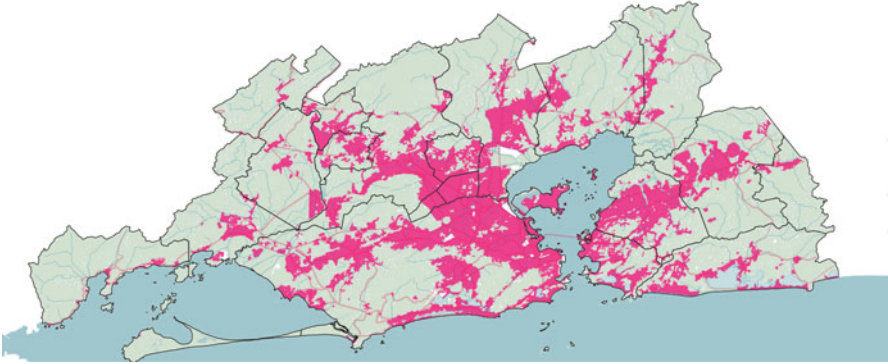


Fig. 4.13 Metropolitan region of Rio de Janeiro—urban occupation in 1994 (Adaptation of the map of RMRJ 1994, Fundação CIDE)

4.3.1 Planning

In 1974, the city-state of Guanabara (municipality of Rio de Janeiro) and the state of Rio de Janeiro merged, with the creation of the metropolitan region. There was then a new impulse of reformulation of metropolitan development, with the objective of planning urban growth and providing the territory with adequate conditions to support it.

In this sense, the creation of the Basic Urban Plan for Rio de Janeiro (Plano Urbanístico Básico da Cidade do Rio de Janeiro; Pub-Rio) (1977) intended to distribute the infrastructure relative to housing and production, and it proposed the integration of the administrative instances of management of the urban territory (Rezende 1982).

Pub-Rio, which was actually a spatial plan, laid the foundations for urban development with indications for structured occupation, roadway infrastructure, and urban services. However, it made no reference to the treatment of open spaces as a strategy in the planning, and was restricted to isolated actions on them, directed toward leisure and the need for creating squares and gardens, among other interventions. With regard to the study area, Pub-Rio maintained the recommendations of the Pilot Plan.

The general strategies dictated by Pub-Rio were to be followed by special plans, called Urban Structuring Plans (Planos de Estruturação Urbana; PEUs), which were devised for and applied over different parts of the city. In the PEUs, which are still current, open spaces had some prominence, with there being a prevalence of options for the protection of biophysical characteristics, and open spaces served as a basis for devising planning directives.

This was followed by the Urban Plan for Rio de Janeiro (Plano Diretor da Cidade) (1992), which was recently reviewed (2010). This plan reflects the growing concern relating to the protection of the environment, such as the concerns that have been

voiced since the Rio Earth Summit (1992), and it incorporates environmental content in the planning of the study area, as an area of “priority for environmental studies and subsequent modification, by law, of the planning rules currently in effect, aiming at making the use and occupation of the soil compatible with its geological characteristics”.

Parallel to the Plano Diretor, the Environmental Plan (Plano Diretor de Meio Ambiente) (1991) was devised, from which measures for the protection of nature present in environmental legislation (1994) ensued. The execution of both plans affects the study area, and a series of projects and municipal, state, and federal law decrees followed during the 1990s,³ dealing with the preservation and protection of nature. Legal measures for the protection of open spaces in the territorial unit were gradually carried out over the last three decades. The first, relating to Tijuca National Park (in 1967), and the second, relating to Pedra Branca State Park (in 1974), demonstrate the recognition by public authorities of the importance of these two reserves of open spaces as natural elements.

The Plano Diretor defines the directives for zoning, legislation, and macro-zoning in the city. In general terms, its most important provisions follow the premise that urban occupation should consolidate the main vectors of growth of the city; among them the territorial unit is hereby discussed.

Part of the plan is a detail of the Pilot Plan, maintaining its definitions and determining the spatial scope of special zone 5 (ZE-5). ZE-5, according to Decree N. 3.046, of April 27th, 1981, is subdivided into 46 sub-zones with proper zoning, subdivisions, and building conditions, and the Plano Diretor maintains the protected open spaces previously provisioned by the Pilot Plan. For the rest of the territorial unit, the Plano Diretor establishes different directives of urban occupation.

In general, the Plano Diretor does not propose the creation of new access ways to the study area, considering that there is still unrealized infrastructure predicted by the Doxiadis Plan, the Rio de Janeiro Highway Department (Departamento de Estradas e Rodagens do Estado do Rio de Janeiro; DER), Pub-Rio, and the Pilot Plan. Thus, the Plano Diretor determines greater accessibility to the area with the implementation of previously predicted routes, a closer connection between the existing infrastructure, and encouragement of alternative means of individual and public transportation, such as the use of bicycles and light rail, respectively. At the same time, it highlights the need to encourage integration among the neighborhoods of the lowlands and between those neighborhoods and the western and northern zones of the city.

One of the intentions of the plan was the creation of programs of sales of urbanized lots and the construction of housing for the low-income population to avoid disordered occupation of public open spaces on the Jacarepaguá lowlands.

With regard to open spaces, the plan defines instruments of protection (some new and some previously established), such as environmental conservation units, areas

³ The end of the 1980s was marked by the transference of environmental laws in Brazil from state or federal jurisdiction to municipal jurisdiction.

of permanent protection, and non-buildable areas. (Further details on planning can be found in Sect. 5.4).

It is worth noting that the plan mentions the observance of biophysical and perception attributes of open spaces relating to their occupation; e.g., the devising and execution of a large-scale plan for drainage and land filling; the definition of areas to compose the landscape heritage of the city subject to environmental protection; and the revision of the occupational criteria of the area considering geological characteristics.

Thus, the Plano Diretor added environmental criteria to the provisions of urban occupation of the area and preserves criteria given in the Pilot Plan, and it generally tends to adopt protective policies over open spaces.

4.3.2 Roadway Infrastructure

During the 1970s, there were several constructions of roadway and urban service infrastructure, with the expansion of the main avenues and roads. These works announced the transformation of these routes into transportation corridors and commercial and industrial axes adapted to the needs of urban occupation of the territorial unit. However, the expansion of infrastructure was insufficient compared with the existing demand in the area, especially in terms of the water supply, sanitation, and electricity.

The 1980s were years of crisis. At the end of the 1970s, the Brazilian economy entered a period of crisis owing to, among other things, surging oil prices, which led to a drastic drop in infrastructure investment and construction. Even so, the process of urban occupation continued in the study area.

Only at the end of the 1990s was the most important roadway intervention in the study area made. This was the construction of the expressway Linha Amarela, in 1997, which was already conceived in the Doxiadis Plan. The expressway passed between the neighborhoods of Jacarepaguá and the Tijuca massif, as a continuation of Avenida Ayrton Senna, and it was an alternative in terms of access to the area and as a connection between the northern zone of the city and the metropolitan region.

The construction of the expressway included the construction of tunnels and viaducts (Fig. 4.14). Unlike the open routes constructed in the previous period, the viaducts not only passed over water but also superposed the settlements and the existing access. In many sections, a route passed directly over soil, and embankments and other adaptations divided existing open spaces. Settlements were also affected because the routes did not establish close links with their surroundings, sometimes dividing the settlements into parts. On the one hand, the overlap affected the original roadway network, which was originally hierarchical. On the other hand, the segmentation resulted in open spaces that remained on the side of the road, without any specific function in relation to the route or its surroundings. Additionally, there were other open spaces related to the roadway functions, such as roundabouts, for which there was no specific management. In both cases, the basis for the expressway project was its urban functions of fast traffic flow and the



Fig. 4.14 Urban occupation scheme of the study area until 2000 (Detail: the Linha Amarela expressway and tunnels) (Source: Author)

connection of functional areas with different activities, without establishing links with open spaces and the rest of their surroundings.

The connections to the metropolis made possible by the expressway not only provided new opportunities of access but amplified the attractive attributes of commercial and service centers in the study area, and presented great tourism potential.

4.3.3 Settlements

The expressway significantly improved access to the study area, as it provided an alternative to the nearly exclusive access through Avenida das Américas and facilitated urban occupation. This promoted new real-estate investment, which is still part of the current development framework of the territorial unit. These occupations tended to take place in Jacarepaguá and Barra da Tijuca, although the greater supply of open spaces in Barra probably reveals its greater propensity to urban growth.

The intense real-estate pressure in the territorial unit, mainly in Barra da Tijuca, grew stronger in the 1970s. During this decade, the territorial unit had a special organ for the implementation of the Pilot Plan, namely the Superintendence for the Development of Barra da Tijuca (Superintendência para o Desenvolvimento da Barra da Tijuca; SUDEBAR). SUDEBAR was related to the municipal government, which guaranteed the implementation of the directives for new settlements. At the end of the 1970s, there was a crisis in the area owing, in part, to the inadequacy of the Pilot

Plan in meeting existing needs, and also to an absence of capital and the need for more infrastructure. To solve these problems, changes were made in the planning for Barra da Tijuca, with respect to issues of infrastructure, public transportation, new parameters of urban occupation, and incentives for tourism, which included the construction and sale of residences for temporary use and the prediction of low-income settlements (which were not implemented).

In this context, the original indications of the Pilot Plan for urban occupation changed over time,⁴ especially with regard to the conditions of subdividing land, the density of settlements, and the land use originally predicted in the plan. We also note the emergence of slums (with minimal lots and no infrastructure or facilities) and condominiums⁵ (immense, closed areas, with infrastructure and facilities, having certain functional autonomy) as elements that were not predicted in the Pilot Plan (Leitão 1999).

The high-income population is found near the sea. Over time, this part of the territorial unit attracted not only corporate headquarters, which used to be in the traditional center of the city, but also large commercial, corporate, and service structures, located along the main routes. Industrial and educational centers emerged, joining the large public facilities already present in the area (i.e., a racing track, convention center, and airport).

From the late 1980s to the present day, there has been a densification of construction on the plains, in Barra da Tijuca (Figs. 4.15, 4.16 and 4.17) as well as in Jacarepaguá (Fig. 4.18).

This affected the intensification of the two movements of urban occupation identified above, which still persist today. The first was close to the sea and around the main routes, and towards the west of the plains. This occupation had more facilities, infrastructure, and public open spaces. The second movement of occupation, in Jacarepaguá, was mainly towards the margins of the massifs, and had the characteristics of discontinuous development, the addition of randomly subdivided land, no planning, and an urban structure that was apparently disordered in that it lacked proper infrastructure, facilities, and public open spaces. Thus, the position of Tijuca and Jacarepaguá lagoons, strategically in the middle of the plains, means that the

⁴Some of these changes in the Pilot Plan were regulated by Decree N. 3046 of 04/27/81. However, despite the growing density of the area, the spatial transformations not predicted in the plan created many problems, which included the absence of an adequate sewage network, traffic saturation, and environmental degradation (PCRJ 1991).

⁵Condominiums are characterized mainly as closed areas with walls and fences that do not allow direct contact with the surrounding area. Generally, they have ample open spaces and services, serving the needs of the population living there, replicating part of the city. Some also possess facilities for collective use, such as schools, which are open to the outside community. In fact, condominiums are an adaptation of proposals for the settlements of residences made in the Pilot Plan, although it proposed, among other modifications, their closing. One of the intrinsic ideas for such places is the realization of needs without people having to leave their vicinity and without allowing free entry. Everything is controlled, and not only social mingling but also contact with the city is avoided, creating self-serving islands that tend toward spatial, functional, and social fragmentation. These are islands that are sold as safe havens without urban disturbances.



Fig. 4.15 Aerial view of the study area (2001) (Photo: Rodrigo Rinaldi)



Fig. 4.16 Aerial view of the study area (2001) (Photo: Rodrigo Rinaldi)



Fig. 4.17 Aerial view of the study area (2003) (Photo: Author)

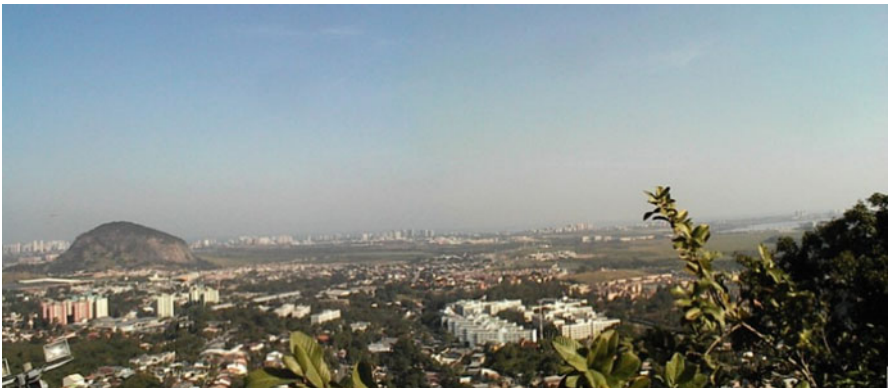


Fig. 4.18 Aerial view of the study area (2003) (Photo: Author)

lagoons served as boundaries and, at the same time, an area of transition between the two occupations.

Today, the area around the lagoons tends to be an area that is increasingly more valued for structured occupation owing to its proximity to local, municipal, and metropolitan reference points and the presence of important axes of commerce and services (Avenida das Américas and Avenida Ayrton Senna). Its margins are now

occupied by large commercial infrastructure, companies, universities, and residential complexes.

On the margins of the Tijuca massif, settlements mostly take the form of low-density and middle/upper-class residential urbanization, although there are also slums and illegal subdivisions. The same is seen in Jacarepaguá, in the occupation of the margins of the Pedra Branca massif, although there are sanitary facilities. In Vargem Grande and Vargem Pequena, to the west of the plains, the occupation consists of small farms and low-density residential urbanization. Many of these residences were used, until not so long ago, as a second residence, whose owners lived in the more consolidated centers of the city, and the residences later became their primary residences. The desire for ample views and distance from the noise of the city, with bucolic surroundings and closeness to nature, attracts real-estate investment and is representative of the tendency of occupation of the slopes of the massifs.

In this context, the location of settlements is important, especially those destined for commercial and service uses. The location of settlements is directly related to the presence of roadway infrastructure. In fact, many of the settlements that have come into being since the late 1970s are representative of a tendency towards isolation and introversion, taking the form of commercial structures, offices, condominiums, and metropolitan facilities. These buildings have resulted from large real-estate operations that occupy immense lots, which are little related among themselves, except for the movement from one to another made possible by the roadway infrastructure. This highlights the tendency towards the unilateral character of settlement–route relations, with certain annulment of the surrounding area.

It can be argued that many of these settlements represent a more general trend that goes beyond the territorial unit itself. Urban occupation is inclined to be independent of location and have the same morphological and functional characteristics anywhere, not necessarily establishing relationships with the physical and socio-cultural structure of the place, except those strictly necessary for its functioning. Contrary to the first settlements built in the territorial unit, these settlements are disconnected from the broader context of the area, being more related to a functional dimension on a metropolitan scale.

The ideal of a place that would assert a new way of life and that would embody the most modern face of the city was built side-by-side with poverty. All this was the origin of the spatial, functional, and social fragmentation of the area, and the subsequent deterioration of open spaces.

4.3.4 *Open Spaces*

The role of open space as predicted by the Pilot Plan was not fully consolidated. Open spaces were gradually turned into spaces waiting for occupation without any real role in the urban structure of the place. Open spaces were almost a victim of urbanization, owing to the loss of their original identity, as natural or agricultural



Fig. 4.19 Aerial view of the study area (2001) (Photo: Rodrigo Rinaldi)



Fig. 4.20 Aerial view of the study area (2001) (Photo: Rodrigo Rinaldi)



Fig. 4.21 Aerial view of the study area (2001) (Photo: Rodrigo Rinaldi)

areas, or to their treatment as isolated spaces, environmentally protected and often threatened by the pressure of urban occupation (Figs. 4.19 and 4.20).

One could argue that even though there are large unoccupied areas in the territorial unit, on the plains as well as on the mountain slopes, the pressures for occupation are distributed everywhere, to a larger or smaller degree, depending on physical conditions (e.g., access, relief, soil, and infrastructure) and functional conditions (especially the existing supply of services) favoring occupation.

In the urban occupation of the territorial unit, open spaces were quickly dismantled with the more accentuated occupation of the plains and the slopes of the massifs, which began in the previous period. The large geographical configurations tended to be ever more isolated, in terms of the relationship between the massifs, the relationship between the lagoons, and the relationship between the lagoons and the sea. Open spaces, besides the large natural reserves, acquired a discontinuous character, and the dispersed structure reduced the perception of their possible role as structuring elements of urban occupation (Fig. 4.21).

The main effects of the construction of roadways and settlements were modifications of the relief of terrain, the greater probability of fire, the even more accentuated contamination of the soil, water, and air, the illegal exploitation of natural resources, the irregular occupation of risk areas, the deterioration of hydric continuities, and the removal of vegetation. These transformations reduced the diversity



Fig. 4.22 Aerial view of the study area (2003) (Photo: Author)



Fig. 4.23 Aerial view of the study area (2003) (Photo: Author)

of natural mosaics in open spaces, which involved the degradation of vegetation and courses of water, the magnification of the risk of flooding and erosion owing to changes in the courses of water and consequently the water cycle, and the loss of vegetation (Figs. 4.22 and 4.23).

The changes in open spaces also reflect new activities in the 1980s and 1990s, with the emergence of private spaces destined for leisure, such as theme parks based on water activities, next to the Pedra Branca massif, and the golf course next to the Tijuca massif. Both spaces belong to clubs and are characterized by their closed nature, with gardens dedicated to leisure. By way of analogy, one could argue that, in a similar way to the settlements being enclosed, these spaces also tend toward isolation from their surroundings and to subsequent spatial segmentation.

These are spaces for which there has usually been a change away from the original vegetation, even though, in many cases, they can benefit water continuity. These open spaces depend on good accessibility and tend to reinforce the condition of social segregation in terms of opportunities of leisure.

In contrast, the emergence of parks around the Tijuca lagoon, mainly owing to initiatives of the private sector, reveals greater concern about the maintenance of open spaces near or within the settlements. Efforts have been made to recover their ecosystems (Chacel 2001). Some parks are open to the public, which increases the supply of public open spaces in the area. Many of these investments intend to combat the ever present threat of illegal occupation on the margins of water bodies in areas having higher market values.

The growing occupation of rural areas has entailed, besides greater subdivision of properties, the emergence of tension. The introduction of uses that were alien to agricultural activity, such as educational facilities or theme parks that attracted people from outside the area, gave rise to a different movement in the existing dynamic, parallel to the increase in market value of the area and the construction of more infrastructure, which reduced activities related to the land and tended towards residential, commercial, and service uses.

The open spaces of the study area (with total area of approximately 30,000 ha) are a product of the segregation of the landscape over time, the main consequence of which was the fragmentation and disarticulation of these spaces. This process of degeneration reflects a loss of the relationships established among the open spaces in the first period of analysis. The process removed or corrupted the attributes that determined the biophysical and visual qualities of the area, as well as the connections between the spaces themselves and between the spaces and the urban occupation, being settlements or roadways.

Today, the open spaces that exist in the territorial unit are mainly large, resulting from the type of occupation and subdivision⁶ of the land throughout history. Considerable portions belong to individuals, usually private owners,⁷ who have established a clear policy of forming land reserves (Fridman 1999).

The current subdivision of the study area (Fig. 4.24) is characterized by a confusing legal status. In many cases, there are no property titles. This is a situation that exists in other parts of Rio de Janeiro. It is common to identify the occupation of the land as that by “squatters”, people who illegally take possession of lots by invading the land, establishing their property, and often promoting new divisions of the land and/or selling them to third parties, with no property titles (something that has happened since the sixteenth century)⁸ (Fridman 1999).

⁶ It was not possible to obtain the charter for the case study from municipal authorities. A morphological reading of the subdivision of the open spaces is presented following the interpretation of orthophotos according to digital mapping carried out by Instituto Pereira Passos (1997).

⁷ Of the area of 15 km² in the region of Barra da Tijuca comprising the neighborhoods of Barra, Recreio dos Bandeirantes, Joá, and part of Jacarepaguá, 7 km² has belonged, since 1958, to ESTA (Empresa Saneadora Territorial e Agrícola S.A.). [...] This company partially succeeded Credito Móvel Bank, which bought the lands of Camorim, Vargem Grande, and Vargem Pequena in 1981. They were transferred to the bank when Companhia Engenho Central de Jacarepaguá ceased to exist. These companies had bought from Mosteiro de São Bento [St. Benedict’s Monastery], which in turn, received a great part of the land as a donation from Dona Vitória de Sá in 1667.

There are 3 km² that belong to Carvalho Hosken in a place called Saco y Saquinho [...], and 1 km² in Recreio dos Bandeirantes. There is still 1 km² that belongs to the Ramos brothers, businessmen, [...]. There are other large glebes that total about 3.8 km². Of this total, 2.5 km² belongs to civil construction companies. (Fridman 1999, pp. 246–7, translated from the original)

⁸ In the area, this practice contributed in the second half of the nineteenth century to the division of large rural properties, allowing the “squatters” to keep the lots they already occupied, through legalization of their properties. Likewise, the abolition of slavery, at the same time, forced some of the owners of large properties to abandon their crops and livestock, while they divided and sold the land, making urbanization possible (Fridman 1999).

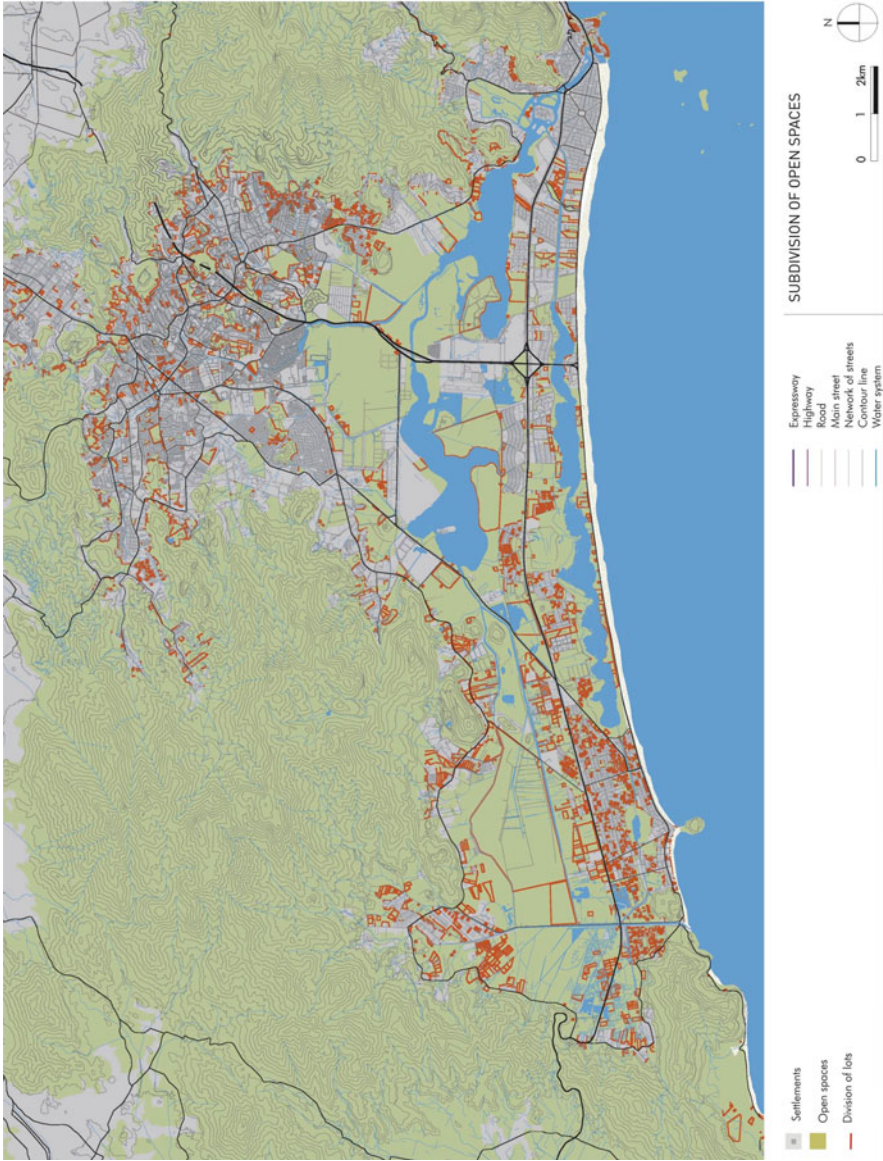


Fig. 4.24 Map of the morphological reading of the subdivision of open spaces

The subdivision of these areas does not follow clearly defined criteria, and divisions are apparently random, mainly on the plains. However, the rationale of the division of lots is related to access and water, especially if one considers that there are few spatial references for the subdivision of the land relative to the flat relief and also the need for a lot be accessible and drained. Thus, the geometry of the lots varies and it is not possible to establish stable criteria or a replicable order.

4.4 Synthesis: Open Spaces to Be Analyzed and Roles that They Can Play in Structuring Urban Occupation

It is clear that open spaces have played a small role in the structuring of the study area over time if we consider how they were treated in the process of constructing roadways and settlements and in planning. In general, there is an overlapping of criteria in the process of configuring the territory: the logic for the construction of roadways and settlements on the one hand, and open spaces, as isolated and/or protected “portions” of the territory, on the other. The highlighted absence of a recognizable structure of open spaces is presented as an apparent disorder. Today, most open spaces remain unoccupied, mainly as directed by plans, although they are constantly under pressure of urban occupation, “legal” or “illegal”. Elements and processes of the set of open spaces, roadways, and settlements are not strongly related to one another, which is characteristic of a fragmented framework (Fig. 4.25).

However, in the study area, there are open spaces that have a character similar to their original character, and open spaces that have somehow significantly changed. The most significant geographical characteristics have been preserved for the massifs, mangroves, beach, and spaces subject to some kind of protection, whereas open spaces that became vast extensions of rural land, vacant lots, and areas of land reserves have generally severely deteriorated in biophysical and visual terms.

In fact, the importance of open spaces in the structuring of the study area was restricted to the conditions imposed by the marked topography of the massifs and the nature of the spaces, such as the floodable nature of fields, which hindered urban occupation in a practical sense. However, most of the time, the logic applied in the construction of roadways and settlements overcame the obstacles offered by open spaces through the application of engineering technologies.

Initially, the implementation of roadway infrastructure was a process of “accommodation” in regards to open spaces, respecting the attributes of open spaces by, for example, following the topography and water courses. In part, this process conformed to the urban needs at that time, when the area was a rural space far from the traditional center of the city. Later, the main roadway infrastructure was conceived as highways and the expressway having a “closed” character. This had a negative effect on open spaces, if we consider the fragmentation of the spaces, the separation of spaces, and the creation of open spaces that were merely project remnants and

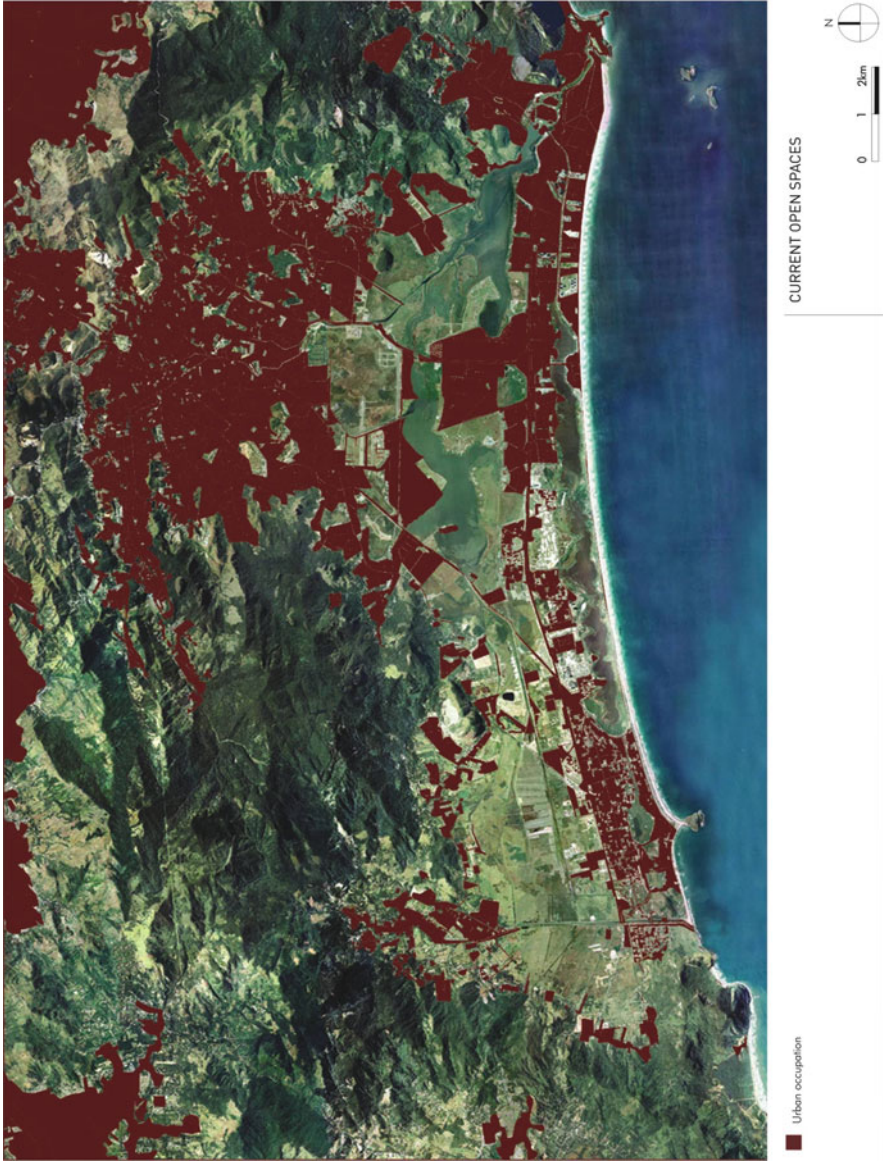


Fig. 4.25 Current open spaces (Adaptation of an orthophoto mosaic obtained from Instituto Pereira Passos 2000)

without defined character, such as roundabouts and side spaces. These modifications were made through interventions that changed the relief of the terrain, water courses, and vegetation, and thus also the visual perception of open spaces. Additionally, the presence of territorial roadway infrastructure allowed the construction of more settlements, thus diminishing the surfaces free from urban occupation.

Settlements gradually occupied open spaces, transforming their conformation and imposing limits on them. Most settlements followed introverted patterns (related to their form and use) or patterns without clear order. In both cases, the main relationships established in the conception and construction of the settlements were between the settlements and access to roadways, sometimes considering the proximity to the beach, main canals, and forest, if they afforded beautiful views and leisure, commercial, and tourism opportunities. In the settlements, the water and topographical conditions, as structuring elements, played a secondary role and were modified, usually by canalization or land movements in accordance with the demands of the type of settlement. The vegetation, in general, was not considered in this process but treated as a residual element that could be removed, unless it had functional value according to the use and commercialization of the settlement. In this context, in many cases, the settlements, illegal or not, were not connected or interrelated, and there were scarce spatial and functional relationships between the settlements and the open spaces in the middle of the plains. Thus, open spaces in the middle of the plains appear more like spaces that separate settlements than spaces that integrate settlements in a physical, biophysical, visual, or social sense.

In the spatial planning of the study area so far, the Agache Plan (1930), Doxiadis Plan (1965), and Pub-Rio (1977) conceived the metropolis from the standpoint of artificialization and attempted regulation and control, whereas some plans, such as the Plano Diretor of 1992 and the PEUs, have considered the protection and management of open spaces. However, there is yet to be a conception of open spaces in a system as restructuring elements of the territory in an integrated way, which would consider the close relation between open and occupied spaces in planning the system and structuring urban occupation.

Open spaces have long suffered a process of disintegration during urban occupation and are largely without defined character relative to the urban structure. In this context, some open spaces have pre-established status (e.g., parks, productive agricultural fields, and natural reserves) and some are often what is “left over” after large occupation, both as the remains of roadway construction, market reserves of space for urban development, and “worthless” remains of settlements and roadways, and as non-productive agricultural fields. This lack of character relative to the urban structure can be reinforced by the tendency of spatial planning to consider environmental legislation and its restriction as “limits” to urban occupation. Thus, the logic of urban occupation is juxtaposed with the “logic” of environmental legislation, and neither tends toward systemic thinking. From this perspective, the urban occupation and open spaces coexist within the territory under different statuses: as protected natural areas, areas already occupied, and unprotected areas designated for new urban occupation. The above leads to the insularity of open spaces, which reinforces the almost complete absence of structural relations between open spaces and settlements and roadway infrastructure.

In this context, it is possible to recognize characteristics of open spaces that will allow analysis and proposals for action on the unit as a whole in order to plan the system of open spaces and structure the urban occupation. Among other aspects, we can identify the following.

- The fragmentation of the urban context, highlighting the need for intervention to reverse the fragmentation of the territorial frame, thus integrating urban occupation, which reinforces the importance of the maintenance of the open spaces, irrespective of whether the open spaces have biophysical and/or visual perception values, and the incorporation of the open spaces in urban occupation projects.
- The fragmentation of the bio-physical matrix, highlighting the need for intervention to recover the courses of water, the ecosystems, and the stability of the soils for example, and insert the biophysical elements and processes into the structure of the urban occupation as directives of the urban occupation, favoring a more balanced development.
- The loss of visual quality, showing the need to identify and preserve the significant visual attributes of open spaces, and integrating the perception of open spaces as a structuring element in urban occupation projects.
- Necessary consideration of the accessibility of open spaces and its consequences as it allows activities and urban occupation, and of the adequacy of the construction of roadway infrastructure in terms of the elements and processes of open spaces.
- The need for planning that focuses on the protection and sustainable development of open spaces, along with consolidation of the system and urban occupation in an integrated way, through consideration of the system of open spaces as a guideline for the construction of the urban territory.

In this context, consideration of the roles that open spaces can play in structuring urban occupation may indicate possible directives for maintaining these spaces free from occupation or conducting occupation under certain conditions, mainly if spaces in the middle of the plains appear more like fragments in urban occupation than spaces that structure urban occupation.

In this situation, one can find open spaces of high environmental and visual value that are not yet protected; environmentally less valued areas that can recover and provide biophysical and visual connections; and areas that, even without having significant biophysical attributes or visual perception values, may play important roles in the planning of the system of open spaces and in structuring settlements and roadways. It is important to reinforce that any of these spaces can play the role of structuring the urban occupation; however, the third group are spaces that, owing to the lack of special attributes related to their biophysical support or visual perception, deserve attention in terms of their maintenance as open spaces as part of the system of open spaces. In total, acting on these spaces would allow the creation of new relationships between elements and processes in the territory toward its restructuring. This reinforces the potential of open spaces as elements that structure settlements

and roadways and join the people that inhabit the territory, thus transforming open spaces in the urban structure into structuring spaces and conforming their associated processes to the needs of the urban occupation.

The incorporation of open spaces as a structuring element of the urban occupation considers the elements and processes of the open spaces and the spatial and functional needs of the occupation, resulting in an integrated landscape where roadways, settlements, and open spaces are together and interconnected. The open spaces can be elements that offer the possibility of having vegetation and water in direct connection with settlements and roadways, they can be places for social events, they can add positively to perceptions of parts of a city and their interrelationships, they can be exploited for tourism and agriculture, they can reinforce the economic value of an area, and they can be a basis for the structuring of urban occupation.

The analyses presented here thus highlight the opportunity that arises from planning the system of open spaces as a restructuring element of the territory, as a possible guideline of spatial planning and a backbone of the urban structure.

Chapter 5

Analysis and Evaluation of the Attributes of Open Spaces: Identifying Possible Spaces of Project Opportunity and Their Situation in the Territory

This chapter analyzes attributes of open spaces: the biophysical support, visual perception, accessibility, and links to planning rules. The proposal is to evaluate each attribute according to specific parameters and a scale of values. It is thus possible to design an initial approach that can designate territorial open spaces that are most suitable to be preserved as unoccupied areas and those that can be occupied under certain conditions, as part of a system of open spaces. The analysis is based on the following parameters.

- Attributes of biophysical support. The analysis evaluates the attributes of the biophysical support of open spaces that contribute to the maintenance of the spaces' natural processes and their recognition as a basis for the structuring of urban occupation. The spaces should remain for this purpose of maintenance and they are very sensitive to exploitation and urban occupation. To this end, the elements that are examined are vegetation, hydrology and slope gradients, and edaphology (where the edaphology is analyzed but not considered in the final evaluation of the biophysical attributes of the spaces, being more a reference).
- Attributes of visual perception. The analysis assesses the attributes of open spaces from a visual point of view, reinforcing the importance of their permanence according to the site's physical peculiarities and as determinants of urban occupation. This analysis focuses on scenic elements, areas with visual prominence, scenic backgrounds, and open spaces of historic and cultural interest.
- Accessibility. The analysis measures the degree of accessibility of the open spaces in the study area, already existing and potential (according to the transport routes planned), to identify spaces for which access increases or decreases the possibility of occupation and/or any other activity.
- Links to planning rules. The analysis of planning rules assesses the protection parameters for open spaces, which are either susceptible to urban occupation or under some measure of strict protection, to identify open spaces that are more or less assured by current planning as being spaces free from occupation.

This evaluation indicates possible *spaces of project opportunity*. These spaces are *anchor spaces*, *reference spaces*, and *other open spaces*. The spaces judged to

have the best attributes of biophysical support and visual perception are prioritized. Open spaces are designated *anchor spaces* if the value of their attributes is high/medium-high, *reference spaces* if the value of their attributes is medium/medium-low, and *other open spaces* if their attributes are deemed to have no value.

The *situation* of the *spaces of project opportunity* in the territory is determined according to the above evaluation and the urban dynamics in which the open spaces can be inserted by identifying the main continuities and discontinuities among the spaces and the characteristics of their borders while taking into account the possible roles the *spaces of project opportunity* play in terms of the system of open spaces and the structuring of urban occupation, as data for the planning of the system of open spaces and restructuring of the territory. This may indicate the importance of essential dynamics of the *spaces of projectual opportunity* related to the urban context, biophysical support, and visual perception. This reinforces their preservation as unoccupied areas and their structuring character in the construction of the territory, as bases for final *project strategies*.

Later, the possible assurances of and threats to the *spaces of project opportunity* that are to be maintained as open spaces or designated for urban occupation are analyzed according to the final evaluation of the parameters of protection established through existing planning rules. This determines the tendency for occupation and the importance that territorial open spaces not yet protected have as elements with an essential role to be played in final *project strategies*.

5.1 Attributes of Biophysical Support

To assess the attributes of the biophysical support of open spaces, it is sought to identify the vulnerability of the spaces to exploitation activities and urban occupation. In this way, the natural elements and processes of open spaces can be maintained through the non-occupation of the spaces or through occupation that focuses on the incorporation of these attributes in the structure of settlements and roadways. For this purpose, we describe and evaluate the following variables.

- **Vegetation.** Priority is given to the vegetation less changed, in terms of how it has changed from its original configuration.
- **Hydrology.** Priority is given to places most exposed to floods and landslides, given the need to preserve places essential to water dynamics.
- **Slope gradients.** Priority is given to places less vulnerable to landslides, according to the slope and soil conditions they present.
- **Edaphology.** The land most suitable for agricultural use is determined. Open spaces that are more suitable for agriculture can be a prime factor in the choice of land use and activities compatible with or appropriate for a particular space. Note that the analysis of edaphology should be taken into account in the characterization of open spaces, although it is not been part of the final evaluation of biophysical attributes.

5.1.1 *Vegetation*

When considering the maintenance of natural processes in the system of open spaces, it is assumed that the conservation of vegetation acts in the opposite direction to change in a given ecosystem. Thus, the less altered the vegetation, the greater the conservation of its original structure and its natural processes will be. Vegetation communities that have changed more tend to have degraded or need additional resources, such as human labor and chemicals. Therefore, the communities are generally less self-sufficient and have the largest changes in structure, which often compromise the quality of their ecosystems (Hough 1995, Odum and Sarmiento 1998, among others).

From this perspective, the less altered vegetation is indicative of components of high ecological quality, which are essential to the functioning of natural processes in the system of open spaces. The most altered vegetation, by contrast, may be of varying importance; changes to vegetation may be positive if they aid the development of natural processes, or negative if they represent a risk to these processes owing to degradation or incompatibilities associated with the type and/or manner of exploitation.

To assess vegetation, the degree of alteration of each vegetation community is taken as a parameter.

- Less altered vegetation communities have suffered little or no change to their original structure or have recovered.
- Most altered vegetation communities have had their original structure greatly altered or degraded.

To measure the degrees of alteration of vegetation in the case study, the current uses of open spaces and the way that they have affected the original structure of the vegetation were observed. Additionally, the results of official state studies¹ were considered (Fig. 5.1).

The most exploited open spaces are those used for agriculture and the farming of livestock; these open spaces are located to the west of the study area. On the plains, there is agricultural cultivation for subsistence, flowers, and livestock. Most banana cultivation is distributed on the slopes of the massifs. The introduction of agriculture and livestock has contributed to the transformation of vegetation in floodable areas and the deterioration of forest nearer agricultural production. However, although marshlands suffer agro-livestock consequences, as they are not favorable for agro-livestock exploitation, this fact favors the maintenance of important aspects of their original ecosystem.

Extents of forest include the natural reserve headquarters, which include infrastructure for collective use and the promotion of leisure and eco-tourism activities but without compromising the forest structures. Well-conserved forest areas can also be found on industrial properties and in some areas of community facilities. As an example, it is worth mentioning the psychiatric hospital Colônia Juliano Moreira (on the margins of the Pedra Branca massif), which envelops part of the forest area

¹The public sector offers no detailed studies, just general information, on the flora and fauna present in the region, which limits the analysis.

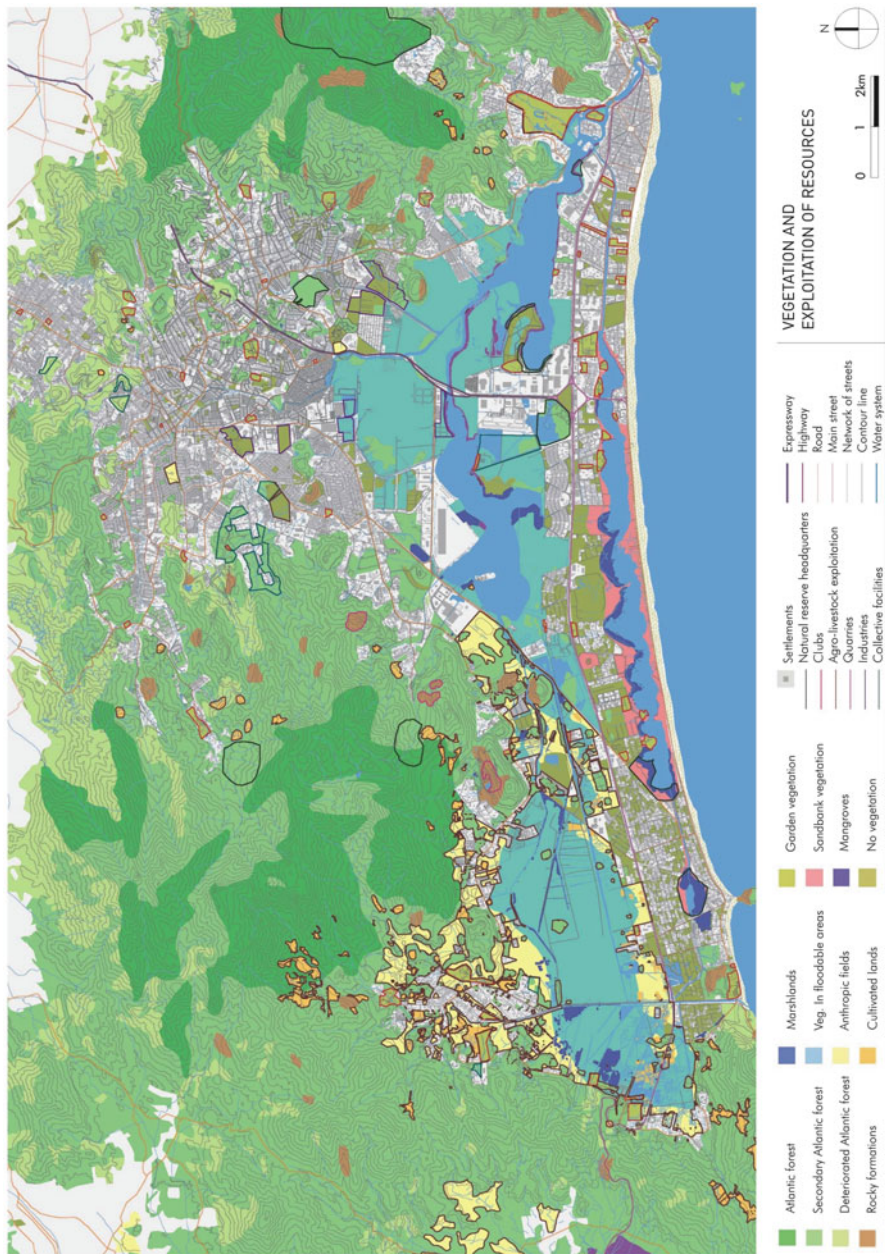


Fig. 5.1 Map of vegetation and exploitation of resources

of the massif. Quarries, some being active and others decommissioned, can be found amid the forest on the margins of the Pedra Branca massif, and they are responsible for degradation of vegetation on the slopes of the massif (Costa 2002). However, the forest areas most affected by exploitation are generally those having degraded vegetation. These areas correspond to areas of deforestation and generally serve as pasture or are not used. Gardens of smaller dimension are open spaces used for club headquarters, and include gardens of golf clubs, water parks, campsites, private clubs, public gardens, and industrial and collective facilities. In general, the gardens comprise cultivated vegetation, which is not original vegetation, and indeed, original vegetation has degraded in some cases.

Areas of mangrove vegetation and sandbank vegetation are generally not targets of heavy use, because they are either already protected spaces or unsuitable for certain activities. Still, there is a trend for clubs to be located in these areas, especially in areas originally covered by sandbank vegetation, which has led to the removal of part of the original vegetation and the transformation of the spaces into gardens. In general, these areas of vegetation are conserved, although they suffer the effects of water pollution, illegal landfill, and the removal of vegetation.

It is worth noting that all vegetation is important to the maintenance of natural systems within open spaces, when considering the possibility of the recovery or rehabilitation of the natural systems, as may be convenient. Thus, according to the conservation of natural systems with no fundamental exclusions, high and medium values are attributed to each vegetation community.

- *High (H)*: The most preserved communities are composed of Atlantic forest, secondary Atlantic forest, mangroves, marshlands, and sandbank vegetation.
- *Medium (M)*: The least preserved communities are composed of deteriorated Atlantic forest, vegetation in the floodable area, anthropic fields, cultivated land, and gardens.

The surfaces with more preserved vegetation dominate the mosaic of vegetation in the study area. This confirms the importance of the presence of vegetation in the territorial unit, and the potential contribution that vegetation makes to the maintenance of natural processes in the system of the open spaces and to the structuring of urban occupation.

The best preserved vegetation is also the most vulnerable to damage, and it mainly borders the most densely urbanized areas; e.g., forest and sandbank vegetation, and culturally undervalued vegetation such as the marshland vegetation. Thus, the need to evaluate and consider the preservation and management of these vegetation types is highlighted by the qualities of the vegetation.

5.1.2 Hydrology

Preserving “places of water” means to act in favor of the maintenance of natural processes in the system of open spaces. The surface water and groundwater and their dynamics of movement and flooding are crucial for the proper functioning of

the watering system of a place. In this context, besides the beds and margins of water sources, essential areas for the maintenance of water dynamics such as those that may experience flooding and/or landslides, by natural or artificial means, should be identified. Identifying these areas means to be attentive to the spaces required for water processes in open spaces, where occupation or exploitation activities may have catastrophic consequences.

Natural processes and the amount of water received or exchanged between aquifers affect the water volume and thus the water level and the risk of flooding and/or landslides. However, the risk of flooding and landslide can be increased by artificial changes in the natural dynamics resulting from exploitation or urban occupation that modifies the capacity of the bed of a water source or course. The urban occupation of water banks favors the accumulation of sediment in the beds of rivers and floodable areas, blocking the flow of water and increasing the speed of runoff and consequently the risk of flooding. The same happens with artificial canals, dams, and pipelines for the urban water supply, which adversely affect the water cycle through strangulation or dispersion of its course, resulting in an increased risk of flooding and/or landslide (Hough 1995).

The water dynamics of the study area are complex, particularly regarding the accumulation of water on the plains and the drainage problems mentioned above, which are distributed through extensive floodable areas around the lagoons and on the western side of the plains. Additionally, these areas are very close to groundwater near the surface, and there is great possibility of land movement on banks and flooding (SMAC 1998).

The rivers that drain the area receive vast volumes of rainwater that descends from the massifs in summer, which is a time of intense rainfall. There greater water volume induces landslides and severely affects the plains, increasing the chances of flooding (Costa 2002). The vast areas of steep mountains and hillsides, especially areas of higher elevation, contribute to the descent of water and sediment, and areas with gradual slopes face an elevated risk of flooding.

The risks of flooding and landslides tend to be accentuated in areas of cultivation, anthropic fields, and buildings close to the aquifer owing to, among other factors, excessive soil compaction and impermeabilization, the greater possibility of erosion on the margins, and the presence of possible bottlenecks along beds (SMAC 1998). In this context, urban occupation in areas at risk of flooding and landslides is a growing problem in the study area owing to legal occupation or illegal occupation.

Since the areas exposed to flooding and landslides include open spaces essential for the maintenance of watercourses and their dynamics, the more exposed to these natural risks that a place is, the more likely its non-occupation will be. According to this criterion, the following values are assigned to surfaces² (Fig. 5.2).

² Data Sources: Secretaria de Urbanismo e Meio Ambiente da Prefeitura da cidade do Rio de Janeiro (SMAC) (1998). *Estudo de impacto ambiental para o projeto de recuperação ambiental da Macrobacia de Jacarepaguá*. Rio de Janeiro: Secretaria de Urbanismo e Meio Ambiente da Prefeitura da cidade do Rio de Janeiro; *Mapeamento digital da cidade do Rio de Janeiro* (1997) (esc.:1:2.000). Rio de Janeiro: Prefeitura da cidade do Rio de Janeiro.

Obs³: There are no detailed studies, just general information, on the lines of flows of the waterways.

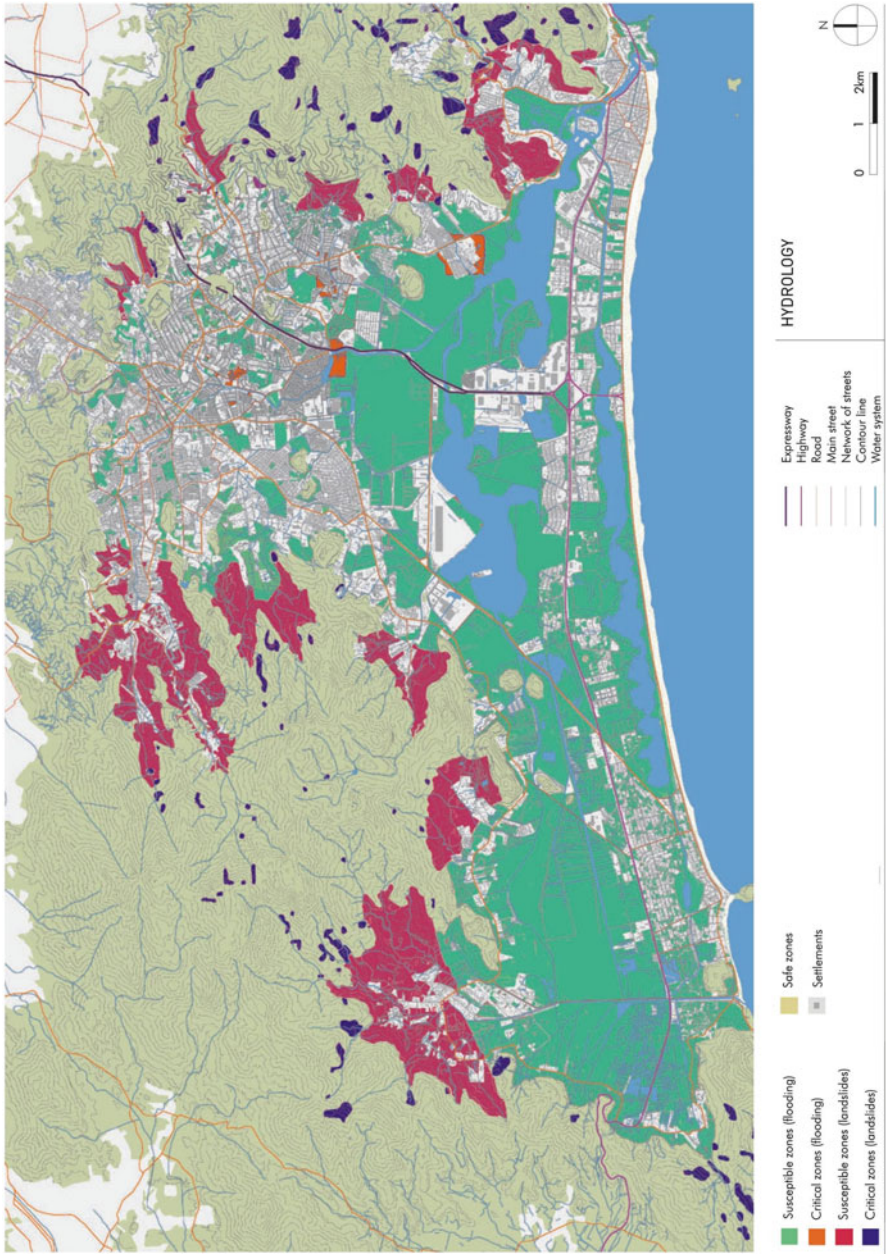


Fig. 5.2 Map of the hydrology

- *High (H)*: critical zones. Areas prone to flooding and/or landslides.
- *Medium (M)*: susceptible zones. Areas where flooding and/or landslides may occur.
- *Low (L)*: safe zones. Areas not exposed to flooding or landslides.

In the study area, the plains are a large surface area likely to flood, although the critical areas are restricted to specific points near the Tijuca lagoon and in the middle of the Jacarepaguá plains. The most critical areas include open spaces around the rivers Pavuninha, Arroio Fundo, Anil, and Das Pedras. Note that the other flat areas susceptible to flooding are currently areas of urban occupation and other interventions, which include the opening of canals for drainage, earthworks, and landfilling. These actions tend to alter water processes, thus increasing the likelihood of flooding, erosion, and sediment transportation.

The areas susceptible to landslides are concentrated mainly along the margins of the massifs, occupying almost the entire length of the western Tijuca massif and east of the Pedra Branca massif, except for the margins of Serra de Guaratiba. Here the critical areas are by contrast more isolated and largely occupy the higher altitudes of the mountains. On the massifs, very steep slopes tend to facilitate landslides, and when associated with urban occupation, cultivation, and vegetation removal, these risks can be even greater.

These areas exposed to floods and landslides are often very vulnerable and deserve protection and management with consideration of possible occupation and/or activities near the areas, and they serve as a basis for the structuring of settlements and roadways.

5.1.3 *Slope Gradient*

Observation of the slope gradient and the associated soil conditions is essential in identifying places most vulnerable to landslides. These places should not be occupied and deserve special attention in terms of possible exploitation activities, and the preservation of natural processes in these open spaces is thus prioritized. In the case of urban occupation, the physical condition of the slopes affects the possibility of access both for routes and infrastructural services, and can pose risks to occupation or even make occupation impossible.

The literature discourages the occupation of hillsides steeper than 20% if they present a risk of landslides due to enhanced erosion and desertification, especially if the hillsides have soils whose texture, structure, and permeability contribute to landslides (McHarg 1969).

A study on the Pedra Branca massif (Costa 2002) revealed that the declivities that encourage landslides are 15–45% and especially 25–45% when associated with unstable soils. This information validates previous indications. However, the indications vary according to the specific processes of urban occupation, which may exacerbate the natural risk of landslides through imposed artificialization, especially in areas of steep slopes, which are generally not suitable for occupation.

The following values are thus assigned to surfaces according to their propensity for landslides.

- *High (H)*: surfaces with inclination $\geq 21\%$.
- *Medium (M)*: surfaces with inclination between 11% and 20%.
- *Low (L)*: surfaces with inclination between 0% and 10%.

In the study area, inclinations predominantly range from 0% to 20% at elevations ranging from 0 to 25 m (above sea level). However, in the southern part of the Tijuca massif, inclinations generally vary from 20% to 60% at elevations ranging from 25 to 100 m. The inclinations in the southern part of the Pedra Branca massif reach 30% in some areas between elevations of 25 and 50 m, and generally increase from an elevation of 50 m, a phenomenon that is seen also for the Tijuca massif (Fig. 5.3).

The plains are considered a large surface that tends to be little affected by landslides. In contrast, a large part of the massifs, with very steep inclinations, would be more susceptible to landslides. Such places are thus completely unsuitable for occupation, which stresses the importance of surveillance of exploitation in these places.

5.1.4 Edaphology

One of the criteria for the analysis of the soil is its potential agricultural use. This factor may indicate the possible development of cultivation in certain areas on the one hand and the benefit of limiting urban occupation in favor of agriculture on the other hand.

Effective agriculture optimally depends on the conjunction of soil quality (e.g., fertility, acidity, and physical structure) and other factors such as drainage and the slope gradient (Turner 1998). However, some cultivation adapts to steeper declivities and many types take advantage of changes in the relief of the land, demonstrating that the relief is not ultimately an element of exclusion.

According to their suitability for agriculture, soils are classified as follows.

- Very suitable soils are excellent for agriculture.
- Moderately suitable soils require corrective measures for agriculture.
- Unsuitable soils are soils not recommended for agriculture.

According to this classification, high, medium, and low values are attributed to soils that are respectively very fit, moderately fit, and unfit for agricultural exploitation³ (Fig. 5.4):

- *High (H)*: very suitable soils

³Data source: Secretaria de Urbanismo e Meio Ambiente da Prefeitura da cidade do Rio de Janeiro (SMAC) (1998). *Estudo de impacto ambiental para o projeto de recuperação ambiental da Macrobacia de Jacarepaguá*. Rio de Janeiro: Secretaria de Urbanismo e Meio Ambiente da Prefeitura da cidade do Rio de Janeiro.

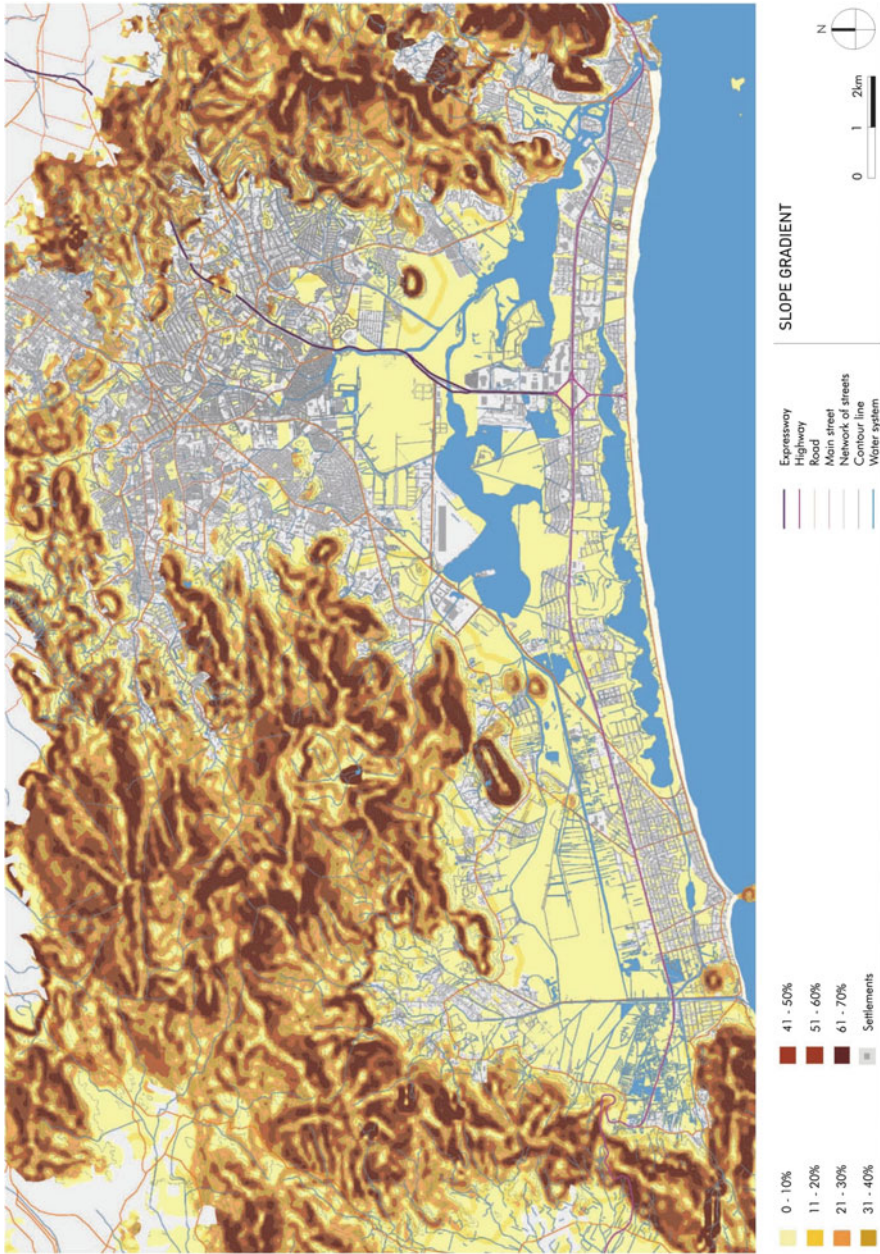


Fig. 5.3 Map of slope gradient

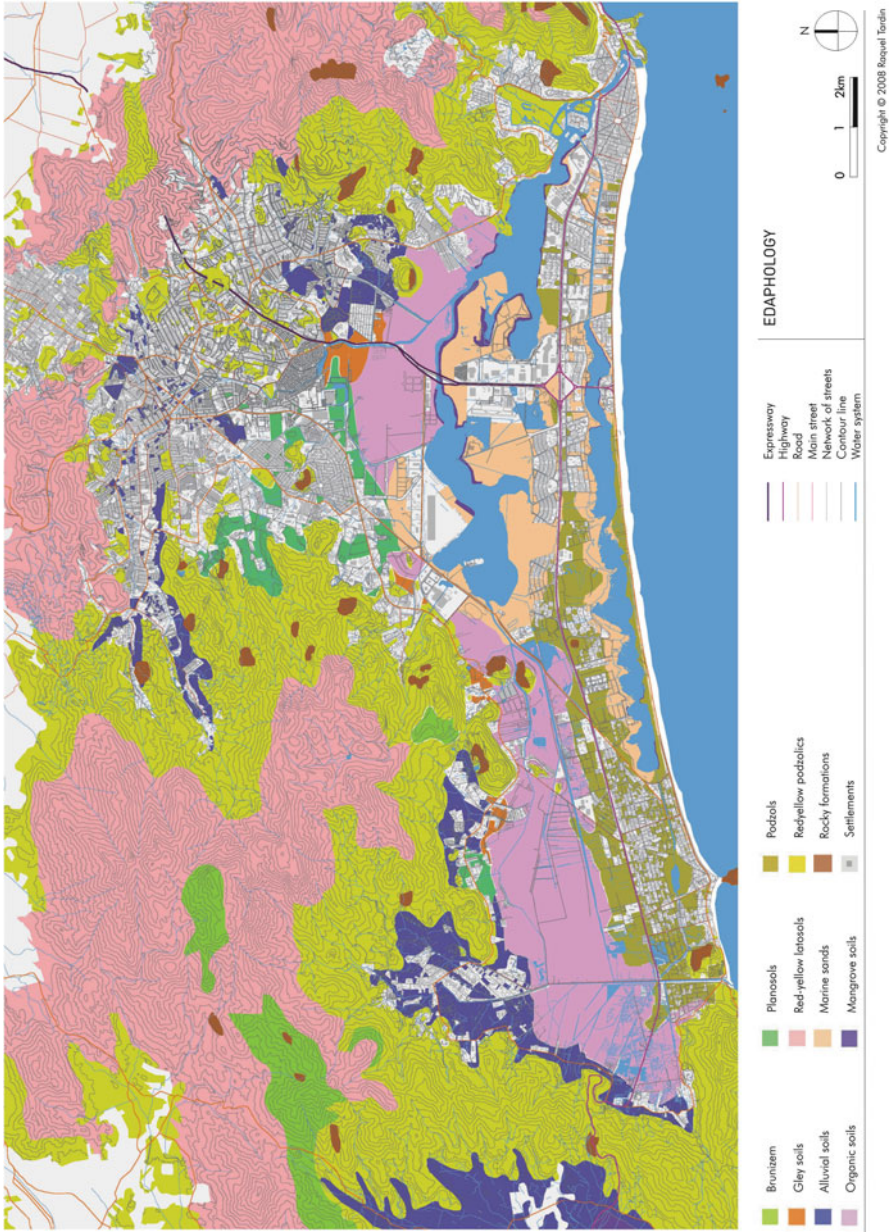


Fig. 5.4 Map of the edaphology

- Brunizem soils are well structured and fertile, although they are found in areas with steep slope gradient having high propensity to erosion.
- *Medium (M)*: moderately suitable soils
 - Gley soils are drained and somewhat shallow, and very common in the basin margins. They are found on plains and are thus not susceptible to erosion, although they limit agriculture owing to an excess of water or acidity.
 - Alluvial soils develop on flat land. The soil depth depends on the location of groundwater, while the structure depends on the nature of the materials deposited. They restrict agricultural use owing to the possibility of flooding.
 - Organic soils are less drained soils, result from the accumulation of plant debris, and are very acidic, which limits fertility.
 - Planosols have very variable structure, and suffer from excess moisture during the rainy season and dryness during the dry season. They generally develop in areas of flat terrain and are thus little affected by erosion, though the variation in water level presents difficulties for agricultural use.
 - Red–yellow latosols are very porous and well drained, and have good resistance to erosion. In general, they are found in areas of hilly and mountainous relief. They limit fertility.
- *Low (L)*: unsuitable soils
 - Marine sands are much drained, acidic, and almost always deep. They are very permeable, and are poor in nutrients and susceptible to erosion. They are not suitable for agriculture.
 - Mangrove soils are flooded, very acidic, and generally not suitable for agricultural use.
 - Podzols are deep, sandy, and acidic or moderately acidic. They develop in areas of flat terrain. They are not suitable for agricultural use.
 - Red–yellow podzolics are not particularly fertile and are susceptible to erosion. They present few favorable conditions for agriculture.

It is observed that most soils in the study area have low or moderate fertility, with the most fertile soils being concentrated at specific locations on the Pedra Branca massif, in areas with steep declivities that are generally difficult to access. It is important to note that a possible development of cultivation in forest areas is an acceleration of substitution of forest by agriculture, which would not be advisable. It is concluded that the area generally does not present good conditions for agriculture.

5.1.5 Final Evaluation of Attributes of Biophysical Support

The final assessment of the biophysical attributes is based on the sum of the values obtained in the evaluation of different aspects of biophysical support. In this way, the final assessment reports the benefit of the non-occupation or controlled occupation of the open spaces analyzed according to the importance of the open spaces in

the maintenance of natural processes. It is worth highlighting the importance of the incorporation of these attributes as a basis for the structuring of future urban occupation.

The classifications of high (H), medium (M), or low (L) for different categories of the analysis (i.e., vegetation, hydrology, and slope gradient) are combined. In the present case study, three general maps showing areas for each classification (H/M/L) were obtained. The overlap of classifications for different analysis categories results in five final qualifications (Fig. 5.5).

- *High (H)*.⁴ Open spaces with a high rating and whose natural processes have low tolerance against exploitation and urban occupation.
- *Medium-High (MH)*.⁵ Open spaces with a medium-high rating and whose natural processes have medium-low tolerance against exploitation and urban occupation.
- *Medium (M)*.⁶ Open spaces with a medium rating and whose natural processes have medium tolerance against exploitation and urban occupation.
- *Medium-Low (ML)*.⁷ Open spaces with a medium-low rating and whose natural processes have medium-high tolerance against exploitation and urban occupation.
- *Low (L)*.⁸ Open spaces with a low rating and whose natural processes have high tolerance against exploitation and urban occupation.

At the same time, a synthesis map is presented. On the map, the results of the evaluations of the parameters related to the conservation of vegetation and the susceptibility to the risks (flooding or landslides) were overlaid, which allows the identification of biophysical elements that affect each piece of the open space (Fig. 5.6).

5.2 Attributes of Visual Perception

To assess the attributes of the visual perception of open spaces in the case study, we identify the genuine characteristics of the physical elements that make up the spaces and that can be perceived as part of the visual identity of the area, and would thus

⁴Including open spaces that have the best preserved vegetation and a high risk rate.

⁵Including open spaces that have the best preserved vegetation and a medium to low risk rate and open spaces having the least preserved vegetation (or exposed soil, without vegetation) and a high risk rate.

⁶Including open spaces that have the least preserved vegetation (or exposed soils, without vegetation) and a medium risk rate.

⁷Including open spaces that have the least preserved vegetation (or exposed soils, without vegetation) and a low risk rate.

⁸Including open spaces with exposed soils, without vegetation, and having a low risk rate.

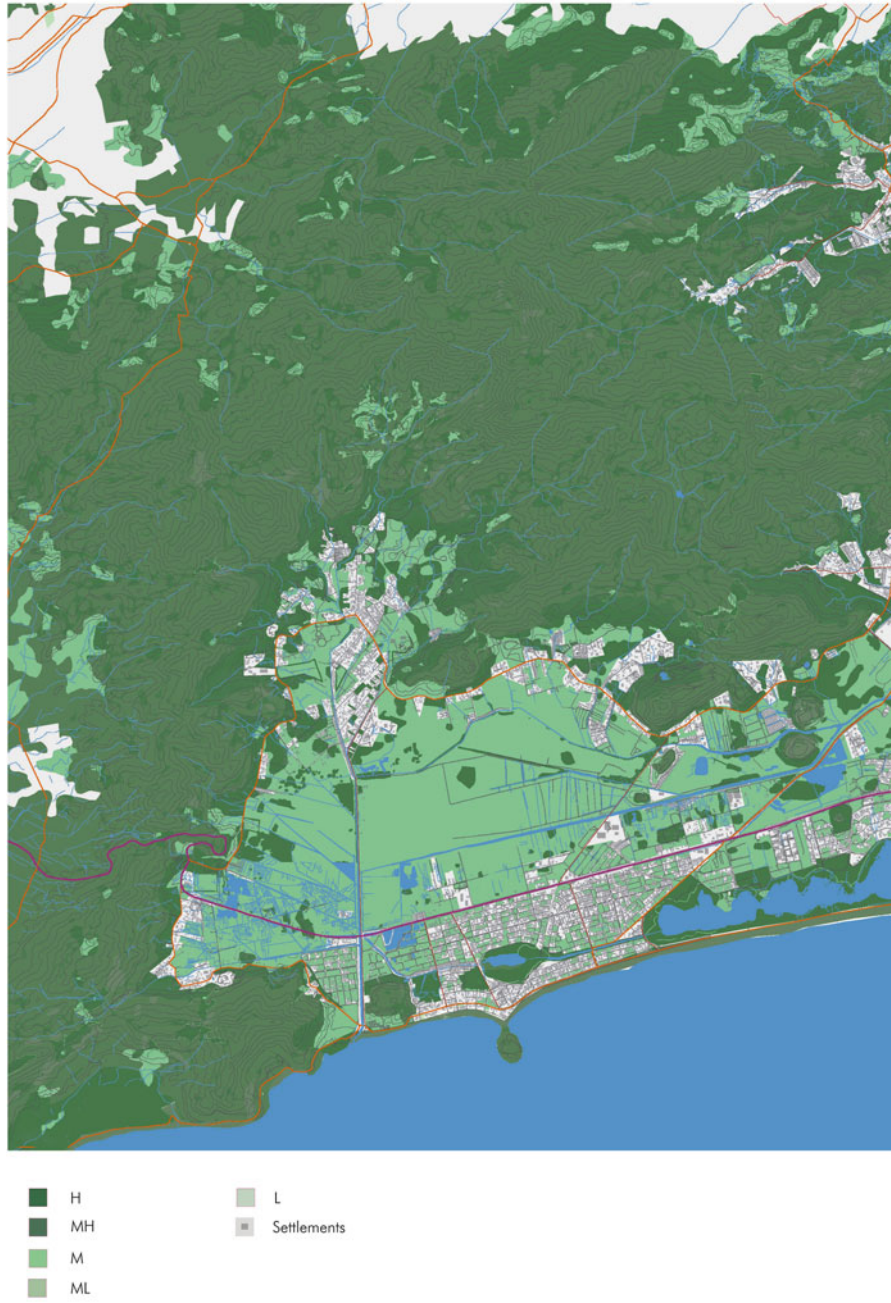


Fig. 5.5 Map of the final evaluation of biophysical attributes



Fig. 5.5 (continued)



Fig. 5.6 Map of biophysical support attributes

be worthy of conservation and being considered as determinants of the structuring of urban occupation. It should be noted that this evaluation has a high degree of subjectivity. The following are described and evaluated in the analysis of attributes of the visual perception of open spaces.

- Scenic elements are considered as natural components of open spaces with an intrinsic visual quality.
- Areas with visual prominence refer to the unique elements that make up the open spaces, specifically the relief and hydrography, and that can be seen from access routes.
- Scenic backgrounds are wider views of open spaces covering the most significant elements of the landscape in a partial way (partial views) or in a wider sense (panoramic views).
- Open spaces of historic and cultural interest are generally remains of urban development that are highly significant to the identity of the area.

5.2.1 *Scenic Elements*

Scenic elements constitute the natural components of the open spaces having the most visual attractiveness, and the scenic elements thus have an intrinsic quality. The importance of the scenic elements is reflected in the character that they bring to the composition of a given landscape, and the elements are a significant portion of the visual identity of the landscape; i.e., they are singularities of the relief, vegetation, and hydrography of the landscape.

The visual appeal of an element can be measured by the particularities of its formal composition; e.g., topographical accidents, which are natural sculptures; vegetation presenting a variety of color, different layers, or a dense mass with a contrasting presence; and water bodies with varying large forms (González 1981; Bolós 1992, among others).

In this context, scenic elements are evaluated in the present case study. The location of scenic elements is an important factor that should be considered in ensuring they remain visible and preserved (Figs. 5.7, 5.8 and 5.9).

The perception of the relief of the study area is based on the succession of peaks that mark the territorial unit as a large amphitheatre framed by mountains. The mountains, which make up the massifs, highlight the principal formations and contain the points of greatest height, and they stand out in the topographic composition. They determine a unique geometry in relation to the plains and peaks, acting as guidelines running towards the most central points of the massifs, and they are arranged in a radial manner in different directions of the plains. Some examples are the mountains of Engenho Velho, Inácio Dias, Pretos Forros, and Serra Geral de Guaratiba, which present an almost complete continuity in the northern part of the plains, where the massifs meet, and form the arcing border of the plains. Serra Geral de Guaratiba is a great arm of the Pedra Branca massif that runs perpendicular to the sea and defines the western part of the plains.



Fig. 5.7 Vegetation and water as scenic elements (2001) (Photo: Rodrigo Rinaldi)



Fig. 5.8 Relief, vegetation, and water as scenic elements (2001) (Photo: Rodrigo Rinaldi)



Fig. 5.9 Vegetation and water as scenic elements (2001) (Photo: Rodrigo Rinaldi)

Rugged zones are predominant on the peaks, and in the specific case of the studied massifs, there are many rocky formations, which may be perceived as large natural sculptures; e.g., Pedra da Gávea and Morro Dois Irmãos.

The lower areas are generally less visible and not of visual interest. Likewise, the vast extent of the plains, with its very homogeneous relief, is not visually attractive. However, the hills on the plains are topographic elevations that contrast with the surrounding flatness and they thus have special character. In addition, some of the hills have unique form (e.g., Pedra da Panela) and others are in specific places and are clearly differentiated from the other hills (e.g., Pontal da Sernambetiba). Some of these hills are covered in whole or in part by vegetation, which reinforces their differences and contrasts with the background.

The hydrography is a decisive factor in the characterization of a place. Important formations can be identified in the study area, such as lagoons, canals, and the sea, which by their size and continuity, strengthen the visual identity of the area.

The coastline is the outer longitudinal line south of the territorial unit. The open sea provides a large surface area of blue water that clearly defines the southern boundary of the study area along the beach.

In general, the lagoons in the study area are large. Specifically, the Tijuca and Jacarepaguá lagoons are prominent aquifers that are part of the conformation of the central plains. Their elongated forms and great width do not allow them to be taken in a single view, and the lagoons are highlights of the landscape. The Marapendi lagoon is highly elongated and its major axis runs parallel to the sea in the southernmost

part of the plains; the elongation reinforces its longitudinal position and its visual appearance. On a smaller scale, Lagoinha lagoon stands out for the contrast between its shape and the canals connected to it, and it is thus one of the main elements of the landscape of the surrounding area.

The lagoonal canals that have a significant volume of water are Joatinga, Sernambetiba, Marapendi, and Das Taxas. They describe linear paths, running longitudinal and transversal through the landscape from east to west. They are important and continuous linear elements that make up the landscape and contribute to the perception of the place.

Often the most preserved vegetation is some of the visually more significant vegetation masses. This adds an aesthetic value to the ecological importance of the vegetation. Vegetation is thus a fundamental component of the visual diversity of the study area. The vegetation of the Itanhangá Golf Club, which has visually interesting gardens that are highlighted by the contrasts with the massif, although the gardens are surrounded by walls that obstruct the external view, may be considered an exception.

Among the more visually significant vegetation masses, the mosaics that make up the forests are dominant. In the forests, a wide variety of vegetation types is distributed in distinct vegetation layers and is observed as a visual constant. The forest areas appear as a large, dense, and extensive green masses, occupying most of the massifs and having a strong visual presence.

The forest fragments on the Sernambetiba fields, to the west of the plains, stand out for their contrast in size with the lower homogeneous vegetation in floodable areas and in anthropic fields. In this context, the perception of agricultural mosaics is not significant, because the agricultural mosaics do not have clear structure that can be grasped visually. This lack of clear structure is due to either the dispersed nature of the cultivation or the large expanse of the fields, which give the fields a monotonous and unattractive appearance.

Mangroves have very particular types of relatively dense vegetation masses highlighted alongside water. Mangroves are located on the banks of the lagoons of Tijuca, Jacarepaguá, Marapendi, and Lagoinha. Also noteworthy is sandbank vegetation, especially around the Marapendi and Lagoinha lagoons. Sandbank vegetation has a rather unique vegetation layer, whose density highlights the vegetation masses in the landscape context. In some cases, the vegetation can still be found in remaining dunes, which distinguishes it even more.

In conclusion, it is important to respectfully treat the physical integrity of the scenic elements as fundamental items in the preservation of the visual diversity of the area and the scenic elements should be incorporated as determinants of the structuring of urban occupation.

5.2.2 Areas with Visual Prominence

The determination of areas with visual prominence allows, in this case, for the identification and preservation of the main topographic and hydrographic references of open spaces that characterize the physical structure of the place and can be seen

from access routes. They are views that emerge as the traveler moves along access routes and they show unique natural formations that generally stand out from their surrounds; the formations are either topographic monuments or large water bodies that define the landscape. Because of their special features and high visibility, the areas with visual prominence can be considered worthy of preservation and they should also be incorporated as determinants of the structuring of urban occupation.

In general, the areas with visual prominence are singular frameworks that make up visual sequences during movement along access routes. They are differentiated elements that break up the possibly monotonous rhythm of the perceived landscape. Additionally, they can work as an element of tension that stimulates interest in the visual environment, thus establishing a relationship between the common and the distinct.

However, the visual perception of areas with visual prominence varies according to the means of transport used (i.e., car, bicycle, train, or foot). Each means of transportation provides distinct visual possibilities, which may be more or less direct, with or without obstacles, and with longer or shorter pauses.

There are also variations relating to the type access route; e.g., the route may have historic roots or it may be a highway or expressway. Historic roads allow proximity to the surrounding areas, travel at moderate speed, and a relatively direct and ample impression of the surrounds. By contrast, the highway and expressway promote high-speed travel and disregard the environment, to the extent that the drivers' purpose is simply to reach their destinations as soon as possible.

Owing to the scale of analysis adopted here and the types of routes and means of transportation in the study area, this work focuses on visual perception from the most common routes (i.e., roads, highways, and the expressway) while using the principal means of transportation (i.e., cars and public transport) in the study area.

The identification of the specific points from which areas with visual prominence are visible thus contributes important information to future interventions in the territory, thus improving the visual value. In this sense, the following areas with visual prominence are identified in the case study.

- Areas with visual prominence perceived from highways and the expressway

In relation to the relief of terrain, one can see (Figs. 5.10 and 5.11)

- Morro da Freguesia from the expressway Linha Amarela,
- Pedra da Panela from the expressway Linha Amarela,
- Pedra da Gávea from the highway Avenida das Américas,
- Morro do Rangel from the highway Avenida das Américas,
- Pedra de Itaúna from the highway Avenida das Américas.

In relation to water, there are views from (Figs. 5.12, 5.13 and 5.14)

- Santos Dumont bridge, located on the highway Avenida Ayrton Senna, in the direction of the Camorim lagoon,
- A bridge on Avenida Ayrton Senna in the direction of the Marapendi lagoon,
- Joatinga bridge, located on highway Avenida das Américas, in the direction of the Joatinga canal,
- A bridge on highway Avenida das Américas in the direction of the Marapendi canal,



Fig. 5.10 View of Pontal de Sernambetiba from Avenida Lucio Costa (2003) (Photo: Author)



Fig. 5.11 View of Pedra da Gávea from Avenida das Américas (2003) (Photo: Author)



Fig. 5.12 View from a bridge on Avenida das Américas in the direction of the Tijuca lagoon (2003) (Photo: Author)



Fig. 5.13 View from a bridge on Avenida Ayrton Senna in the direction of the Marapendi lagoon (2003) (Photo: Author)



Fig. 5.14 View from a bridge on Avenida das Américas in the direction of the Sernambetiba Canal (2003) (Photo: Author)

- A bridge on highway Avenida das Américas in the direction of the Sernambetiba canal,
- Highway Avenida das Américas in the direction of the Joatinga canal.
- Areas with visual prominence viewed from roads

In relation to the relief of terrain, one can see

- Morro Dois Irmãos from the roads Estrada dos Bandeirantes, Avenida Salvador Allende, and Estrada da Curicica,
- Pedra do Itanhangá from Estrada de Jacarepaguá,
- Morro da Freguesia from Estrada dos Três Rios,
- Pedra da Gávea from Avenida Lúcio Costa,
- Morro do Rangel from Estrada do Pontal,
- Pontal de Senambetiba from Estrada do Pontal and Avenida Lucio Costa,
- Hills of Cantagalo, Amorim, Portelo, and Urubu from Avenida Salvador Allende,
- Pedra da Baleia from Avenida Salvador Allende.

In relation to water, there are views from

- Viaduto do Pontal, located on Estrada do Pontal, in the direction of the Sernambetiba canal,
- A bridge on Avenida Salvador Allende in the direction of Rio Marinho,
- Estrada de Jacarepaguá in the direction of the Tijuca lagoon.

5.2.3 *Scenic Backgrounds*

Scenic backgrounds are broader views of the landscape allowed by open spaces. Scenic backgrounds can be partial views, which cover a limited part of the landscape and can be seen from lower elevation, and panoramic views, which can be seen from points of higher elevation and are wider views of the landscape.

The most valued scenic backgrounds allow recognition of the most characteristic features of the landscape. In these views, the scenic elements making up panoramas provide contrasts between the topography, water, and vegetation, which can be perceived as a whole.

Partial views are limited views of the landscape and show local morphological conformation and its peculiarities. Among the most significant partial views in the study area are those seen from Avenida das Américas and Avenida Lúcio Costa on the coastline. These views include many of the most unique scenic elements of the area and their combinations (Figs. 5.15 and 5.16). Because of the proximity of the observer and the observed landscape, partial views also show elements of visual conflict in open spaces; e.g., there are slums on the banks of some rivers.

Panoramic views offer broader scenes of the landscape, with some viewing points allowing almost the entire territorial unit to be viewed as a whole. The panoramic views transform the landscape into a spectacle, and the contrasts, differences, and variations between forms reach their climax, giving the panorama its visual quality.



Fig. 5.15 Partial view (2003) (Photo: Author)



Fig. 5.16 Partial views (2003) (Photo: Author)



Fig. 5.17 Panoramic view from Morro da Freguesia, in the direction of the Jacarepaguá lowlands (2003) (Photo: Author)

Routes that pass through the hills and massifs thus allow the opening of wide views with great visual quality because of the large differences in height between the massifs and the plains. Panoramas are seen from (Figs. 5.17, 5.18 and 5.19).

- Estrada de Furnas, toward the Jacarepaguá lowlands,
- Estrada da Grotta Funda, toward Campos de Sernambetiba,
- Avenida Estado da Guanabara, toward the beach of Barra da Tijuca,
- Pedra da Gávea, toward the Jacarepaguá lowlands,
- Morro da Freguesia, toward the Jacarepaguá lowlands,
- Morro da Capela de Nossa Senhora de Montserrat, toward Campos de Sernambetiba.



Fig. 5.18 Panoramic view from Avenida Estado da Guanabara, in the direction of Barra da Tijuca beach (2003) (Photo: Author)



Fig. 5.19 Panoramic view from Pedra da Gávea, in the direction of the Jacarepaguá lowlands (2003) (Photo: Author)

Scenic backgrounds can be quickly transformed by the occupation of open spaces. In this context, we highlight areas in which construction is possible between the landscape observed and viewing points offering partial views. These are the “visual corridors” (Laurie 1975) that include much of the open spaces of the plains. These open spaces deserve special attention with regard to the conditions of urban occupation so that certain views can be preserved and they also should be incorporated as determinants of the structuring of urban occupation.

5.2.4 Open Spaces of Historic and Cultural Interest

Open spaces of historical and cultural interest are important spaces that are generally left over from the occupation of an urban area. These spaces are often witnesses to the history and representative of some of its traditional values (Bolós 1992). The open spaces require identification and assessment to control urban occupation within and should be considered in the structuring of urban occupation.

There may be many reasons for the permanency of such open space as unoccupied space; e.g., the open space is a protected place, a place for continued community practices, a forgotten property, or a space with other significance to the local community. These spaces can strengthen relations between the community and the physical surroundings, and their conservation and evaluation would contribute to keeping the past alive, and to allow the preservation of important cultural processes and the permanence of open spaces.

We preserve current signals of the past or control the present to meet our images of the future. Our images of the past and future are present images continually recreated [...] The spatial environment can strengthen and humanize this present image of time, and I suppose that this function is one of the most widely unvalued roles. (Lynch 1972, p. 75, translated from Spanish)

In many cases, open spaces of historical and cultural interest contain elements of construction that are visually incorporated into the spaces and consequently provide its meaning; e.g., Christ the Redeemer and the mountain of Corcovado in Rio de Janeiro, and the Acropolis and its hill in Athens (McHarg 1969). In some of these cases, the construction is one of the main reasons that the open space has remained as such, without undergoing substantial physical change. In the study area, such open spaces of historical and cultural interest are already protected by the public sector as public heritage. Examples are

- Morro da Capela de Nossa Senhora de Montserrat,
- Colônia Juliano Moreira,
- Morro da Freguesia with the church of Nossa Senhora da Penha,
- Fazenda da Taquara,
- Fazenda do Engenho d’água.

These spaces are historical remnants of the rural past of the area (Figs. 5.20 and 5.21) and survive in areas of cultivation and native vegetation in the middle of roadway

Fig. 5.20 Morro da Capela
Nossa Senhora de Montserrat
(2003) (Photo: Author)



Fig. 5.21 Colônia Juliano Moreira (2003) (Photo: Author)

infrastructure and settlements. Because of their uniqueness, the spaces should be preserved and managed in accordance with their most genuine characteristics and as a basis for the structuring of urban occupation.

5.2.5 Final Evaluation of Attributes of Visual Perception

The final evaluation of the attributes of the visual perception of open spaces determines which areas are most relevant to the visual conformation of the area, and thus have high visual significance and should be considered as spaces unsuitable for occupation when planning the system of open spaces and also important references to be incorporated in the process of urban occupation construction.

In this sense, the following identified elements are of *high (H)* value (Fig. 5.22).

- Areas with visual prominence are areas viewed from the expressway, highways, and roads and relate to the relief of the terrain and water, in this case.
- Scenic elements relating to the relief of the terrain are the massifs, peaks, and hills on the plains; those relating to the hydrography are the sea, the lagoons of Tijuca, Jacarepaguá, Marapendi, and Lagoinha, and the canals of Joatinga, Sernambetiba, Marapendi, and Taxas; and those relating to vegetation are forest masses, the forest fragments in Campos de Sernambetiba, mangroves, sandbank vegetation around lagoons, and the gardens of the Itanhanga Golf Club.
- Scenic backgrounds are the partial and panoramic views described above.
- Open spaces of historical and cultural interest are the spaces described above.

5.3 Accessibility

Analysis of the accessibility of open spaces describes and evaluates the accessing capacity of existing and planned routes in the study area. The objective is to determine the degree of accessibility of the surfaces, viewed as a factor determining the probability of intervention in an open space through urban occupation or other activity.

Although accessibility depends on the means of mobility, the focus here is on automobiles since their use is predominant in the territorial unit and they pertain to a larger number of people.

5.3.1 Accessibility via Existing and Planned Routes

Accessibility, which is considered the possibility of moving along a route to a specific destination, is an important functional attribute when planning the system of open spaces. The routes provide continuity between spaces, allowing access to the spaces and the occupation or use of the spaces.

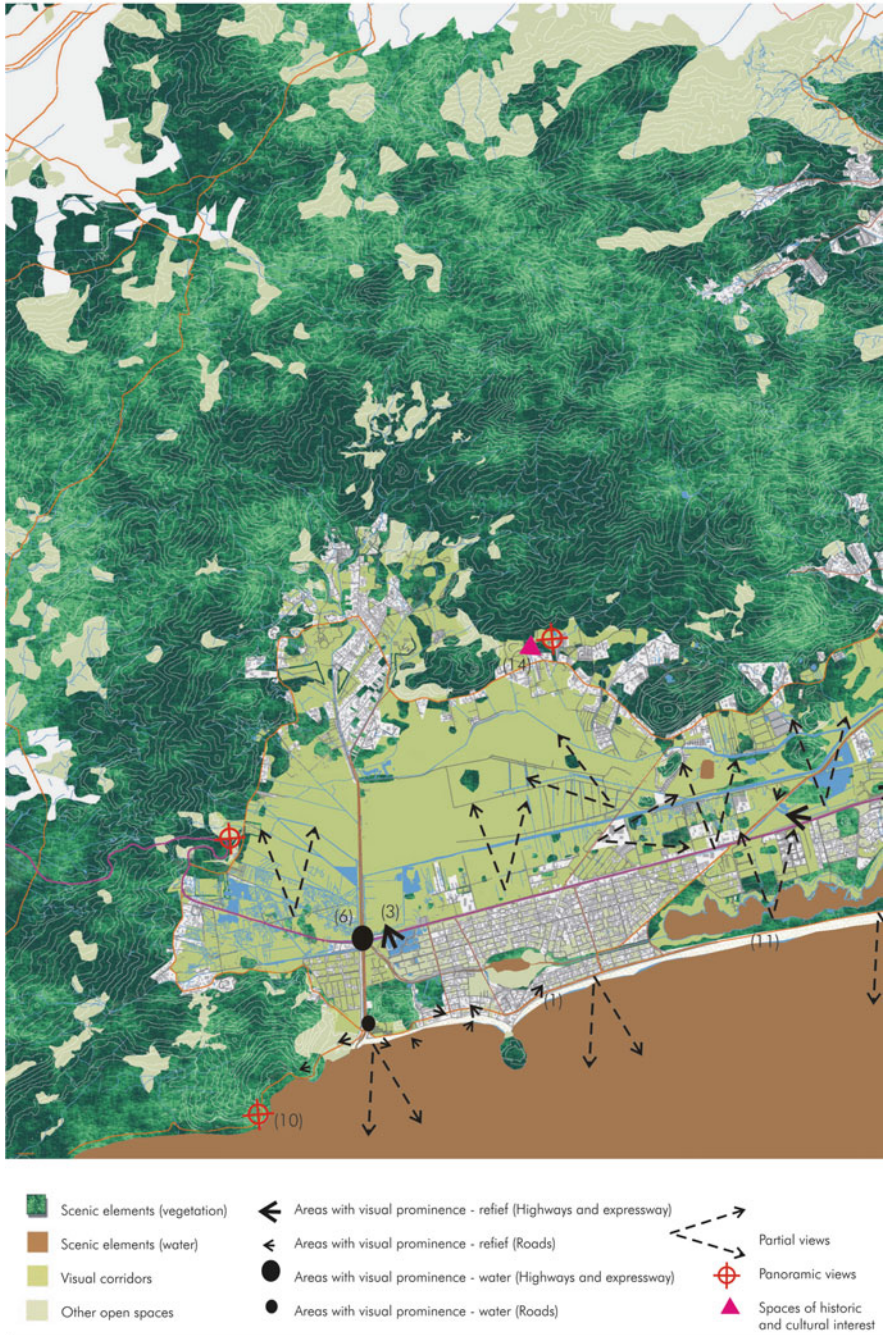


Fig. 5.22 Map of the final evaluation of visual perception attributes



Fig. 5.22 (continued)

In general, the greater the capacity of the route, the more the route tends to function as a channel for fast connections between different parts of the territory, which provides opportunities in terms of the location of settlements. However, this does not necessarily mean that the construction of new settlements is the best alternative for open spaces. The dynamics of these spaces need to be considered to better determine the most suitable places for settlement.

Accessibility may facilitate activities in open spaces and ensure their vitality, as accessibility enhances the human presence. In some cases, however, activities may be incompatible with the visual perception and biophysical attributes of the open spaces, and the degree of accessibility of the spaces can thus serve as a baseline measurement parameter for the implementation of future limitations to the possible use of the open spaces.

To measure the degree of accessibility of open spaces from the routes that access them, the following variables are considered.

- The type of route refers to the scale of the route, the extent of its connections, the type of section, and its ability to support traffic flow.
- The speed of traffic allowed on the routes is a variable that determines the time taken to arrive in a given space.
- The territorial scope of the connections is the spatial extent that can be accessed from the expressway via the surrounding streets, and it is therefore a measure of the number of people and number of places that can be connected.
- The traffic capacity refers to the route's transversal section, the number of lanes and the number of vehicles that can travel along the route, and the types of vehicle allowed on the route.
- The variations in the relief refer to the ease of travel through terrain of flat relief and the increase in difficulty when the relief becomes uneven.

According to these criteria, the accessibility of open spaces varies and has different characteristics according to the existing routes.

- In relation to surfaces alongside highways and the expressway. Expressways and highways allow high-speed travel, greater capacity for traffic, and longer territorial connections. The expressway sometimes has a "tunnel effect" when connecting farther areas of the territory in a short time, in that it has restricted accessibility. On the other hand, the highways allow more modest speeds and offer greater accessibility along their margins.
- In relation to surfaces alongside roads. Roads allow more opportunities to pause during travel, allow medium-level speed, and connect distances shorter than those connected by highways and expressways, while they have a considerable traffic capacity and provide access to their margins.
- In relation to surfaces alongside main streets. The main streets of the neighborhoods are generally well connected to the main and secondary roadway networks, allowing low and medium-level speeds, medium-level traffic capacity, and access to their margins.
- In relation to surfaces that border the general network of streets. The general network of streets provides different degrees of accessibility, although hierarchically, they are below main streets in terms of the possibilities for access, speed, and traffic capacity.

5.3.2 *Final Evaluation of Accessibility*

The accessibility of open spaces is now evaluated, with consideration of already existing and planned routes (offering potential accessibility), in accordance with their hierarchy. The accessible distance is considered to be 500 m from the route if the terrain is flat and 200 m if it is uneven, which schematically distinguishes the differences related to relief that could affect the accessibility of the spaces. The classifications are (Fig. 5.23)

- *High (H)* for areas alongside the expressway (its connections) and the highways,
- *Medium-high (MH)* for areas alongside roads,
- *Medium (M)* for areas alongside main streets,
- *Low (L)* for areas alongside the general network of streets.

It is seen that there is low accessibility in a large extent of the massifs' borders, which translates into the relatively high maintenance of the quality of vegetation in these places and reinforces the option not to encourage the urban occupation of or exploitation activities in these places.

In contrast, the high and medium-high accessibility to open spaces of the plains, existing or planned, requires effective control of urban occupation and activities in these places according to their biophysical and visual perception attributes. Among these spaces, the areas to the west of the plains, mainly those near the border of the Pedra Branca massif, and the areas to the north of the lagoons of Tijuca and Jacarepaguá are highlighted.

There is medium-level accessibility, again existing or planned, to areas of great biophysical and visual perception interest, especially around the lagoons of Tijuca, Jacarepaguá, and Marapendi, which would require the management of possible urban intervention.

5.4 Links to Planning Rules

Analysis of the links to planning rules verifies the protection parameters for the open spaces and identifies the spaces more or less likely to remain free of urban occupation in accordance with the provisions of current planning, the precision of spatial boundaries determined by the instruments of that planning, and the constraints imposed on occupation. For this analysis, the following are described and evaluated.

- Macro-zones and areas of agricultural interest are areas that may have restricted urban occupation.
- Protected surfaces are areas that cannot be occupied.
- Buildable surfaces are areas destined for settlements (which are analyzed but not considered in the final evaluation of the parameters of protection).

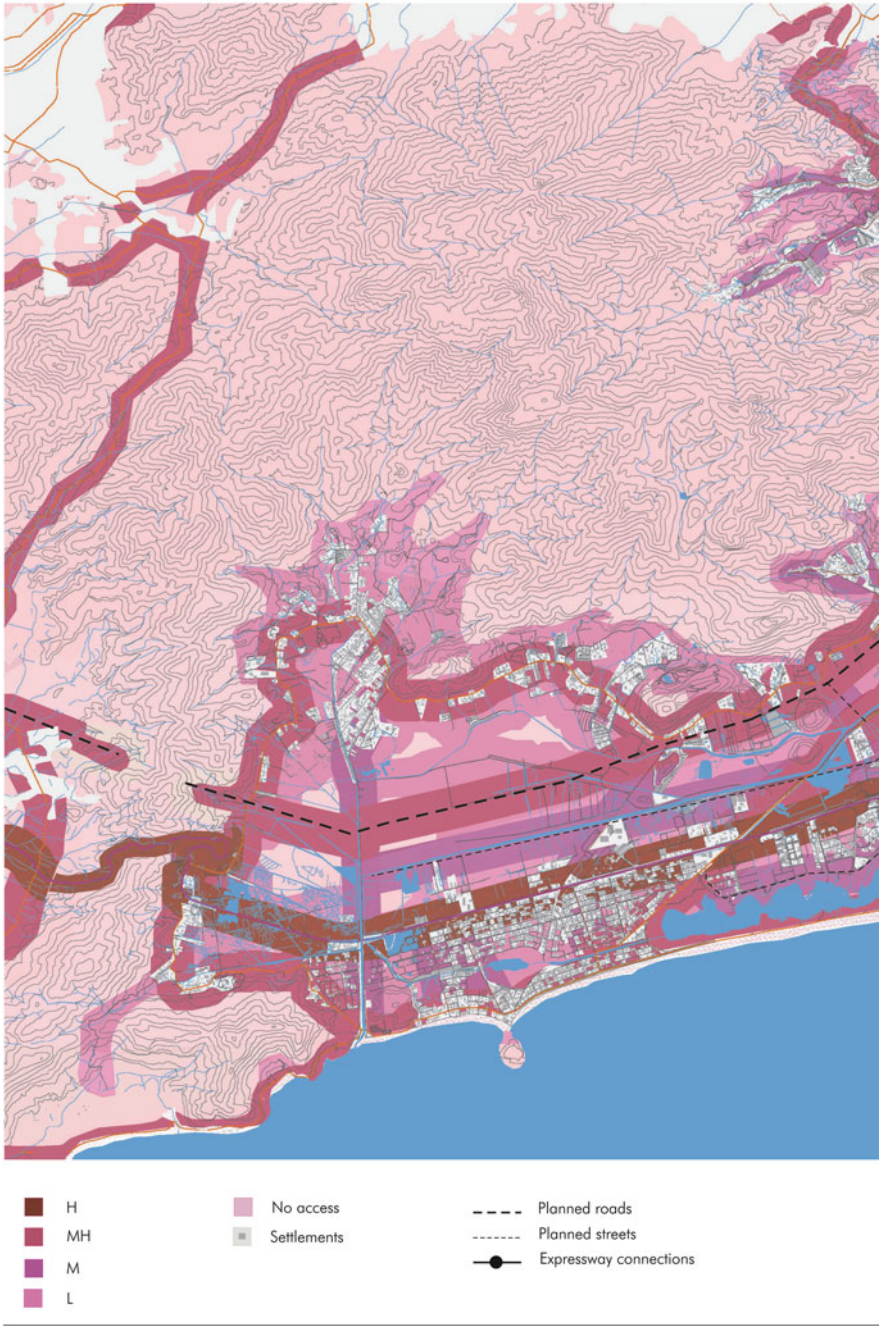


Fig. 5.23 Map of the final evaluation of accessibility



Fig. 5.23 (continued)

5.4.1 *Macro-Zones*

Macro-zones regulate the occupation of the soil of the municipality into (Fig. 5.24)

- Urban macro-zones,
- Macro-zones of urban expansion,
- Macro-zones for which urban occupation is restricted.

Macro-zones for which urban occupation is restricted comprise agricultural areas, areas that have conditions adverse to occupation and/or are inadequate for urbanization, and areas destined for environmental protection.

- Agricultural areas are delimited for the maintenance of agricultural and livestock activity, including areas suitable for agriculture, areas inappropriate for urban occupation, and areas recovered for agricultural use or essential to the maintenance of biophysical balance. On the other hand, agricultural areas may serve for low-density residential use, commercial activities, and services related to residential and agricultural use, agro-industry, and recreational and cultural tourism activities.

In the study area, Agricultural Area 7 corresponds largely to areas of the neighborhoods of Vargem Pequena and Vargem Grande, for which the city administration is currently in the process of revising its planning rules.⁹

- Areas that have conditions adverse to occupation and/or are inadequate for urbanization may experience flooding or landslides, or other changes that can affect their stability. Prior studies and technical works are required to determine the viability of the occupation of these areas.
- Areas of environmental protection, in most cases, should not be occupied. However, in some situations, they may be suitable for residential, agricultural, recreational, or research use, when their protection is guaranteed and with prior authorization.

The creation of macro-zones corresponds to general intentions, which may or may not be implemented by more specific planning instruments.

5.4.2 *Protected Surfaces*

Protected surfaces include all open spaces that are subject to legal measures prohibiting urban occupation. In some cases, there is overlapping of various instruments of protection for the same spatial scope. Among the areas protected by planning are the following (Fig. 5.25).

⁹ The new plans that are being developed for the territorial unit correspond to the Urban Structure Plans (Plano de Estruturação Urbana—PEU) called “Vargens” (which include the mentioned agricultural area) and “Taquara”, covering the neighbourhoods of Vargem Grande, Vargem Pequena, and Camorim, and part of Recreio, in Barra da Tijuca, and the neighbourhoods of Tanque, Taquara, Freguesia and Pechincha, in Jacarepagua.

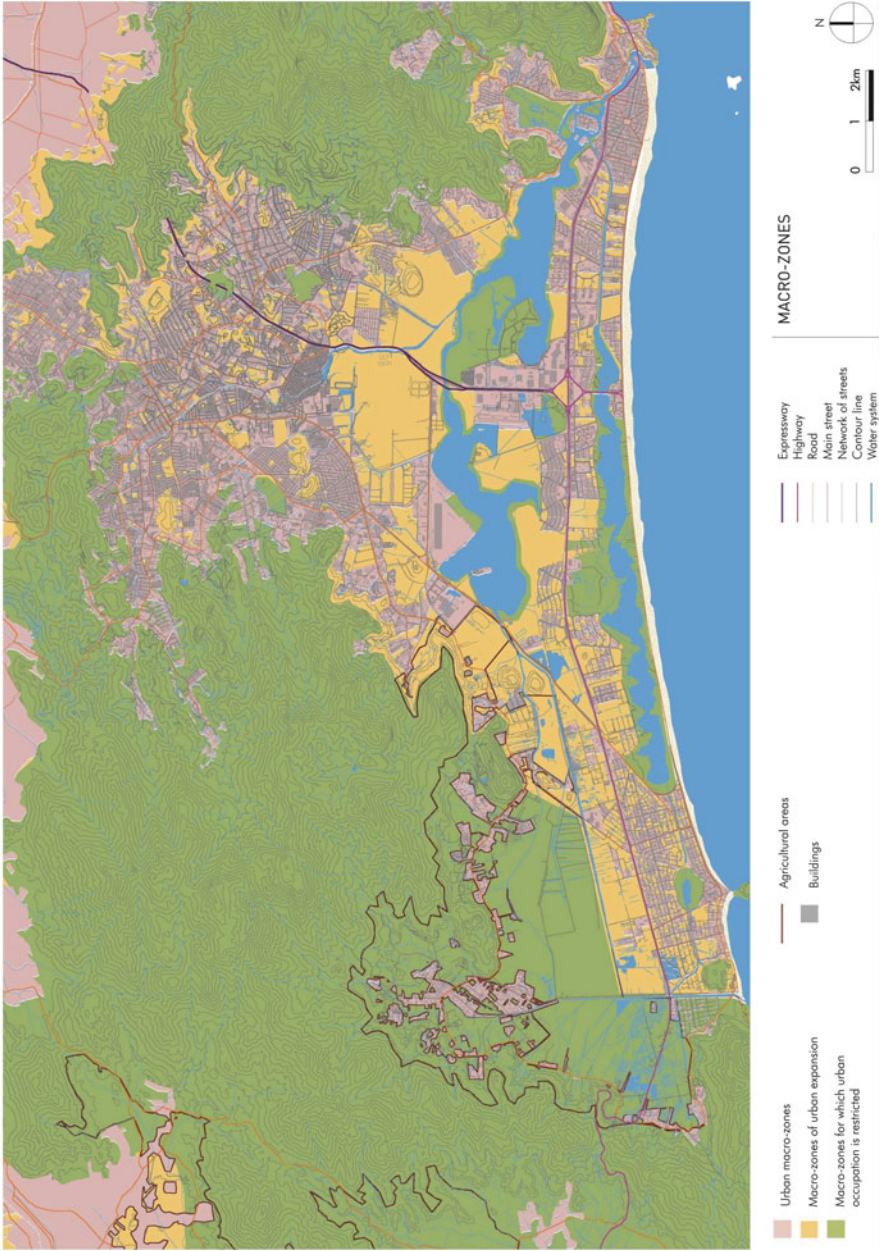


Fig. 5.24 Map of macro-zones

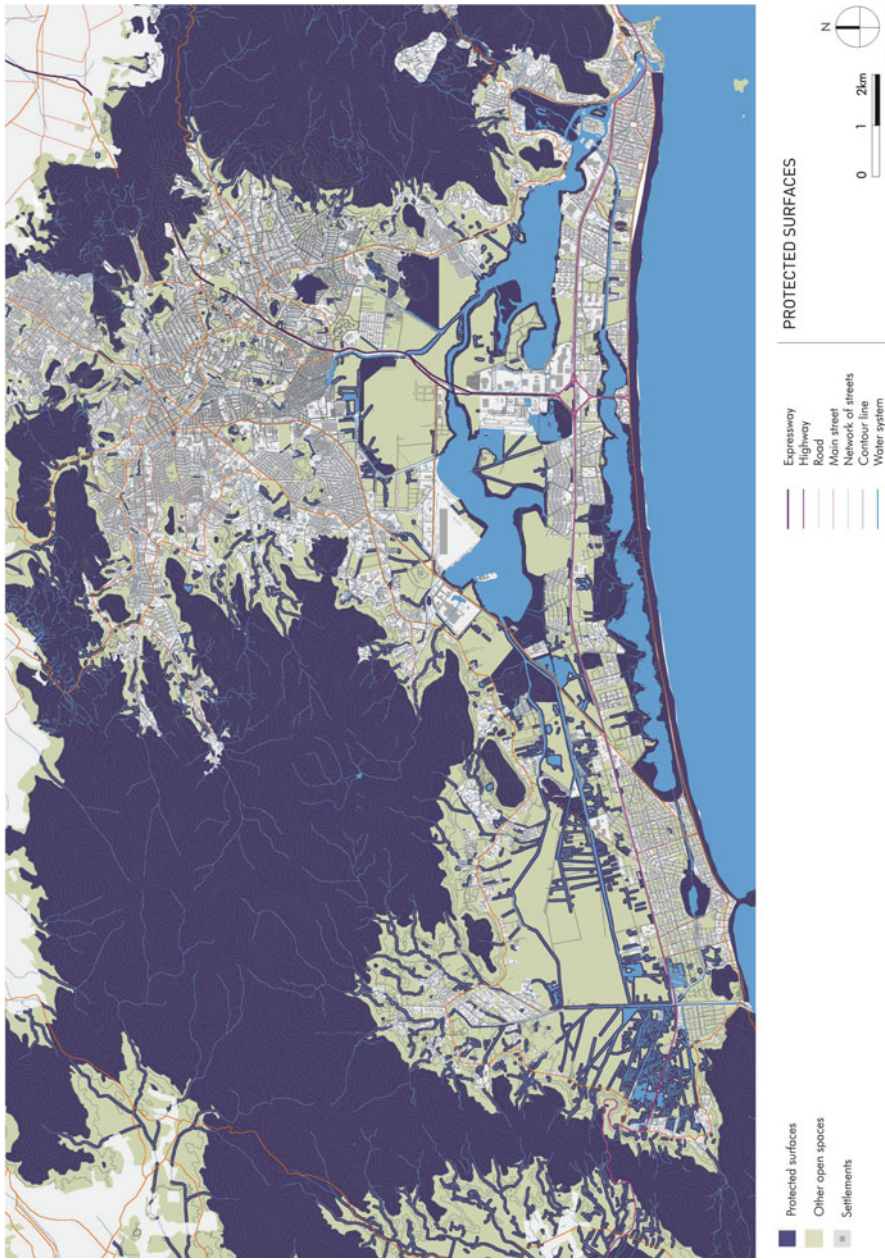


Fig. 5.25 Map of protected surfaces

- Environmental conservation units¹⁰ are strictly protected under a special management regime. These may be the following.
 - Fully protected units:
 - Biological reserves
 - Parks
 - Natural assets
 - Areas suitable for sustainable use:
 - Areas of environmental protection
 - Areas of environmental protection and urban regeneration
- Areas of permanent protection¹¹ include the banks of rivers, lakes, lagoons, and estuaries with a minimum width of 30 m; hillsides with inclination greater than 45°; the tops of hills and mountains; areas with mangroves and sandbank vegetation; areas that secure dunes; forests (according to some specific recommendations); and beaches.
- Areas considered as special zone 1¹² are above 100 m in elevation, almost throughout the entire city.

Non-buildable areas are certain portions of the territory, previously defined, which must remain as open spaces. They include reserves of land that are required for future urban occupation and are designated to be urban open spaces.

Besides the specific planning rules of the municipality, Federal Law No. 6766 (December 19, 1979) defines rules for the allotment of urban land, where it is forbidden to divide land, for example, in floodable areas, on terrain with inclination equal to or greater than 30%, at sites where geological conditions make occupation unadvisable, and in areas of ecological preservation. In addition, this law gives percentages related to the density of settlement and the reserve of land for the public sector, and addresses the traffic network, the implementation of urban and community facilities, and open spaces for public use.

It appears that not all protection measures have the same specificity with respect to the delimitation of spatial boundaries of the protected area, which results in variations in the planning rules for open spaces. The environmental conservation units and the non-buildable areas, previously defined, have well-established spatial boundaries, whereas areas of permanent protection and special areas 1 are more generic assignments, without specific spatial boundaries.

¹⁰The Federal Law No. 9985 of July 18, 2000 defines the conservation unit as “the territorial space and its environmental resources, including territorial waters, with relevant natural features, legally established by the public sector for the purposes of conservation and having defined limits, under special arrangements for administration, to which are applied adequate guarantees of protection.”

¹¹CONAMA Resolution No. 303 of March 20, 2002, Law No. 4771 of September 15, 1965.

¹²*Zoneamento do Município—Regulamentação*. Rio de Janeiro: Prefeitura da cidade do Rio de Janeiro. Secretaria de Obras e Serviços Públicos, 1976, artigo 163.

5.4.3 *Buildable Surfaces*

In general, considerations regarding land use in the study area take into account the development of areas that already have infrastructure, especially in Jacarepaguá the neighborhoods of Pechincha, Freguesia, Taquara, Tanque, and Praça Seca.

The planning rules foresee the consolidation of sites destined for industrial use, which occupy the center of the Jacarepaguá plains and the southern margin of Estrada dos Bandeirantes. Additionally, they promote the development of tourism, sports, and culture, especially around the Tijuca and Jacarepaguá lagoons and along the beach. The prediction of public facilities focuses on specific spatial points, also close to the lagoons of Tijuca and Jacarepaguá. In contrast, the prediction of residences is broader and distributed across the plains. These residential areas also have commercial uses in some parts near the sea and around the Jacarepaguá lagoon, alongside Estrada dos Bandeirantes, and on the Jacarepaguá plains. In the surroundings of Estrada dos Bandeirantes, near the southern edges of the Pedra Branca massif, industries may also be established. Commercial use is prioritized around the routes of greater capacity, such as Avenida das Américas and Estrada dos Bandeirantes (Fig. 5.26).

In this context, it appears that besides the areas already protected from occupation, the remaining open space is susceptible to urban occupation.

5.4.4 *Final Evaluation of Protection Parameters*

The final evaluation of protection parameters, to which the open spaces are subject to, observes the specificity (with regard to the spatial boundaries of the protected area) and degree of restrictions on urban occupation by the legal instruments governing each surface. According to this criterion, the analysis of the planning gives the following classifications (Fig. 5.27).

- *High (H)* for fully protected units and non-buildable areas. These areas are specifically delineated by planning, in spatial terms, and are fully protected from being occupied.
- *Medium-high (MH)* for areas of sustainable use. These are areas specifically delimited by planning, and occupation of the areas is allowed under specific management conditions.
- *Medium (M)* for permanent protection areas and special areas 1. These are areas without specific spatial demarcation, although they are generally considered areas to be protected.
- *Low (L)* for macro-zones with restricted urban occupation. These areas are the subject of general protection/occupation intentions, and there is a lack of more specific planning instruments to ensure the effectiveness of restrictions on urbanization.

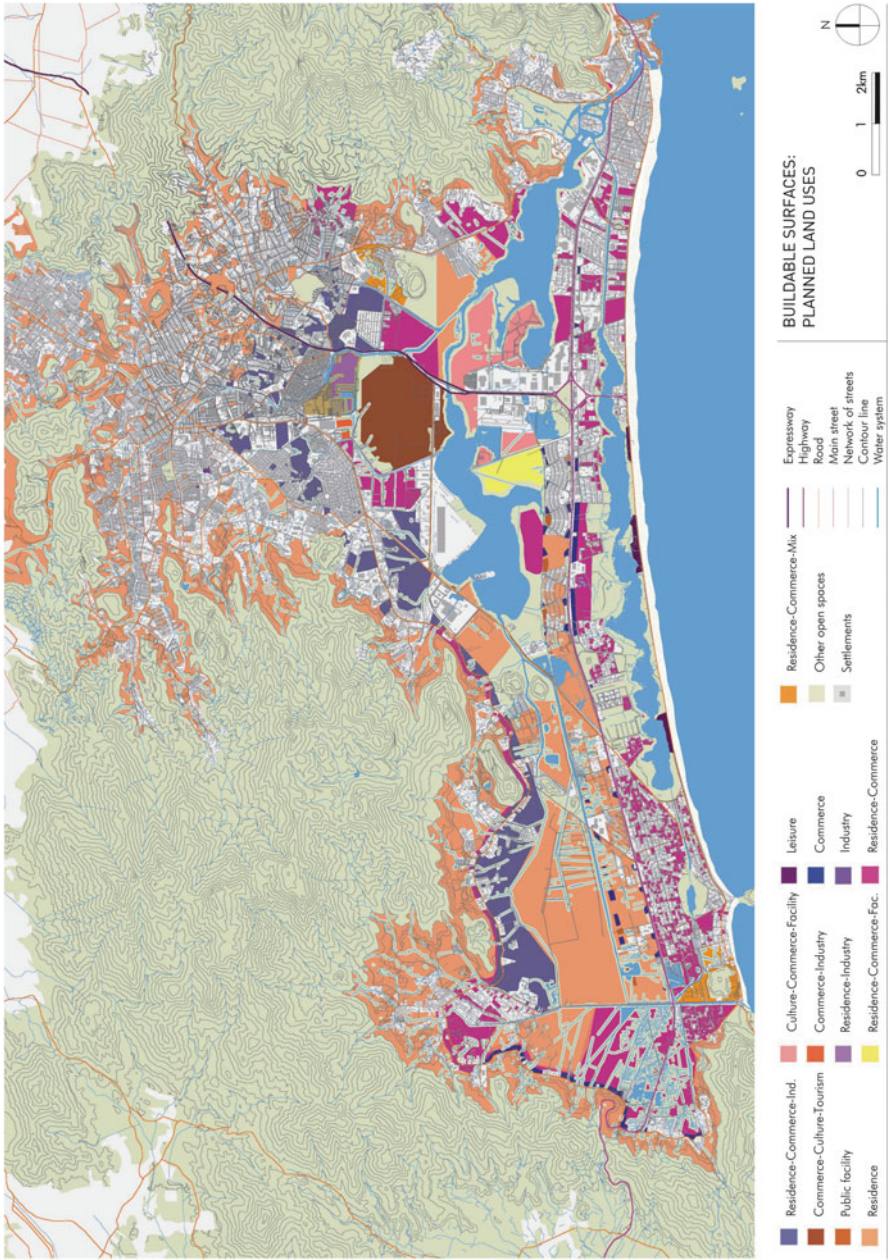


Fig. 5.26 Map of buildable surfaces and predicted land uses

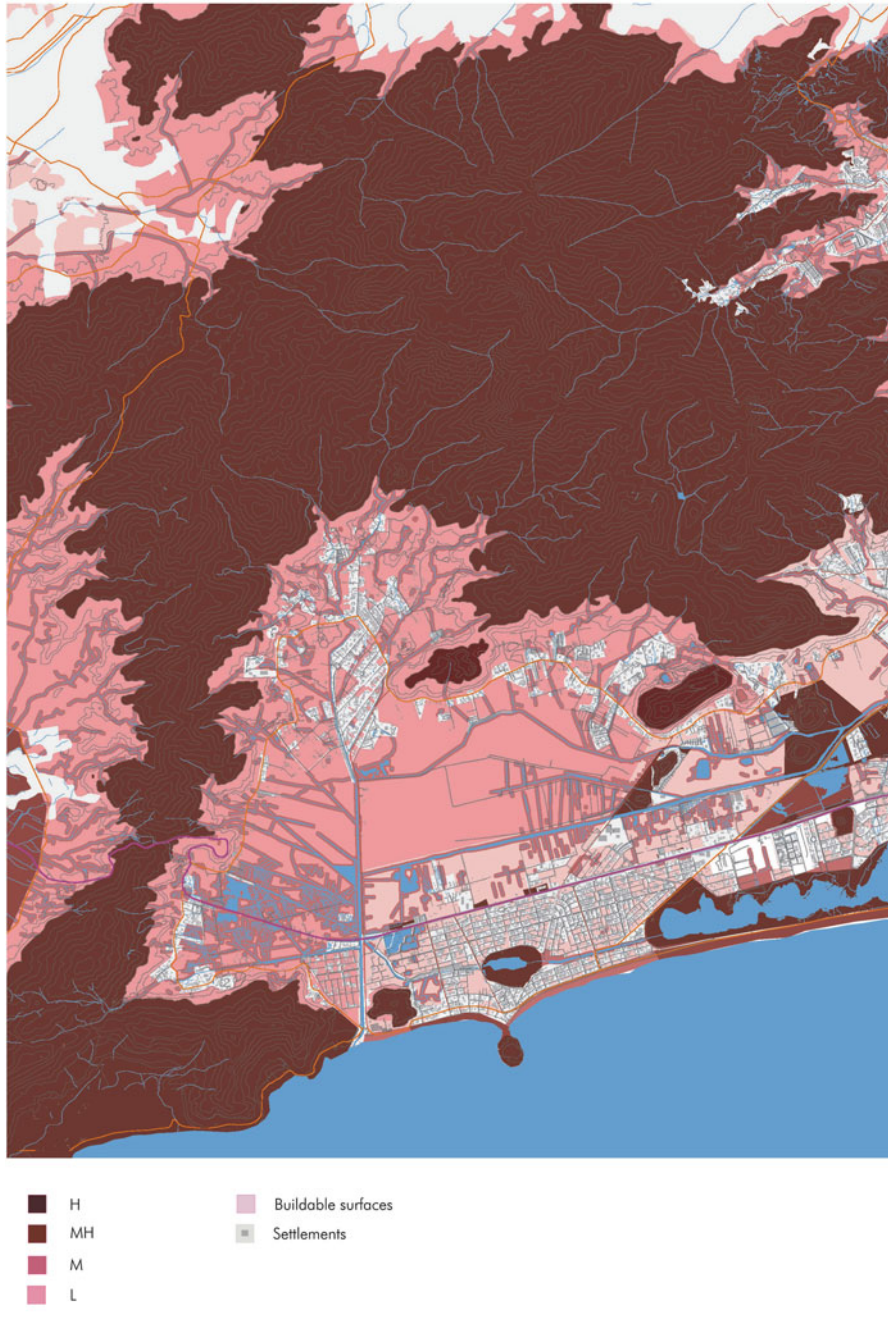


Fig. 5.27 Map of the final evaluation of protection parameters

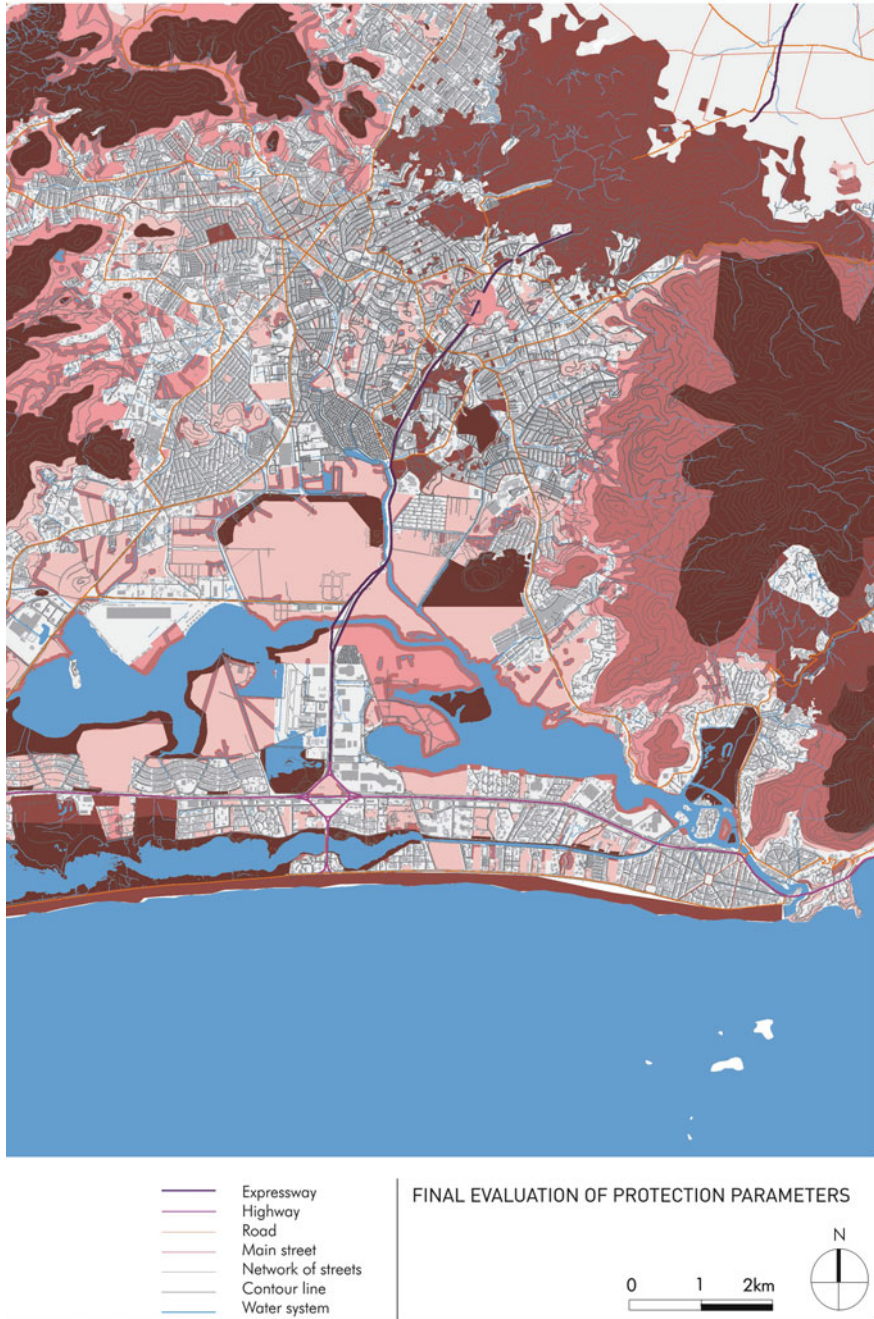


Fig. 5.27 (continued)

5.5 Synthesis of the Evaluation: Possible Spaces of Project Opportunity and Their Situation in the Territory

5.5.1 *Anchor Spaces*

Anchor spaces (Fig. 5.28) are spaces that obtain high and medium-high final ratings according to their biophysical attributes, and that possess a remarkable visual significance, although they can have different degrees of accessibility. Because of their characteristics, they are key spaces in the system of open spaces and would tend to be preserved from urban occupation. However, *anchor spaces* can establish important relationships with urban occupation when incorporated into an urban occupation project.

It should be noted when planning the system that the more accessible *anchor spaces* deserve greater attention, in terms of their propensity to be exploited and/or occupied and their suitability for the elements and processes in the spaces.

Anchor spaces have heterogeneities that give them special characteristics. The high values for visual perception and biophysical attributes together tend to characterize distinct spaces. Such spaces include those with clear ecological and/or visually recognized features for both vegetation (together with relief) and water. In fact, owing to the coincidence of the most preserved vegetation and great visual significance, most *anchor spaces* possess both strong ecological and strong visual features, for example. However, some spaces that have no remarkable biophysical value can also be recognized as spaces of high visual significance; e.g., some spaces of historical and cultural interest. On the other hand, some spaces of high biophysical value do not have high visual significance; e.g., marshlands.

Observation of *anchor spaces* in the study area reveals that they dominate the extent that they occupy. Some important references are waterways and their respective margins, Atlantic forest, and sandbank vegetation.

5.5.2 *Reference Spaces*

Reference spaces (Fig. 5.28) are spaces that obtain a medium or medium-low final rating in the evaluation of their biophysical support attributes and have unremarkable visual significance. They can have different degrees of accessibility. The spaces possess the least preserved vegetation, or are without vegetation, and are at medium or low risk of flooding or landslides.

Reference spaces can play distinct roles from protection to occupation according to their relationships with the surrounding areas, being open or occupied spaces. The *reference spaces* that are highly accessible may be very vulnerable to urban occupation and/or exploitation. If this is appropriate, this would require clear guidelines regarding future development taking into account the incorporation of the elements and processes of the open spaces in the projects to establish adequate

directives for the construction of settlements and roadway infrastructure or for activities in the open spaces, benefiting the integration of urban occupation.

Reference spaces occupy most of the land on the plains of the study area and are characterized primarily by anthropic fields, vegetation in floodable areas, cultivation, and gardens. On inclined slopes, they are represented by spaces with deteriorated Atlantic forest.

5.5.3 *Other Open Spaces*

The remaining open spaces are those without relevant visual perception or biophysical attributes and with varying degrees of accessibility. These spaces have exposed soils, without vegetation, and have little chance of suffering natural hazards. They are spaces likely to be occupied, especially if they have easy access.

However, even without having notable values, *other open spaces* (Fig. 5.28) can play important roles in the planning of the system of open spaces by supporting interventions aimed at restoring functional and spatial relationships in the open spaces related to biophysical support and visual perception and between the open spaces and their surrounding areas. Consideration is primarily given to the possible relations that *other open spaces* can establish with urban occupation to integrate the elements and processes of the settlements and roadways, the consequences of which can be significant for the composition of the whole system and in the restructuring of the territory.

Other open spaces are present in reduced number and size, as in sporadic cases on the plains of Jacarepaguá.

5.5.4 *Situation of the Spaces of Project Opportunity in the Territory*

5.5.4.1 *Continuities*

Continuities are spaces that, in addition to contributing to the ecological or visual quality of the place, through the maintenance of their attributes or their restoration, establish a close relationship with occupied spaces, thus integrating parts of the urban occupation in a continuous way. Continuities are thus important aspects of urban intervention projects and their implementation.

Continuities, especially those between *anchor spaces*, may promote the maintenance and development of natural elements and processes together with possible visual connections. At the same time, continuous *anchor spaces* that are not yet protected are places that maintain continuity under a constant risk of extinction through urban occupation, and they thus deserve protection. On the other hand, continuous *reference spaces* can be renewed to promote more biophysical and visual connections and they also deserve protection.



Fig. 5.28 Map of the synthesis of the evaluation



Fig. 5.28 (continued)

The observation of the *situation of spaces of project opportunity* in the study area reveals that, among the *anchor spaces*, waterways and their respective margins are the elements of greatest continuity. The group of *anchor spaces* represented by Atlantic forests, lagoons and their margins, marshlands, sandbank vegetation, and the beach are huge spaces that could be maintained to promote continuity. Other *reference spaces* of significant size, between *anchor spaces*, could be recovered to promote continuity because of their relative positions; e.g., most spaces with vegetation in floodable areas and anthropic fields (to the west of the plains).

5.5.4.2 Discontinuities

Discontinuities between open spaces are commonly associated with the presence of urban occupation that has been introduced, little by little, into the original space.

Discontinuities disrupt continuity between spaces according to their position, in that the spaces are more or less isolated and even spatially separated. Hence, discontinuities hinder the establishment of spatial connections in the system and reduce the possibility of recovering biophysical and visual perception attributes. In some cases, however, discontinuous spaces can provide an opportunity to relate settlements and roadways that have no interaction with each other, allowing greater integration of the elements and processes of urban occupation and reversing urban fragmentation. Discontinuities can also be occupied under certain conditions.

In the study area, because of intensive urbanization in the central and northern parts of the plains, open spaces are highly fragmented. They are mostly isolated and far apart, and contribute little to the connectivity of the area, although they can integrate surrounding occupied areas or be occupied under certain conditions. In this situation, we see empty lots and other open spaces related to industrial lots, public facilities, and urban service facilities. These lots could be renewed as elements for the development of new relations in the urban context.

5.5.4.3 Borders

The borders are the most immediate “filters” of open spaces and allow their appropriate treatment, according to the characteristics of each open space. This promotes the development of the elements and processes in the system of open spaces and those that can establish relationships with surrounding areas (Forman 1995; Pesci 1999, among others).

In this way, we see borders as places that highlight issues relating to the open spaces themselves (e.g., biophysical attributes and visual perception attributes) and to the spatial and functional relations they can promote. In this way, it is possible to integrate and structure the occupied surroundings, including in terms of social uses of the land.

The borders between open spaces that are highly evaluated have high potential for preservation. In contrast, the borders between highly evaluated open spaces and degraded open spaces may represent a limitation of natural processes and a negative

effect on the visual quality of the spaces. Similarly, poorly evaluated occupation or exploitation (e.g., junkyards and dumps) near *anchor spaces* tends to be a degrading factor of visual quality, besides possibly degrading biophysical attributes. Thus, they are places that possibly require intervention in the planning of the system of open spaces with the intention of promoting their preservation and rehabilitation.

Borders vary in their vulnerability to the possibility of urban occupation. Both high and low vulnerability may represent opportunities for intervention that respects the attributes of the open spaces and seeks the best conditions for their development and also their possible interrelationships with the occupied surroundings.

The most vulnerable borders are those close to roadway infrastructure and those with slightly rugged topography, combined with good soil and drainage conditions, which are favorable for occupation. However, facing the possibility of occupation, and apart from the maintenance of biophysical attributes and visual quality of the spaces, there is the opportunity to recognize borders as areas that can integrate contrasting spaces and interrelate their elements. These are possibilities of merging open and occupied spaces, merging their natural and artificial features, exacerbating their differences, and promoting their improvement. In the study area, such borders include much of the central and western parts of the plains, the least steep slopes of the massifs, and most open spaces along the coastline.

Among the less vulnerable borders are those not suited to roadway infrastructure or occupation, owing to their very irregular relief, unstable soils, and poor drainage, among other factors. These are areas where the maintenance of biophysical attributes and visual quality is also advisable. They also present the possibility of establishing a close relationship with urban occupation, mainly through the possible continuities of the elements of the open spaces (such as water or vegetation) within the occupied areas. An example of such borders in the study area is most of the open spaces in the massifs and marshlands, to the west of the plains.

5.5.4.4 Assurances and Threats Related to Existing Planning Rules

In planning the system of open spaces, it is necessary to verify, besides the possible *spaces of project opportunity* and their features, the assurances and threats relating to whether these spaces remain open or become occupied. This verification is in accordance with the final evaluation of the protection parameters established by the planning rules. According to current planning, the following situations are possible for open spaces that deserve protection.

- Favorable situations (Fig. 5.28) in which protection instruments having high and medium-high levels of spatial precision and restrictions on urban occupation are approved. The area in question thus receives certain assurance, in accordance with the planning, that it will remain as open space.
- Unfavorable situations in which protection instruments of low or medium level are approved, or where building is allowed. Resolving these situations is a great challenge requiring management efforts (although in some cases it can be

extremely important), once the threat of occupation is considered latent issue for the consolidation of the system.

The evaluation of *spaces of project opportunity* could determine the need for more or less protection, but this may conflict with the conditions imposed by current planning rules, which do not always coincide with the results of this assessment. In any case, it may be that *anchor spaces* do not have notable protection, or that *reference spaces* or areas without relevant biophysical and visual attributes are strictly protected.

Some areas favored in the final assessment of the protection parameters coincide with *anchor spaces*. Such areas include most of the forest area above an elevation of 100 m; areas of mangroves and large areas of sandbank vegetation; areas considered open spaces of historical and cultural interest; areas scattered across the plain, such as the Freguesia woods and Barra woods; and other areas to the west of the plains, such as Morro do Cantagalo, Amorim, Portela, and Urubu. The coincidence between conditions favorable for the protection of *anchor spaces* reinforces the high evaluation of these spaces, previously observed, and tends to secure the permanence of the spaces in the planning of the system of open spaces and as a basis for the structuring of urban occupation.

Some *anchor spaces* do not coincide with areas favored in the final assessment of the protection parameters. Such areas include a significant part of forest areas on the Tijuca massif, the marshlands, part of Recreio dos Bandeirantes beach, and forest areas of Colônia Juliano Moreira. This highlights the threats of occupation in these areas, which should be observed and managed.

There are also rare instances of favored assessment overlapping with *reference spaces* and *other open spaces*. This allows their consideration in the planning of the system of open spaces through the state of protection that has already been established. In general, this situation occurs when the protected area is larger than the area that needs to be protected, which acts in favor of environmental preservation.

Favorable situations are those in which the open spaces are already protected by planning rules and can be used as parts of the system. With regard to unfavorable situations, one can highlight the need to determine which spaces should be part of the system of open spaces as unoccupied areas and which should be occupied under certain conditions, according to dynamics relating to the urban context, biophysical support, and visual perception, going beyond the consideration of the link to planning rules. The transformation of an area in which building is permitted into an area without buildings is an enormous challenge. If we consider that urban occupation is allowed in unprotected areas, reversion of the protection framework in planning the system of open spaces and restructuring the territory is an issue (Table 5.1).

Table 5.1 Analysis and evaluation of the attributes of open spaces

Analysis and evaluation of the attributes of open spaces			
Variable	Partial evaluation		Final evaluation
Attribute of biophysical support			
Vegetation	Preservation		H/MH/M/ML/L
	H/M		
Hydrology	Flood and landslide risk		
	H/M/L		
Slope gradient	Landslide risk		
	H/M/L		
Edaphology	Agricultural aptitude		Not considered in the final evaluation of biophysical attributes
	H/M/L		
Attribute of visual perception			
Scenic elements	H		H
Areas with visual prominence	H		H
Scenic backgrounds	H		H
Open spaces of historical and cultural interest	H		H
Accessibility from existing and planned routes			
Expressway and highways			H
Roads			MH
Main streets			M
General network of streets			L
Link to planning rules			
			Protection parameters
			According to
			– Restriction of urban occupation.
			– Spatial limit established by each instrument.
Protected surfaces			H/MH/M
Macro-zones (restricted to urban occupation)			L
Buildable areas			Not considered in the final evaluation of protection parameters
Synthesis of the evaluation			
	Final evaluation of attributes of biophysical support	Final evaluation of attributes of visual perception	Final evaluation of accessibility
Spaces of projectual opportunity			
Anchor	H/MH	H	Any
Reference	M/ML	–	Any
Other open spaces	L	–	Any
Assurances of and threats related to existing planning rules			
Protection assurance	Final evaluation of protection parameters (H/MH)		
Occupation threat	Final evaluation of protection parameters (M/L)		

Chapter 6

Proposals of Concrete Project Strategies: Planning the System of Open Spaces and Restructuring the Urban Territory

This final chapter, on the basis of the previous analysis, proposes *project strategies* that allow the planning of the system of open spaces and the restructuring of the urban territory, thus creating combined strategies for open and occupied spaces and reinforcing the relationship between planning and design concepts. The objective is to maintain and develop the dynamics of the open spaces and relate open spaces to each other and structure the urban occupation. Thus, the *project strategies* are suggestions for the planning of open spaces and an opportunity to restructure the territory, and involve the following.

- *Project principles* for planning the system of open spaces are proposed as project guidelines for open spaces. These *project principles* refer to the system of open spaces and the functional, spatial, and synergic relationships that the parts of the system establish between themselves and with the urban occupation, and they maintain or recreate the different dynamics of the open spaces and give new order to the urban structure. The *project principles* can be applied to each of the open spaces and provide guidance for future urban occupations.
- *Project actions* for planning the system of open spaces are strategies for the structuring of the system of open spaces as guidelines for future urban occupation. These *project actions* are established following the previous analysis of the *spaces of project opportunity*, their *situation* in the territory, the relationships they establish with their surrounding areas, occupied or not, and the structuring character that each open space has in the system and related to urban occupation. The *project actions* thus structure the system of open spaces and urban occupation. As a result of this relational analysis, the *project actions* may indicate possible roles that the spaces could play in the planning of the system of open spaces and, consequently, in restructuring the territory. These *actions* are *adding, delimiting, connecting, adapting, articulating, and linking*.
- The system of open spaces and planning instruments allow effective consolidation of the system of open spaces. Opportunities offered by the existing planning instruments are identified and it is possible to reclaim the necessary flexibility in planning to allow consolidation of the system of open spaces as a guide for spatial planning.

These *project strategies* therefore endorse the clarification of the complex nature of open spaces that one can use in constructing urban territories, where urban occupation and open spaces comprise a whole, and the planning of the open spaces in a system can substantially affect urban occupation. In other words, it is proposed to plan the system of open spaces with the intentions to protect, define, and relate the spaces to each other and structure roadways and settlements, whether existing or yet to come, thus redefining the structure of the urban territory.

6.1 Project Principles for Planning the System of Open Spaces

The objective here is to establish *project principles* for the planning of the system of open spaces as a strategy for restructuring the territory according to the following relationships.

- Functional relationships in the system consider the importance of the development of the dynamics related to the biophysical matrix, visual perception, and accessibility in the adequate designation of urban land uses and exploitation activities in open spaces. Thus, the dynamics of open spaces are maintained and relations between open spaces and their surrounding areas are established.
- Spatial relationships in the system are based mainly on the necessity for continuity between the open spaces of the system as a fundamental condition for the structuring of both the system of open spaces and the surrounding areas. This affects the spatial orientation of urban occupation and the exploitation activities.
- Synergic relationships in the system correspond to the functional and spatial relationships between open and occupied spaces that are closely interrelated. This allows the development of the dynamics of the open and occupied spaces through interventions in open spaces for the creation of new urban structures in the territory, with possible repercussions for both open spaces and occupied spaces.

6.1.1 Functional Relationships in the System: Designation of Land Uses and Activities

The observation of functional relationships established in open spaces can aid the establishment of equilibrium of the elements and processes of urban land uses and exploitation activities, as a factor of physical and functional limitation. Functional relationships can be characterized as factors for structuring the system by pointing to the places that are more or less able to be occupied and/or exploited, according to the conservation and development of existing dynamics of the open spaces.

The objective of recommending which pieces can be occupied, and how occupation should be carried out, is to provide directives of intervention in the territory that will preserve resources, through occupation that is more responsible than just random, expansive, and speculative occupation.

Beyond the possibilities of preserving resources facing urban occupation, the importance of the exploration of functional relationships for culture and urban life is undeniable owing to the social and economic values of the relationships in agriculture, tourism, leisure or the extraction of raw materials. In this direction, the recommendations for occupation can direct the conscious use of the resources of open spaces, and they demonstrate comprehension of the narrow relationship between human needs and experiences and nature in the urban context.

6.1.1.1 Functional Relationships in the Biophysical Matrix

Functional relationships in the biophysical matrix can indicate criteria related to the possibility of whether a space will be occupied, and how such occupation should be carried out, beyond determining the most adequate locations for distinct exploitation activities in open spaces. The recommendation for occupation is based on biotic and abiotic elements and the fundamental characteristics of their maintenance.

The characteristics of biophysical elements in open spaces, which can determine the possibilities of urban occupation and exploitation activities, also relate to the general dynamics of natural processes in the system of open spaces. Although biophysical elements and their respective dynamics develop in local situations, they are linked to a context determined by hierarchical levels, which are interrelated and interdependent, where the upper levels establish the operational guidelines of the lower levels (Forman 1995). In this relationship, there is superior logic related to the operation of the biophysical elements that coordinates the inferior manifestations and determines the dynamics of the natural processes and their flow. Here the occupation or exploitation activity may be incompatible with the conditions dictated by these dynamics or may need to adapt to the conditions.

As an example, deforestation around headwaters decreases the volume of water. In the same way, the reduction of forests negatively affects the whole water cycle, whether it is the elimination of the intermediate passage of water through vegetation or the increased possibility of erosive impact of water on soil, mainly observed on steep slopes. Therefore, the maintenance of forests on slopes can prevent erosion and allow hydric retention, which favors the water cycle (Hough 1995).

Given that the natural processes are connected to the biophysical matrix, the open spaces would have functional, general, and superior logic. Owing to the reach and importance of the logic in the development of natural flows of the system, the logic can be considered as guidelines for possible future occupations and activities in each space, by viewing the group of spaces in the totality of the system.

This leads us to suppose that the recognition of the functional logic of the biophysical matrix in the system of open spaces can be translated into *principles* for the planning of the system from the local to the general scale, as parameters for urban intervention. This would permit the proposal of conditions for the development of urban occupation and exploitation activities. In this sense, the guidelines could suggest, for example, the protection of the most fragile vegetation from urban growth with physical barriers in cases of explicit risk of urban invasion; the limiting of occupation in a way that guarantees the necessary permeabilization of soil; and the structuring

of urban occupation by incorporating the dynamics of the biophysical matrix in the processes of construction; e.g., respecting the dynamics of water (Figs. 6.1 and 6.2).

6.1.1.2 Functional Relationships in Visual Perception

The visibility of the most significant physical characteristics of open spaces can be considered a reference for the orientation of exploitation activities and the conditions placed on possible urban occupations. This is done with respect to the physical integrity of the spaces as a guideline for the restructuring of the territory.

The permanency of the physical characteristics of a landscape with the most visual significance tends to favor the appropriation of open spaces by the population as a collective manifestation. The enhancement of this appropriation usually serves as an instrument for environmental conservation and for validation of the sense of belonging of the community that daily uses that space (Lynch 1976; Hough 1995).

The collective character of an open space does not necessarily mean that the space should be public. Its collectivity refers to the physical and/or visual access independently of whether the space is public or private, which facilitates the establishment of codes and common experiences. However, the transformation of some private open spaces into spaces of public use may be beneficial, in the case that there is great public interest in the singular attributes of the open spaces.

Some of these spaces, being highly exposed topographically, have vulnerable visual quality, especially when the visual appeal is affected by urban occupation or exploitation activity. Therefore, careful consideration is required for future interventions, which could deteriorate characteristic physical structures in the surrounding areas or the space itself.

The visual vulnerability can be measured, particularly in relation to the vegetation and topographical characteristics of the area (orientation and slope gradient). That is, if an area is highly exposed, being on a steep slope for example, it will be more visible and more vulnerable to interventions that adversely affect the perception of the whole. Likewise, an area will be more visually vulnerable if it possesses specific conformations that cannot hide possible alterations resulting from use or occupation; e.g., in the case of small vegetation that cannot visually sustain its characteristics after intervention (Bolós 1992).

Possible degradation of the visual perception of open spaces can, however, result from alterations on the scale from scenic elements to scenic views, where the two scales are linked in reality as they are fundamental parts of the landscape. To this extent, interventions in the visual composition of open spaces should consider the scale of the alterations that can result and their respective impacts; it is then possible to prevent visual degradation of the landscape.

The most significant visual characteristics are usually those of places suitable for urban occupation or exploitation activities related to recreation or tourism. According to their implementation, these uses can work against the maintenance of visual quality in these areas, affecting them irreversibly. Thus, careful and preferably beneficial interventions are required. Moreover, there are different situations of visual conflict in open spaces, such as quarries and high tension lines, which require effective control.



Example of intervention illustrative of *project principles* based on functional relationships in the biophysical matrix:

Fig. 6.1 and Fig. 6.2 Recuperation of waterways and margins of the Gállego River, Zuera, Spain, 1999. This is an example of a delimited and projected margin that controls urban occupation and guarantees the permeabilization of the soil, offering a space for leisure in the city (Source: Arqto. Iñaki Alday Collection)

On the other hand, the incorporation of the most significant physical characteristics of open spaces (e.g., scenic elements, scenic backgrounds, areas with visual prominence, and open spaces of historic and cultural interest) into the structure of urban occupation and into exploitation activities provides alternatives for interventions that afford new relations between the spaces and their surrounding areas. This can be done, for example, through the maintenance or re-interpretation of the elements and processes, involved in the conformation and presence of the physical characteristics as structuring elements of the occupation and/or activities. In this sense, visibility has a deep relation with human experience and needs, beyond being a physical concept.

6.1.1.3 Functional Relationships in Accessibility

The accessibility of open spaces is important to the designation of appropriate urban land uses and activities. The roadway network usually stimulates new settlements and exploitation activities that depend on access for development and, at the same time, the network can be an obstacle to functional relationships of the system owing to incompatibilities with the dynamics of the system.

Accessibility, however, can also represent opportunities for intervention that favor the maintenance of open spaces and their resources and functions, in areas facing occupation and exploitation activities.

In many places today, settlements that have developed along highways and expressways often have a dispersed character, with low built density and without functional autonomy. Moreover, along these roadways, there are large commercial buildings and other buildings that are positioned in direct relation to the road, taking advantage of the accessibility and exposure afforded (Font et al. 1999). Both types of settlements tend to extend through the territory and conflict with the maintenance of the attributes of open spaces and their functions.

However, in addition to the creation of new settlements, existing roadways are able to compress current settlements and create urban nuclei that are more compact and self-sufficient. The creation of more compact and self-sufficient nuclei can avoid the need for new roadway infrastructure, the dispersion of settlements through the territory, and greater displacement. Consequently, such nuclei can promote lower energy expenditure, reduce air contamination, and reduce soil impermeabilization. In this sense, accessibility to open spaces is an important factor in the management of future urban occupations in terms of the convenience of maintenance of open spaces.

Likewise, in terms of future exploitation activities in open spaces, the accessibility of open spaces allows for alternative uses that are low impact and provide conservation, enjoyment, and even the development and betterment of biophysical and visual perception attributes. It is recommended to take into account the current use and adequacy of the spaces, together with the needs and wants of the community.

On the basis of these arguments, indications for interventions can be suggested. Examples are the signaling of existing uses that are undesirable because of their noxiousness to the environment, such as quarries or mass tourism in more fragile areas, including the redirection of these activities to more suitable areas; limiting the

contact of the most fragile points with the roadway network, such as points that are more subject to exploitation, thus clearly delimiting the proliferation of undesired activities that adversely affect the spatial structure of open spaces; and controlling types of access to open spaces, according to their dynamics; e.g., according to the values and formal possibilities of each type of vegetation and water.

6.1.2 Spatial Relationships in the System: Maintenance of Continuities

For the system of open spaces, it is necessary to guarantee open and continuous spatial contact among the pieces as a fundamental condition for the system to work as an integrated whole, where the breaking of spatial relations tends to affect the functioning of the whole or part of the whole.

Continuities are important for the system of open spaces, and the spaces should thus be contiguous. Furthermore, continuities can affect the structures of both open spaces and their surrounding areas. The possibility of establishing/maintaining continuities between open spaces can determine the most opportune places to guarantee continuities and, consequently, the spatial orientation of the urban occupation and exploitation activities. Thus, ensuring continuities among pieces of the system of open spaces could work as a directive to control the development of the occupation and activities that may adversely affect the integrity and diversity of the dynamics of open spaces.

6.1.2.1 Spatial Relationships in the Biophysical Matrix

Continuities in the biophysical matrix allow for biological connectivity among animals in search of food and mates, and ecological connectivity, which includes abiotic flows (e.g., flows of air, water, nutrients, and soil). Continuities are usually a spatial bridge between distinct ecosystems and they can include various habitats. On the other hand, continuity allows for the maintenance and development of the diversity of the plant mosaic and distinct types of spaces occupied by water, which co-exist and co-evolve (Forman 1995; Hough 1995, among others).

The maintenance and restoration of the continuities thus act against fragmentation of the ecosystems and consequently favor the maintenance of the diversity of the ecosystems and the entire development of natural processes of the ecosystems. Such maintenance and restoration thus constitutes possible limits on and directives for the structure of urban occupation and exploitation activities. Biophysical continuity tends to avoid the interruption of natural processes, whether in the form of a road, an embankment, or division of the land. Such interruption would disturb the biotic and abiotic structure of the place and interrupt energy exchange through physical impacts, which would generally favor ecological degradation and can be a grave risk to urban occupation. Therefore, reforestation of compartmentalized areas and reestablishment of volumes of deteriorated waterways or wildlife corridors along roadways, among other solutions, are enormously important to the spatial composition of these continuities and their surrounding areas, thus benefiting the biophysical dynamics.

The borders of the biophysical continuities are usually fragile, and can easily deteriorate, especially near areas of urban occupation. This requires spatial solutions that can foster flexibility in the biophysical borders of vegetation and water, through transitions that develop functional nuances and relate them to the urban occupation. That is, it is advisable to create conformations of borderlands that allow such dynamics, whether they are the rise or fall of water or the gradual exchange of the type of vegetation, as areas for high mobility among animals and for transition to vegetation. This action favors the growth of uncultivated plants for example, and conserves biophysical dynamics in general (Forman 1995).

In this sense, the maintenance and restoration of the continuities of the biophysical matrix and the inclusion of the biophysical matrix in the structuring of urban occupation and exploitation activities tend to work as a spatial reference and limit actions within open spaces.

6.1.2.2 Spatial Relationships in Visual Perception

The visual perception of the landscape through open spaces also demands a certain level of continuity between open spaces. This requires the observer to be able to identify and enjoy the visual features of a place without significant interruption, thus allowing the physical elements and their insertion within the landscape to be perceived as a whole.

In this sense, the maintenance of the visual continuities of open spaces allows recognition of the landscape. The maintenance may require the consideration of the visual “potential” of each piece of open space and its visual link to the territory, which would allow suitable measures to be taken to positively associate the visual attributes of the spaces with the structuring of the urban interventions and exploitation activities in terms of visual continuity.

The visual continuities of open spaces can have distinct forms. Frequently, visual continuities are related to the type of access; e.g., a road, path, passageway, water, or trail. These act as corridors that tend to offer an articulated vision of a place, which is more than the experience of fragmented and discontinuous information. These continuities can form an image of a place through visual cohesion, allowing the reading of a sequence of events and facilitating the collective and personal identification of the place (Lynch 1976; Alexander 1977, among others).

The visual continuities give value to the perception of the diversity of existing spatial mosaics in the open spaces and can be ensured by maintaining existing views or by creating targeted access routes. Such routes are established mainly for visual enjoyment; e.g., routes that traverse the most visually valued spaces and allow the integration of the most featured elements.

For the maintenance of these continuities, it is indispensable to determine areas requiring careful intervention, according to their visual significance. This requires the spatial orientation of urban occupation and exploitation activities with the objectives of rehabilitating the architectural heritage present in the open space; having the largest possible opening of the most visually significant places; and creating new perspectives that give value to spatial structures and do not hide the outlines of the

main elements of the relief (e.g., hills and ridges), which means special care must be taken with the skylines of buildings and their intersection with views. Thus, occupation close to water should be avoided as it tends to block the view of rivers and the sea (Zoido 2002).

6.1.2.3 Spatial Relationships in the Access Network

The access network is continuous and enables the establishment of spatial relationships among open spaces and among the open and occupied spaces. This same network, which frequently fragments open spaces and the territory on the whole, can also physically and visually connect open and occupied spaces.

The access network is made up of distinct types of access. They can be trails bordering water or passing through vegetation, rural routes, the water itself, and roadway infrastructure.

In the context of urban territories, access routes are the elements that most reveal the continuity among territorial and urban open spaces. The network inter-relates spaces of different scales, makes the natural and urban processes visible, and allows movement through the territory (Lynch 1976).

Access routes can highlight the dynamics in open spaces and occupied spaces; e.g., dynamics related to the biophysical and visual perception attributes of open spaces and dynamics related to building heritage. In cases that open spaces appear more like spaces that separate settlements, inducing their isolation, continuities through access routes can transpose barriers and allow greater integration among settlements and among settlements and intermediate open spaces.

The access network allows possible conciliation between territorial open spaces, which are frequently isolated or abandoned, and urban open spaces. This can be a directive for more general urban interventions that are not only centered on the recuperation of the access network but also take into account the extent of the network in the territory linking territorial and urban spaces in an alternative way, according to low impact routes with low capacity for flow of vehicles and people.

It is therefore important to define a hierarchy of routes and to propose new routes that penetrate the natural space and connect urban and rural routes in an enjoyable and civic manner, recuperate the waterways, and provide pathways for pedestrians, bicycles, and horses along their margins, among other possibilities. It is also important to have a good network of public transport, which would foster greater interaction among open and occupied spaces (Figs. 6.3, 6.4 and 6.5).

6.1.3 Synergic Relationships in the System: Interconnection of Open and Occupied Spaces

Synergic relationships correspond to the close functional and spatial interconnection between open and occupied spaces. Synergic relationships assume this interconnection as an important factor in the structuring of both types of spaces, and are beyond



Example of intervention illustrative of *project principles* based on spatial relationships in the network of accesses:

Fig. 6.3, Fig. 6.4 and Fig. 6.5 Generación del istmo de la Lanzada, Pontevedra, Spain, 1994. This is an example of the proposal of a network of trails that creates paths and penetrates the natural space (Source: Arqto. Fernando Agrasar Collection)

simple adaptation or mutual respect between the spaces. The interconnection of open and occupied spaces entwines the two types of spaces and determines where other forms of open space can exist. These forms differ from the open spaces of traditional parks and reserves, and present two-way agreement between open and occupied spaces, in which the open space is able to accept and give new structure to urban occupation and the urban occupation would guarantee “vital” conditions for the open spaces in a complementary manner (Hough 1995; Battle 2002; Pesci 2003, among others).

It is at the “meeting” of distinct realities that the richest opportunities for exchange, proximity, aggregation, and attraction are presented. These are special places for clarifying spatial and functional processes in the landscape with the goal of providing consistent, enriching, and innovative solutions that create spaces adaptable to the realization of different dynamics. These are heterogeneous places and their most important relationships are the dynamic relationships and balance between open and occupied spaces. These “meetings” are thus viewed as opportunities to join open and occupied spaces and inter-relate their differences to produce an aggregated and continuous territory (Pesci 1999; Corner 2006; Waldheim 2006).

On the basis of the above, there is the possibility to conform complex urban structures by taking into account the interconnection between open and occupied spaces. This would allow the mixing of formal instances and uses that would guarantee the sustainability of the environment, thus shaping what can be identified as *synergy spaces* and bringing together open and occupied spaces by creating other references for the structuring of the territory. Hence, it is possible not only to create and implement environmentally correct urban solutions but also to present another way of seeing, building, and interpreting the territory and implementing alternative interventions in open and occupied spaces.

6.1.3.1 Urban Nature

Urban nature is the intersection of urban and natural environments, and it acts to avoid the separation of the two environments. As *synergy spaces*, *urban nature* may be part of the urban dynamics, through which urbanization and its main functions develop. This situation may arise through the penetration of the biophysical matrix in settlements, which determines the spaces around which buildings, lots, routes, and urban open spaces could be structured. This affects the definitions of land uses in terms of the type and density of occupation and the possibility of expansion or restriction of occupation, favoring a closer relationship between open and occupied spaces.

At the same time, *urban nature* tends to act as urban elements of connection between different parts of the city. It can indeed structure a whole city. Examples of such cases are rivers that are the main axes of urban centers and that establish relationships among settlements, uses, and people; hence, they serve as axes of attraction in the city.

On the other hand, *urban nature* offers the possibility of inserting urban uses into areas of nature since *urban nature* is directly related to the population. *Urban nature* also allows, in some cases, the functional and spatial balance of urban occupation in

the surroundings of open spaces by eliminating possible deficiencies, mainly in densely populated areas, in the availability of public facilities or public open spaces, which can be inserted into *urban nature*. The creation of public facilities in nature can bring the community closer to nature, by establishing a hybrid border having different but not contradictory features. This demonstrates the recognition of natural elements in occupation construction and the provision of facilities for settlements.

In *urban nature*, such as areas of riverbeds and their margins, woods, and beaches, the attributes of the place and its resources can be used to establish and maintain spaces of nature and their use by the population; e.g., through the insertion of water-related activities, timber extraction, or agricultural techniques and crops, in accordance with the visual and biophysical dynamics of the open spaces. This optimized use of natural and visual resources may also result in good maintenance and management conditions for open spaces, which will positively affect public and private investment and is a way of controlling the occupation of the territory (Hough 1995).

However, reaching the goal described above would require important actions such as identifying activities and land uses that are compatible with each open space and their respective spatial delimitation; delimiting places to be fully preserved or places that may have a more variable pattern between the natural, the recreational, the rural, and the urban; delimiting areas that are suitable for the establishment of public facilities and areas for common use; and creating support infrastructure for tourism and leisure activities that is compatible with the place, the activity, and the number of people that are expected there.

In certain circumstances, restoring such nature in a context of restructuring the territory may be the start of simultaneously renewing a natural area and urban area, where the possibility of establishing new functional and spatial relationships may produce synergies that lead to sustainable use and highlight the intersection between nature and urban occupation.

6.1.3.2 Recreated Scenery

The concept of *recreated scenery* represents the spatial and visual “re-signifying” of degraded open spaces and allows us to contemplate actions that produce beautiful landscapes, besides possible biophysical and urban improvements, adapted to collective and sustainable uses such as the creation of true parks from obsolete agriculture and the renewal of residual open spaces in urban occupation. In many cases, as *synergy spaces*, *recreated scenery* leads to the reshaping of ordinary open spaces, large and small, into spaces that are connected to their surrounding areas, thus inviting visits, participation, and gatherings while relating settlements and roadways and being new references for the territorial structure.

As an example, the recreation of scenery from agriculture may restore the quality of cultivated fields through intervention programs that contemplate both production and recreation, among other activities complementary to the settlements in the surrounding areas. Additionally, this intervention provides opportunities for the visual reshaping of degraded fields, in the interests of tourism and social activities for example (Hough 1995) (Figs. 6.6, 6.7, 6.8 and 6.9).

In this context, given the possibility of renewing obsolete agricultural land into *recreated scenery* and considering that such land is usually destined for urban expansion (especially if productivity is unsustainable), one can emphasize the importance of the permanence of these areas in structuring the surrounding areas, spatially and functionally, especially if the agricultural areas are of significance to the traditions and common practices of the locals.

The *recreated scenery* may correspond to fully regenerative interventions in seriously degraded places, which are generally marginal or oriented toward uses that are not to their benefit, such as dumps and quarries. These places may provide public open spaces in peripheral areas and may create certain conditions that, in some cases, encourage urban regeneration.

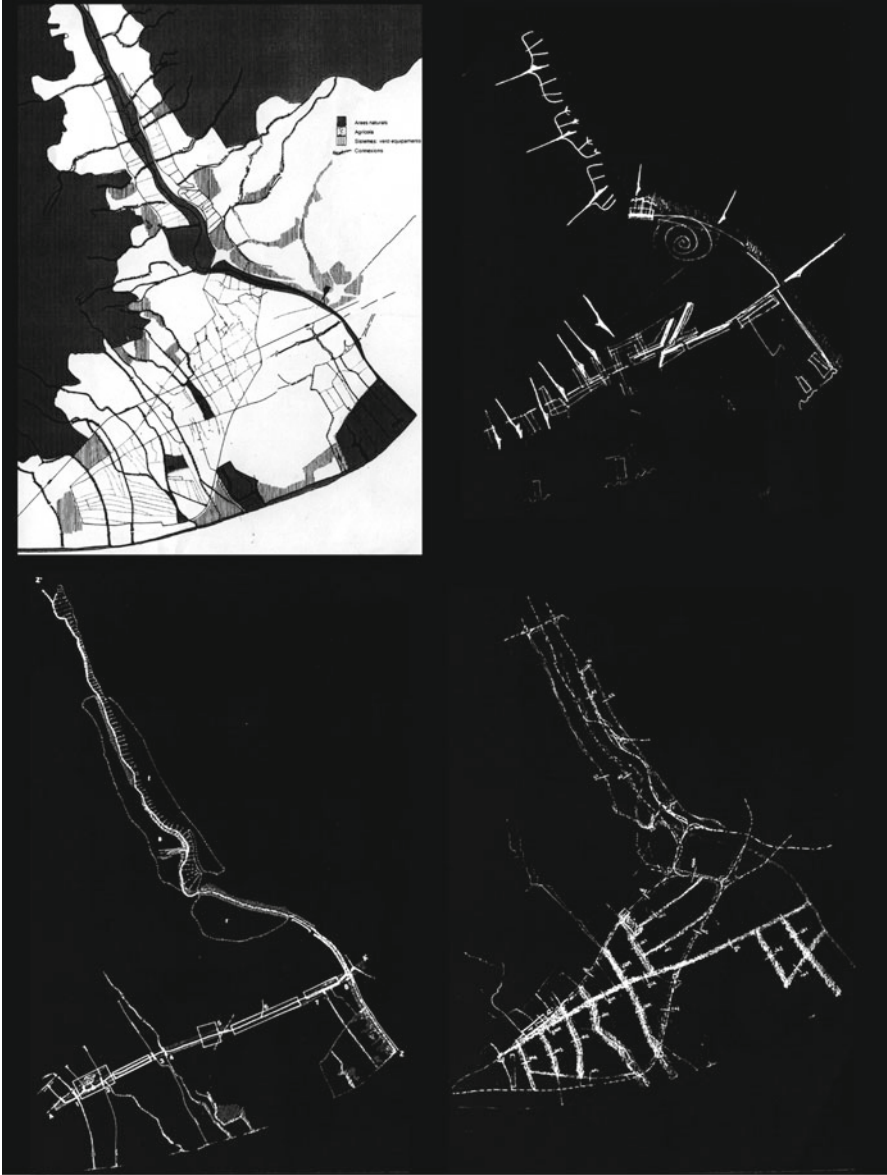
This can be the case also of deteriorated waterbeds that can be recovered. Such transformation indicates the renewal of the spatial and functional structure of natural elements, and a change in their urban functions. Waterbed projects that regenerate the quality of the water and the water margins provide physical conditions suitable for public use, and can start a process of improving the surrounding areas by providing new uses and types of settlement and renewing old settlements. This process can be seen in many parts of world, mainly in city centers, such as in Singapore.

The *recreated scenery* may also mean the developing of gardens in residual areas that have not been used for urban occupation (e.g., empty lots, large public facilities, and industrial lots) as part of the system of open spaces, and it may also benefit the integration of urban occupation. These gardens might combine local natural elements with small-scale agricultural, artistic, and functional interventions, and leisure, which besides visually reshaping the spaces for the community, may be associated with urban renovation initiatives, mainly, in areas of obsolete occupation (Hough 1995).

6.1.3.3 Landscape Roadway Infrastructure

The roadway infrastructure, besides allowing urban occupation, facilitates movement throughout the territory and contact between settlements and open spaces, is a group of elements having spatial characteristics that usually promote the physical separation of settlements and open spaces. Additionally, in the case of open spaces, roadway infrastructure may degrade biophysical and visual attributes for example. These dissociations of roadways in open spaces suggest the possibility that the roadway can be a *synergy space*, or a space of connection, having a landscape that conforms to the open spaces. This can bring, by itself, new meaning to traditional conflicts between roadway infrastructure and open spaces.

The presence of roadway infrastructure tends to result in conflicts of biophysical nature that deserve attention, such as the possibility of a “barrier effect” as the roadway infrastructure hinders the passage of individuals within an ecosystem. Roadway infrastructure also fragments the natural habitat by interfering with water flows through ill-adapted bridges and viaducts and through soil erosion, mainly on steep embankments (McHarg 1969).



LÓGIQUES DE PROJETE

Example of intervention illustrative of *project principles* based on synergistic relationships in *recreated scenery*:

Fig. 6.6, Fig. 6.7, Fig. 6.8 and Fig. 6.9 Parc agrari del Baix Llobregat, Barcelona, Spain, 1999. This is an example of a project for an agricultural area that maintains farming activity and introduces new functions, such as tourism, by improving the visual and biophysical qualities of the area and by representing a new urban structure with repercussions in the territory (Source: Arqto. Joaquín Sabaté Collection)



Fig. 6.6, Fig. 6.7, Fig. 6.8 and Fig. 6.9 (continued)



Fig. 6.6, Fig. 6.7, Fig. 6.8 and Fig. 6.9 (continued)

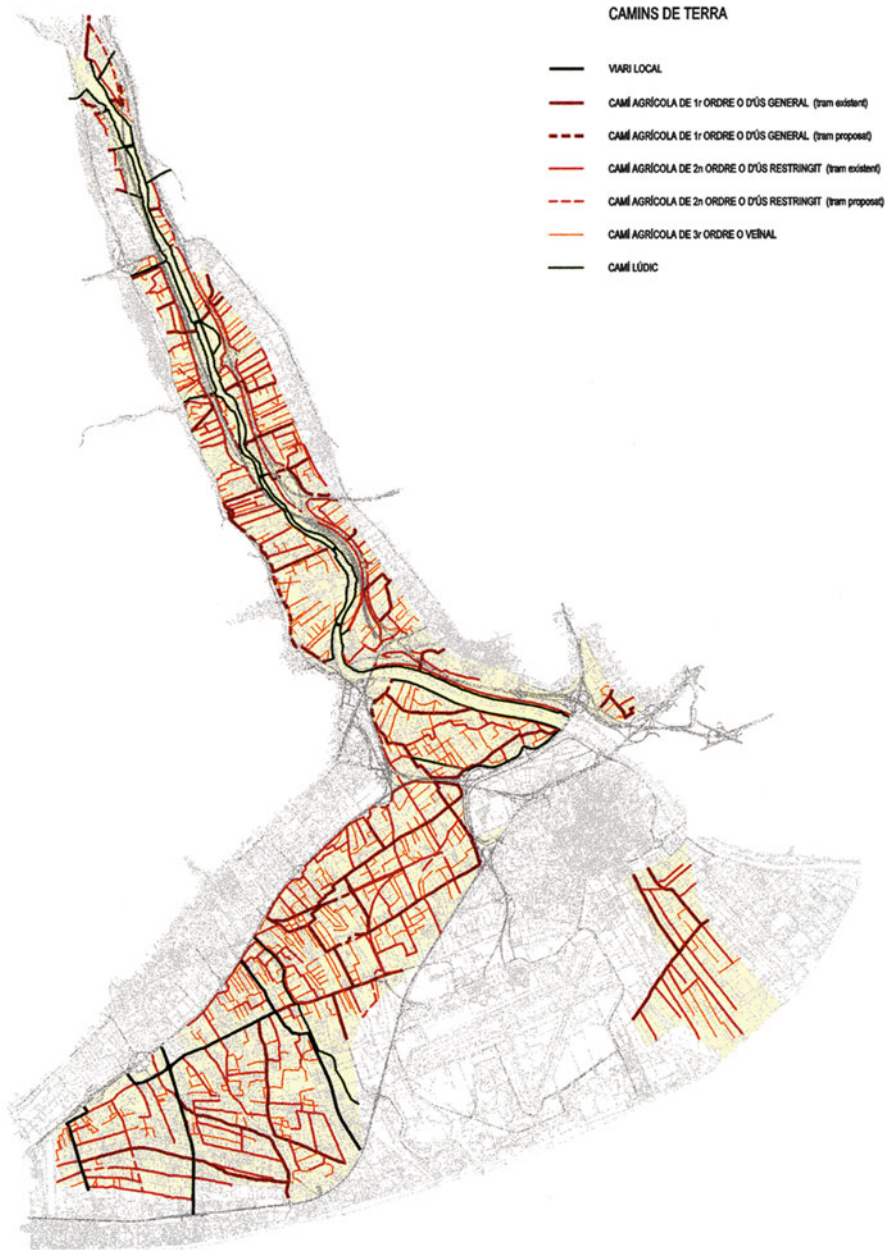


Fig. 6.6, Fig. 6.7, Fig. 6.8 and Fig. 6.9 (continued)

According to their positions and transversal sections, roadways may visually conflict with the landscape, as they pass through spaces of great visual quality or hinder the visibility of such places. Roadways may also compromise the movement of people and work more as an obstacle than as an element of connection.

The adaptation of roadways to visual and biophysical elements is indispensable. Thus, it is convenient to delimit the most appropriate places for the design of the route to preserve the resources belonging to the open spaces. However, besides degrading the biophysical environment or visual integrity of areas, roadways may also favor the development of these attributes if such attributes are considered in the project (Lynch 1966; McHarg 1969, among others).

To avoid the degradation of certain attributes of open spaces or to even favor them, one can propose solutions for the fauna and flora passageways and tunnels for vehicles that allow the development of biophysical attributes; the naturalization of the waterways with compatible drainage solutions, using local vegetation; solutions for viaducts that respect the water dynamics and the characteristics of the soil to mitigate erosion; solutions that respect the elements of greater visual value with the maintenance of their diversity and physical integrity and the best views; and the provision of services areas, skywalks for pedestrians, lanes for bicycles, and quality side spaces, especially along highways and expressways.

In this context, where possible, a more human interaction between roadways, people, settlements, and open spaces should be encouraged. Such interaction would include the presence of natural elements, amplified visibility, and the movement of people and vehicles, thus creating visual conditions according to the human needs of moving safely and enjoyably. The intention is to make roadways civic, visual, and natural axes; an important part of the system of open spaces; and an element that can relate to its surrounding areas and conform to the landscape in a positive way instead of being a problem to be solved. This includes the treatment of flowerbeds, roundabouts, and other residual spaces along roadways as potential open spaces to compose the system of open spaces and relate parts of urban occupation (Lynch 1966; Hough 1995, among others). It is worth emphasizing the importance of joining the roadway infrastructure to a network of appropriate urban services and, if possible, using alternative (especially collective) means of transport, water supply and sanitation, energy supply, garbage collection, and communication services, in an integrated proposal (Table 6.1).

6.2 Project Actions for Planning the System of Open Spaces

Project actions are strategies for the structuring of the system of open spaces as guidelines for future urban occupation. The determination of *project actions* requires the prior identification of open spaces through which intervention will be carried out. The aim here is to plan the system of open spaces and characterize its structuring potential for the urban occupation. To that end, spaces that are already protected by planning are observed as spaces that have an assurance to take part in the system.

Table 6.1 Project principles

Reference	Functional	Spatial	Synergic
Biophysical matrix	<p>Maintenance of natural processes within open spaces</p> <p>The establishment of criteria concerning the possibility of occupying an area and the most adequate locations for different exploitation activities in open spaces, according to the natural elements and processes they present</p>	<p>Maintenance of biophysical continuities</p> <p>The consideration of the maintenance and restoration of biophysical continuities in the system of open spaces, favoring the diversity and the full development of natural processes, as spatial references for urban occupation</p>	<p>Creation of urban nature</p> <p>The creation of natural spaces that establish an intersection between the urban and natural environments, as opportunities for ensuring spatial and functional balance between open and occupied spaces, and as urban elements for the interrelation of different parts of the city</p>
Visual significance	<p>Maintenance of the visibility of the most significant characteristics of the open spaces in the territory</p> <p>Respect for the most visually relevant physical elements of open spaces as references for applying conditions to possible urban occupations and exploitation activities</p>	<p>Maintenance of visual continuities</p> <p>The maintenance of visual continuities, indicative of recognition of the landscape according to considerations of the visual significance of each open space and its visual relation with the territory as a whole</p>	<p>Intervention in the landscape resulting in recreated scenery</p> <p>The spatial and visual reshaping of degraded open spaces through the creation of beautiful landscapes, besides possible urban and biophysical improvements, adapted to collective and sustainable uses as new references in the structure of the territory</p>
Access	<p>Control of interventions in accessible open spaces</p> <p>The limitation of intervention in open spaces according to their biophysical and visual perception attributes, as an opportunity for making more compact settlements and for proposing activities having less impact</p>	<p>Maintenance and improvement of the access network</p> <p>The maintenance and improvement of the access network as an opportunity to establish spatial relationships between open spaces and between open and occupied spaces</p>	<p>Creation of landscape roadway infrastructure</p> <p>The creation of roadway infrastructure to promote a closer relationship among open spaces, settlements, and people, which should adhere to the visual perception and biophysical elements of open spaces and to the respective conditions for the maintenance and development of their integrity and diversity</p>

Those outside such protection are the focus of *project actions*, as they constitute spaces under threat of urban occupation. The permanence of open spaces and their dynamics are fundamental to the structuring of the system of open spaces and to deciding whether the spaces can receive occupation and the conditions for this; it is thus a guideline for the structuring of urban occupation. With this goal in mind, the following procedures are carried out.

- Observation of *spaces of project opportunity*. Each open space is characterized as a *space of project opportunity*; i.e., as an *anchor space*, *reference space*, or *other open space*.
- Observation of the *situation* of the *spaces of project opportunity* in the territory and the relationships they establish with the surrounding areas, occupied or not. The conditions provided by the surroundings of the open spaces relative to the presence of *anchor spaces*, *reference spaces*, and *other open spaces* (either protected or not) and urban occupation are gauged. Additionally, the conditions presented by the continuities, discontinuities, and borders of the surfaces are considered.
- Observation of the conditions necessary for the establishment of spatial, functional, and synergic relationships within the system of open spaces to structure the system and urban occupation. The best opportunities to connect pieces of the system and interrelate them with their surroundings are highlighted in terms of both the attributes of open spaces and their *situation* within the urban context. Hence, it is possible to structure the system of open spaces and urban occupation while guaranteeing their integrity, diversity, and cohesion.

As a result of this relational analysis, the *project actions* indicate possible roles that the open spaces play in the planning of the system and consequently in spatial planning. It is important to note that the *project actions* presented do not constitute the totality of all possible *project actions* in open spaces. They are only modalities, being the most important *actions* in the planning of the system of open spaces and the basis for the structuring of urban occupation.

In this context, the *project actions* can be summarized as *adding*, *delimiting*, *connecting*, *adapting*, *articulating*, and *linking*. Some spaces, despite having a stronger tendency towards one or other *action*, can be the subject of more than one modality of intervention; however, the most important *project action* in a space will be highlighted here.

6.2.1 Adding

Adding means including open spaces with those already under the protection of specific instruments, where the open spaces are contiguous among themselves, thus expanding the spatial limits of the protected area.

Generally, the pieces that can be *added* to protected spaces are *anchor spaces* (having high and middle-high values of biophysical and visual perception attributes in the final evaluation). However, in some cases, *reference spaces* (having middle

and middle-low values in the final evaluation) or *other open spaces* (without relevant attributes) can be areas where *adding* is possible; e.g., cases in which pieces that have not been considered by the instruments of protection are near areas having already-protected scenic elements or areas with visual prominence that can enhance the perimeter of the protected area, if necessary.

The *adding* of spaces provides the possibility of conserving the resources of open spaces without a strict instrument for their protection, and *adding* thus tends to act in favor of biophysical continuity and the preservation of visual perception.

Commonly, the *added spaces* are vulnerable areas whose borders are close to urban occupation. Hence, the *added spaces* demand special attention, especially when the spaces have well-preserved vegetation, a high risk of flooding or landslides, and important visual perception attributes but, because of their resources, are possibly the object of various interventions. Some cases may require biophysical restoration so that the areas are able to become part of their surroundings; e.g., degraded areas that are highly exposed to risks, or areas with poor biophysical and visual perception conditions, as in the case of deteriorated Atlantic forest areas and areas of cultivation that need restoration in the study area.

Usually, the areas to be *added* have received little attention regarding the preservation of their resources or the roles they may play along with already-protected spaces within the urban context, whether as possible *synergy spaces*, located between better-preserved natural areas and surrounding urban occupation, or as *spaces of control* of such occupations. In this sense, the roles of *synergy* and *control spaces* can be considered together.

Recent planning of French regional parks can be highlighted for its combination of protected natural spaces and urban occupation, which provides opportunities for the development of relationships between protected natural spaces and urban occupation and for the structuring of the surroundings. These parks are considered adequate places for reconciling urban and natural areas, according to directives that “extend” the limits of the park beyond the area of strict protection and include urban occupation inside the park and under strict conditions and the development of agriculture on the margins, facilitating the establishment of borders. The parks are references, with resources and vulnerabilities, for the increment of possible new occupations in the surrounding areas. At the same time, they encourage the population inhabiting the limits of the park and its surroundings to take part in preservation programs. Additionally, they offer services and activities that are directly related to nature that contribute to their maintenance. Criteria allowing the protection and consolidation of open spaces as a reference to the urban structure are thus established (Fig. 6.10).

Examples of possible pieces to be *added* in the study area are the surfaces adjacent to the large forest parks of Tijuca and Pedra Branca, and part of Recreio dos Bandeirantes beach.

The borders of the massifs mainly have a clear function of being “pre-park” areas. These areas are related to their surrounding areas, both occupied and explored, and may be the subject of planned interventions for the maintenance of the visual perception and biophysical attributes of the place, which may, in some cases, restrict any possible use.



French regional parks:

Fig. 6.10 Urban occupations near protected areas and in agricultural zones (Source: <http://www.parcs-naturels-regionaux.tm.fr>. Accessed 10 July 2008)

Here it is important to highlight the importance of thinking of the borders of the *added* and protected areas as “filters” with distinct degrees of “porosity” related to urban occupation or exploitation activities, according to their own dynamics and the dynamics of their surroundings. Taking this approach, it is possible to establish intrinsic correspondence between *added spaces* and urban occupation. Additionally, there is the possibility of transforming the “buffer zone” of the parks, or “pre-park areas”, into areas of “irradiation” of the structuring logic of the open space, both biophysically and visually, and relating them to the urban occupation. Their “irradiation” can affect the structuring logic of the surrounding occupied areas and include them in a protected area. This means overcoming the defensive concept of “dampening” impacts of urban occupation and offering the possibility to structure urban occupation as part of the system of open spaces.

Specifically, protected areas may play an important role in the case of forest areas with slums nearby. The treatment of such areas as *synergy* and *control spaces*

may provide places of occupation with facilities for leisure and education, for instance, and halt the expansion of slums at the same time.

In smaller spaces, the areas to be *added* may be natural areas related to surrounding urban public open spaces, and they may constitute a good opportunity for the realization of environmental activities within the community.

6.2.2 *Delimiting*

Delimiting as a *project action* means establishing the spatial limit of a space, outside of which there are no surrounding protected spaces.

In a general sense, *delimiting* is a protective action carried out over *anchor spaces* that are not the subject of more specific protection instruments.

Just like *added spaces*, *delimited spaces* tends to act in favor of biophysical continuity and the preservation of the visual perception attributes, including those of the surrounding areas.

Generally, spaces to be *delimited* are spaces of possible occupation that have not received the proper attention they deserve in terms of possible intervention directives. Therefore, they may play the same roles played by spaces to be *added* and, just like them, they may be the subject of different actions of intervention, according to their resource possibilities and vulnerabilities. They may also serve as *synergy* and *control spaces* between areas that should be protected and areas of occupation, acting as possible agents of urban structuring.

In specific cases relating to water that must be protected and that can act as an axis of urban structuring, an interesting example is the treatment of riverbeds and their margins in Denver, CO, USA. By law, there must be a defined corridor along the waterways where occupation is prohibited, and this corridor is managed by local authorities to preserve the waterway and avoid the flooding of neighboring areas. Therefore, the protected areas must be defined before the occupation of their surroundings and they must be kept as open spaces destined for the preservation of natural and visual attributes, besides offering leisure activities. In realizing these goals, the establishment of Horseshoe Park (1986), an area of swamps, canals, and rivers, suggests the importance of the connections between riverbeds and swamps. The project substituted the traditional structures of the concrete canals of the rivers in favor of more flexible solutions, using the vegetation and unevenness along riverbeds and margins, creating spaces that were better adapted to leisure, creating pathways along the water, maintaining natural habitats, and stabilizing their margins to control floods. Thus, the fluvial space was consolidated through its structuring in the face of possible human occupation (Figs. 6.11 and 6.12).

This example shows the need to consolidate protected spaces, and also spaces yet to be protected, through the implementation of effective spatial solutions and planning rules; otherwise, spaces tend to become areas of illegal occupation when they are abandoned to their own devices.



Horseshoe Park:

Fig. 6.11 and Fig. 6.12 Views of the park (Source: <http://www.ssc.k12.ar.us>. Accessed 10 July 2008)

Examples of spaces to be *delimited* in the study area are marshlands distributed over the western part of the plains, the margins of most waterways, and areas facing an elevated risk of flooding and landslides.

6.2.3 *Connecting*

The *project action* of *connecting spaces*, in biophysical and visual terms, involves the connections among spaces that are already protected, spaces that have been *added*, and the spaces to be *delimited*, through a continuous surface. In this direction, *connecting* means to act on *reference spaces* and *other open spaces* in a way to establish connections between the pieces of the system.

The *connecting spaces* are of strategic importance to the planning of the system, where the areas of connection, which would have both biophysical and visual roles, may be previously planned. Here, the priority is achieving the largest continuity possible among open spaces, thus favoring the development and restoration of their bio-physical attributes and respective processes in the search of landscapes that retain their essential dynamics.

Connecting spaces, along with already-protected spaces and the spaces to be *added* and *delimited*, would act as a biophysical central axis of the system of open spaces that could be planned before urban occupation. In this direction, the design of this central axis could have the same importance as the design of the axis of roadway infrastructure, which is usually predicted before urban occupation as part of an “alignment project”, and settlements are thus forbidden along this axis. This axis, as a whole, may serve as *synergy* and *control spaces* structuring urban occupation.

In determining biophysical continuities, attention should be given to protected spaces and the continuities and discontinuities among them, which perhaps direct the choice of open surfaces that could serve as possible *connecting spaces*. In this sense, waterways are relatively easy to manage, and their paths can be redirected if necessary. The restoration of vegetation, on the other hand, is much more complicated because urban occupation frequently introduces discontinuities. However, the presence of gardens and agriculture, besides other altered vegetal communities, remains an alternative for the connection of biophysical elements and processes. Their presence allows for the adaptation and management of biophysical attributes and contributes to continuity among pieces of the system. At the same time, in the *connecting spaces*, which usually coincide with areas of high visual significance, maintained or recovered, scenic routes might be designed to allow the enjoyment of the most important attributes of the place, besides other possibilities of establishing visual connections. Nevertheless, it is sometimes necessary to reestablish connections in the system through already-occupied areas. It may even be necessary to dismantle or restructure the occupation, even if this seems absurd according to the current logic of urban occupation.

In such context, the project of the coastal front of Albufera (Valecia, Spain, 1995) is an interesting example that tries to reconcile the reestablishment of sandbank

vegetation ecosystems along a coastline that is under marked urban pressure, especially from tourism. It was thus proposed to replace roadways, existing decking, and other occupational elements with stable dunes through the introduction of autochthonous vegetation. Owing to the system's vulnerability, the passageway through sandbank vegetation was controlled with the introduction of picnic areas between the dunes, with the facilities being concentrated in specific places, thus realizing the dune–beach connection and controlling activities in a fluid way. The complex is completed with the cleaning of the lakes within areas of vegetation and limiting access to the woods. Thus, the desired connections were established and the structuring rules for surrounding areas were set (Figs. 6.13, 6.14 and 6.15).

In the study area considered in this book, the main candidates for *connecting spaces* are floodable areas with vegetation, which have a direct relationship with spaces with important biophysical and visual perception attributes.

6.2.4 Adapting

Adapting to open spaces means to structure future urban occupation by adjusting the needs of occupation to the conditions that guarantee the integrity and diversity



Project of the coast of Albufera (Source: Arqto. Alfredo Fernández de la Reguera Collection):
Fig. 6.13 Aerial view of the area



Fig. 6.14 Detail of the dunes



Fig. 6.15 Detail of the parking lot area

of the biophysical and visual attributes of the open spaces, at the same time using them to determine the components of the urban occupation and their projects. Hence, *adapting* is a mutual process between open spaces and urban occupation.

The spaces to *adapt* are *reference* and *other open spaces*. It is considered that these spaces would be able to withstand some degree of urban occupation owing to their accessibility, visual perception, and biophysical attributes.

However, some conditions on urban occupation may be necessary according to the vulnerability of open spaces to occupation. In general, the conditions placed on urban occupation would relate, beyond the consideration of continuities, biophysical values, and the preservation of the visual quality of the place, to good accessibility and to specific characteristic of the settlements that are directly or indirectly related to the open spaces.

If there is good accessibility from current roadways, it is possible to propose urban occupation using biophysical and visual qualities and processes as guides. These guides may indicate alternatives for the planning of land uses, new organization between lots, buildings, roadways, and urban open spaces, and different degrees and densities of occupation. However, the determination of a suitable location of urban occupation would require further investigation of accessibility, since it may be beneficial to resolve existing matters related to the creation of more settlements without constructing more roadways. If accessibility is poor, occupation would not be advisable owing to the lack of roads among other factors, which could result in the creation of more roadway infrastructure, thus exposing more open space to possible occupation. In addition, it is desirable to locate urban occupation around current centralities without causing further dispersion for this reason, besides having

the convenience of pre-existing public facilities and services that would facilitate new urban growth.

With regard to the construction of new urban occupations in the spaces to *adapt*, it is supposed to clearly limit areas that can support occupation, explain the conditions appropriate for their formalization, and consider the elements and dynamics of the open spaces as guidelines for urban occupation. However, the definitions of spaces that may or may not be occupied tend to relate more to considerations of the demand for new urban development, although this does not exclude the observation of the support capacity of the open spaces according to their attributes and processes relevant to the occupation.

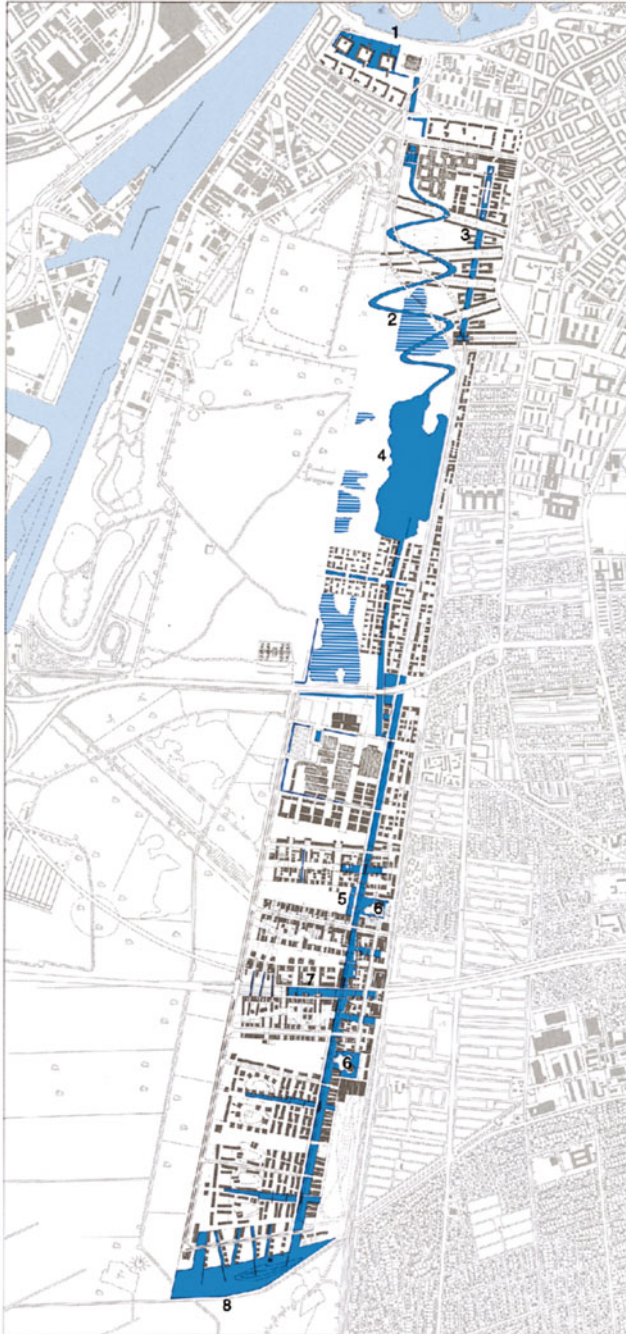
An example of an attempt to propose the *adaptation* of urban occupation to the elements and process of open spaces, respecting the attributes and dynamics of these areas and using them for urban structuring, is a project in the region of Ørestad (Copenhagen, Denmark, 1994). Without going into detail about the controversies that surround the project, by including a possible nature reserve and focusing on the proposed urban solution, the project seeks the intersection of open spaces and occupation to integrate both types of spaces within the rules of the Copenhagen Finger Plan (1947).

In the region of Ørestad, new urban occupation has been designed with the goal of preserving existing wetlands by integrating the wetlands with new access routes and settlements and by linking them to urban uses, thus maintaining the continuity of the water. This created a large vertical axis in which the main element is the water that surrounds spaces in different forms and on different scales, from large swamps, to lakes and canals. The water acts as a place of circulation, and at the same time, it is related to the occupied spaces and creates public open spaces and channels of mobility. The outer water channel coincides with the creation of an access route that connects the new occupation to already occupied areas. There are also bicycle paths, and a new railway line following the water channel is being considered. The project has proposed an increase in the building density to allow more open spaces to work as “fingers” within the occupation and thus preserve nature, inter-relate the occupied areas, and provide a recreational area for the community. Thus, the project preserved the essential attributes of open spaces, and the open spaces were used as structuring elements of urban occupation (Figs. 6.16, 6.17 and 6.18).

Examples of areas where *adapting* can be applied in the study area are those having deteriorated Atlantic forests, floodable areas with vegetation, cultivated areas, and anthropic fields. These are areas that can accept some degree of occupation, while they can contribute to the maintenance of important functions in the system of open spaces at the same time.

6.2.5 *Articulating*

The *project action* of *articulating* provides the possibility of working in open spaces that can relate elements of the urban occupation with no interaction between them.



Project of the area of Ørestad (Source: ARKKI-architects Collection):
Fig. 6.16 Water network

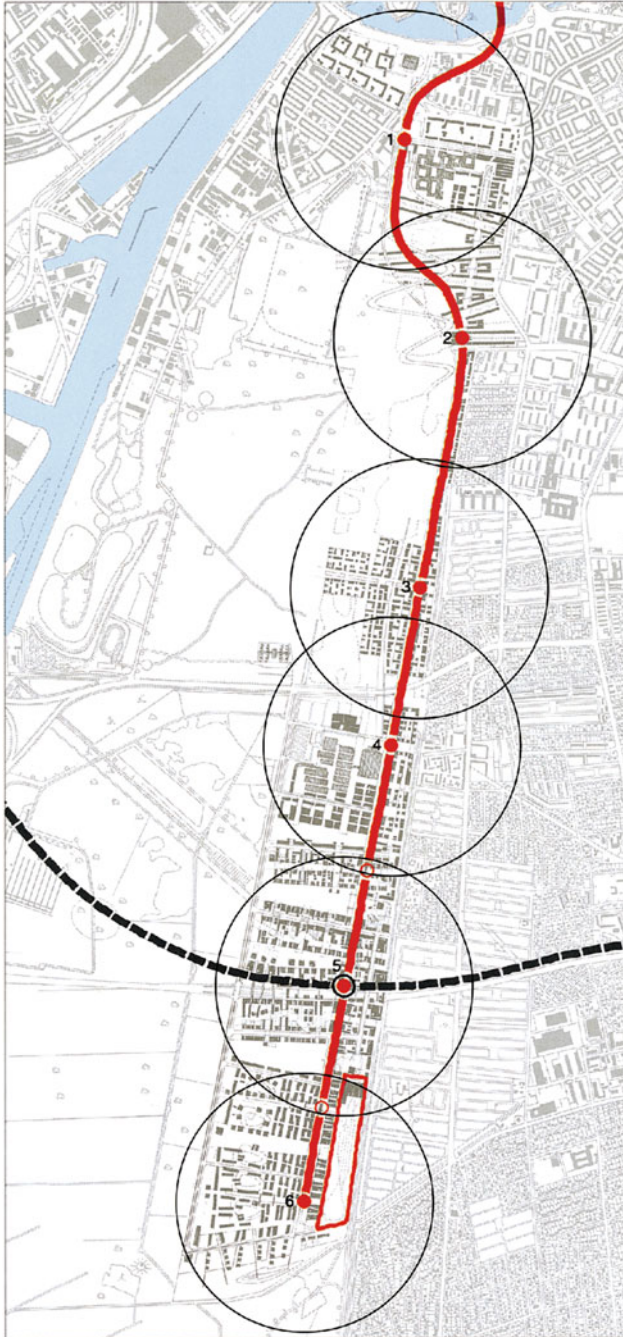


Fig. 6.17 General plan with predicted railway

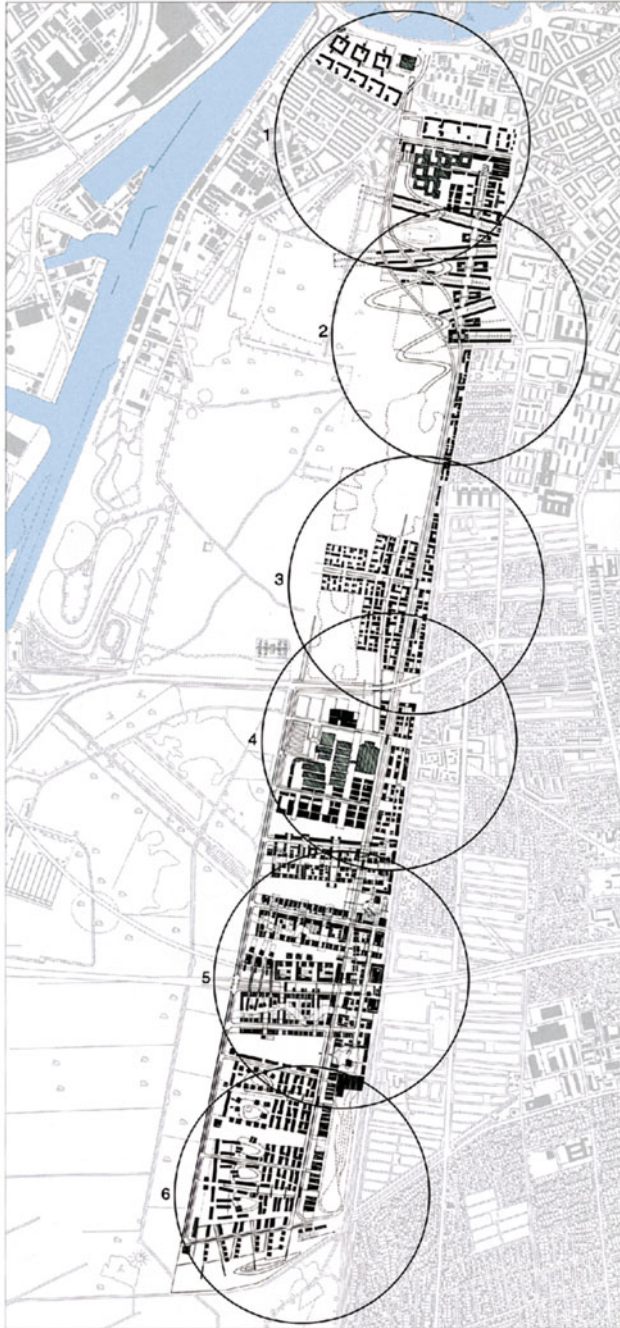


Fig. 6.18 Urban occupation

It is thus the articulating of parts, which is of particular importance in fragmented urban contexts.

Articulating therefore corresponds to a *project action* on parts that, regardless of the evaluation of their attributes, are located within or between settlements. In general, *articulation* may embody certain vitality and good accessibility.

Articulating spaces are generally fragmented open spaces and discontinuities in the territory, and they can be *anchor*, *reference*, or *other open spaces* and even spaces already protected that would fit the profile described. Therefore, these spaces may have different attributes, being more ecological or visual, or having historic interest.

In general, these spaces are important pieces in the local area or they may promote interest on the scale of the territorial unit or even larger scales according to their dimensions. They can be places that encourage urbanity by promoting collective coexistence and visual recognition of the place and bringing nature closer to citizens. Additionally, an *action* on spaces without notable attributes could mean the spatial and functional improvement of the degraded frame directly related to the surrounding settlements and their needs.

Articulating spaces can also improve and control the expansion of urban occupation, such as by limiting settlements and providing them with facilities, encouraging collective activities, and designating areas for community gardens, community centers, and popular festivals. *Articulating spaces* can bring balance to areas of dense urbanization and restore currently degraded areas, which promotes the conversion of such spaces into places for collective living and *spaces of attraction* in the urban structure, reinforcing the economic value of an area.

As an example of *articulation*, we cite the project of the Youth Park in São Paulo (São Paulo, Brazil, 2003). The park (240,000 m²) is a result of the conversion of the residual area of the Carandiru Penitentiary, and it is located in a densely consolidated urban area and includes part of an old prison building and the ruins of an unfinished prison. In the proposed park, there are areas of existing vegetation to be preserved and other areas of vegetation were proposed (Figs. 6.19 and 6.20). The park promotes the relationship among elements of the urban occupation in wooded areas distributed into three parts: a sports park; a central area for contemplative leisure, which contains an area of protected vegetation and the ruins; and an institutional park, with a subway station, a theater, and areas for cultural activities.

In the middle of the park, running across the three parts, a pathway was proposed. The pathway connects parts of the park and access to it. In general, the park creates a space that *articulates* the surrounding urban occupation and makes it possible to provide facilities for it, thus promoting the collective experience with nature, allowing alternative routes through the park and the settlements, and limiting the growth of urban occupation.

To precisely define *articulating spaces*, however, detailed studies are needed to consider the needs of the urban occupation in having an *articulating space* and to define the character of the *articulating space* and the possibility of the space being used by the local community. In this sense, we can observe, for example, the general features of existing settlements and the kind of fragmentation they have with their surrounding areas; the lack of public open spaces in the settlement; the real possibility that these spaces can be used in accordance with local collective practices; the



Parque da Juventude:

Fig. 6.19 General plan (Source: Arqta. Rosa Kliass Collection)



Fig. 6.20 Details of the project (Photo: José Luiz Brenna)

land uses and the conditions of the settlements (i.e., if they have vitality or are degraded or abandoned); and the best uses for the *articulating space*.

The *articulating spaces* may sometimes have buildings at their borders as new developments and as opportunities to promote relations between the existent settlements and the open space, while representing a new structure for urban occupation.

In the case study, possible *articulating spaces* are the fragments of open spaces located mainly in the central and northern parts of the plains, which are mostly between consolidated urban occupations and capable of contributing to the integration of the settlements and their improvement and control.

6.2.6 *Linking*

Linking is a *project action* to be adopted for open spaces that are found on discontinuous surfaces owing to the presence of some element of disruption; e.g., roadways. That *link* can act favorably in some parts of the system of open spaces, especially in those parts with high visual and biophysical significance, by creating pathways that can be used for recreation within a pleasant environment.

The *project action* of *linking* can be applied to *reference spaces* and *other open spaces*, which can assist in the composition of the access network. These areas represent the possibility of creating connections, allowing passage through open spaces that are initially segmented and also connecting settlements and their elements.

Thus, *linking* creates *links*, literally, between fragmented open spaces, which often require improvements, with the emphasis on being able to move along them and, at the same time, allowing the creation of recreational areas and public facilities along the routes.

Many of these possible *linking spaces* are under pressure of urban occupation. Therefore, it is noteworthy that the spaces conducive to *linking* can be predicted before future occupation and designed and managed with the objective of being consolidated as true landscape routes through the construction of possible future urban occupation, which should respect the conditions of passageway and the limitations of the biophysical and visual attributes.

In the case study, possible *linking spaces* are especially areas close to the lagoons and the coastline, and they could assist in improving access to these places and in connecting settlements in between.

6.2.7 *Observations on Project Actions*

We can conclude by saying that the proposed *project actions* (Fig. 6.21) on open spaces would achieve a stronger relationship between the main spaces in the study area considered in the book and simultaneously relate them with the urban occupation as structuring elements.

This amounts to a possible change in the perception of open spaces. Open spaces, until now fragmented by urban occupation, can be related to their surroundings through the proposed method. This is especially true in the case of water (e.g., lagoons, rivers, and canals) and the most valued vegetation, although it also applies to non-valued spaces, which make up part of the system of open spaces.

Although the *project actions* are related to some of the most important open spaces, which are crucial in shaping the system, other spaces were not considered owing to the scale of analysis; however, these other spaces may play a significant role in shaping the system.

In this sense, smaller areas are observed and, owing to their location and dimensions, are presented as fragments of open space distributed throughout the study area. These parts can have attributes of great interest or simply be land of low quality. They have the potential to be considered, depending on a proper analysis, possible public spaces that will encourage urbanity by providing a collective local experience and increasing the possibility of a current network of public open spaces. In this context, it would be advisable to encourage the permanence of these open spaces, which include small parks, clubs, and public facilities, as an opportunity to promote integration in a landscape that is combined with low impact uses and collective practices. In the same way, the treatment of the route margins, or other residual spaces, is encouraged since biophysical, visual, and social links and spaces for travel, including travel by bicycle and on foot, raise the quality of the landscape.

In addition to considering open spaces, it is of utmost importance to address the social structure of the area in the structuring of the system of open spaces if one wants to achieve the proposed objectives, since the planning of the system of open spaces does not hold if there is no human interaction. This is especially so when dealing with places where social inequalities are very strong. In this sense, it is important to promote the democratization of the system of open spaces by increasing the area of public open spaces, thus offering more opportunities for public life.

In its entirety, the planning of the system would reconsider the current logic of urban occupation and would propose another structure for the planning and design of the urban territory and, consequently, the future urban structure (Table 6.2).

6.3 System of Open Spaces and Planning Instruments

6.3.1 *Alternative Use of Planning Instruments*

The consideration of the system of open spaces as a strategic aspect of the territorial project can have important consequences for existing planning instruments. This allows the creation of bases for spatial planning that differ from the bases typically developed according to the premise of extensive occupation. The bases involve

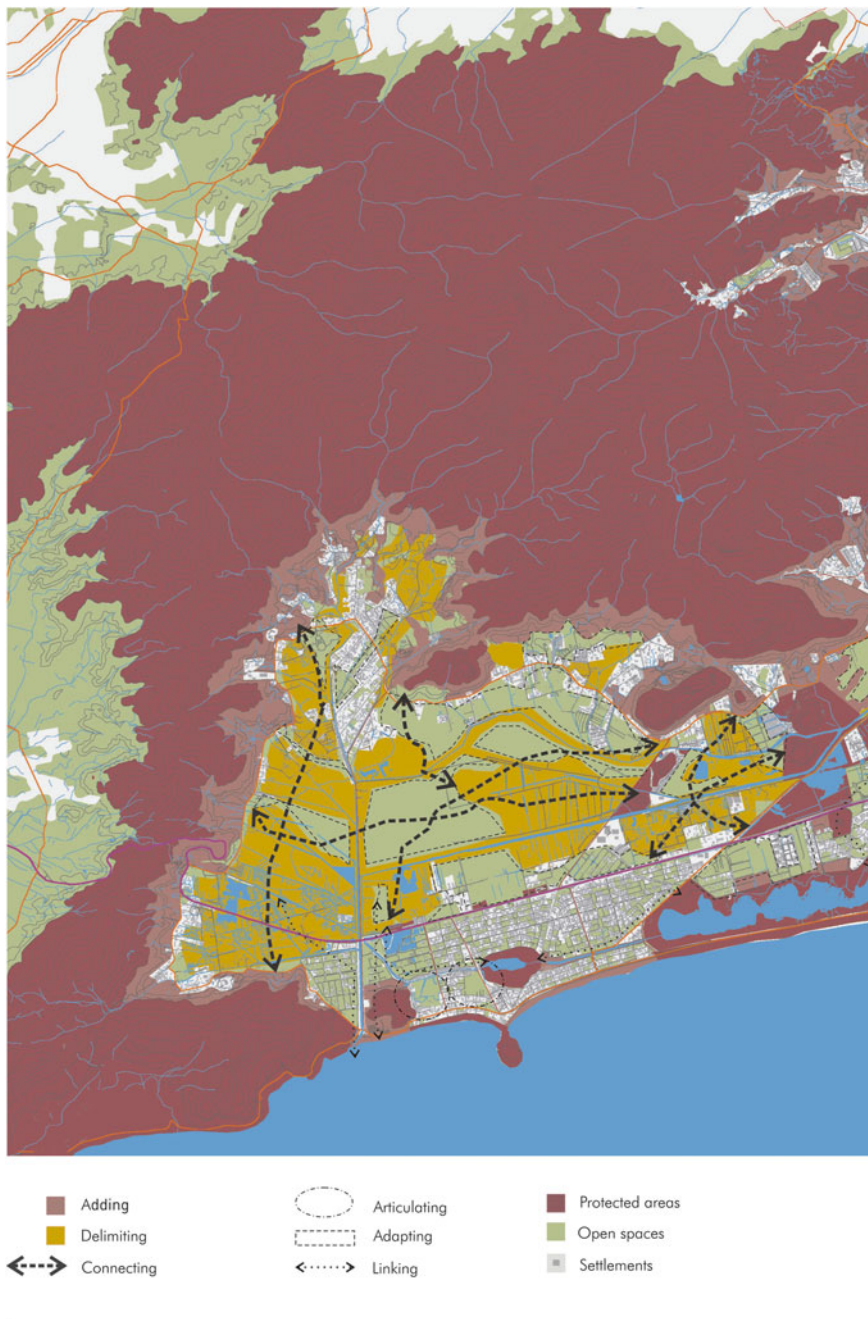


Fig. 6.21 Map of project actions



Fig. 6.21 (continued)

Table 6.2 Project actions

Project actions	Concept	Situation	Space of project opportunity
Adding	<i>Adding</i> combines open spaces with others already considered with a specific protection instrument	Open spaces adjacent to protected areas	<i>Anchor spaces</i>
Delimiting	<i>Delimiting</i> sets a limit in open spaces where no limit has been established	Open spaces without nearby protected reference areas	<i>Anchor spaces</i>
Connecting	<i>Connecting</i> joins the already protected open spaces, <i>added spaces</i> , and open spaces to be <i>delimited</i>	Surfaces between protected spaces and spaces to be protected	<i>Reference spaces</i> and <i>other open spaces</i>
Adapting	<i>Adapting</i> structures the urban occupation by adjusting its needs to the conditions that guarantee the integrity and diversity of the dynamics of the open spaces as guides to determine the components of the urban occupation and their projects	Any	<i>Reference spaces</i> and <i>other open spaces</i>
Articulating	<i>Articulating</i> represents the possibility of working in open spaces that can relate to elements of urban occupation with no interaction between them, thus promoting the articulation of parts of urban occupation	Discontinuous open spaces between urban occupations	Any
Linking	<i>Linking</i> creates pathways between open spaces that can be used for recreation within a pleasant environment	Discontinuous open spaces, especially between spaces highly valued in biophysical and visual terms	<i>Reference spaces</i> and <i>other spaces</i>

indispensable protection and the conservation of open spaces and the elaboration of guidelines for the urban occupation according to functional and spatial references “dictated” by the dynamics of the system of open spaces.

However, putting this proposal into practice presents a series of challenges for the application of concrete planning instruments that allow the physical consolidation of the system and the restructuring of the territory.

The proposal of planning alternatives that differ from traditional practices of occupation requires consideration of existing challenges and realistic consideration of the local conditions; e.g., the property, the subdivision of the land, the current planning, the needs of the population that will be satisfied, the conflicts between interests of public and private agents, and the possibility of realizing and maintaining the system of open spaces.

In general, realizing the system of open spaces and redirecting urban occupation is a long-term proposal that involves a series of players with differing interests, and there may be a high cost if adequate mechanisms of viability and management are not adopted. In addition, there is a requirement of political willingness, the lack of which is the reason that many proposals are not implemented.

It is therefore worth emphasizing the importance of the timing of the planning and implementation that guarantees the sustainability of the plan of the system of open spaces. This includes the approval of the planning, the oversight of investments in the territory, and the follow-up of the evolution of the landscape following pre-established criteria and employing general strategies. In relation to the timing of the execution of the plan, the political question can be a large problem owing to the duration of political mandates. It is common for projects to be abandoned because they are politically incompatible with newly elected representatives.

Initially, however, once there is approval for a plan that predicts a system of open spaces, the feasibility of the system and the adaptation of the rules of occupation of its surroundings would have to be assured. Consideration of the most efficient use of existing planning instruments (as expropriations, mandatory concessions, and compensation) could be a significant contribution toward the consolidation of the system of open spaces without having to make fundamental alterations to plans.

The use of these planning instruments would entail keeping the existing buildable indices and adapting them through rigorous determination of occupational criteria. In this way, the obligations that were previously defined in planning, relative to the property and the urbanistic interventions proposed by the spatial planning based on the system of open spaces, are adjusted. Certainly these adaptations tend to generate conflict among the public and private sectors, which requires negotiation of the planning proposals with territorial building agents and, especially, the willingness to apply them.

Negotiations with private agents run the risk of being driven by private interest instead of public interest. In a reality where the public sector is farther and farther from direct investments in the city, such negotiations could result in actions that satisfy economic interests more than collective interests.

However, to achieve some of the goals of the consolidation of the system of open spaces and the structuring of its surroundings, considerations with respect to planning can be suggested mainly in what is referred to as the permanence of the spaces in areas that can be occupied. The following considerations are examples.

- The determination and defense of specific areas that remain unoccupied, where there is interest in the system configuration. Examples are the permanence of the biophysical and visual continuities that may relate to mandatory concessions, areas of service, negotiations on the transfer of building rates, or when necessary, acquisition by the public sector.
- Encouragement of the concentration of urbanization, rather than its dispersal. Examples are the control of land use and legislation corresponding to the management of the consolidation of residential areas and access routes. Forms of control,

from the approval of the project to its implementation, are thus established. These controls include constant negotiations between investors and the public sector.

- The possibility of establishing different degrees of protection for open spaces with clear rules for use and occupation, adjusting the land regime to this reality.
- The incorporation of other economic development possibilities into the plan, where the possibilities take advantage of opportunities offered by the use of protected areas, such as tourism or agriculture, with commitments that may improve the social and ecological landscapes; i.e., establishing an obligation to consolidate and maintain open spaces, including the provision of water treatment, maintenance of vegetation through cleaning, replacement and reforestation, garbage collection, and recycling.
- The proposal of the public/private management of open spaces, with the possibility of public management of private land when it is in public use, or private management under public control.
- The use of large urban operations to consolidate open spaces further; e.g., operations that involve the duplication of roadway infrastructure, creation of subways, redevelopment of obsolete spaces, and construction of metropolitan facilities, shopping and business centers or large residential condominiums.

To plan the system of open spaces and restructure the territory, particularly in relation to areas that can be occupied and their acquired rights, presents a great difficulty. However, it can also provide opportunities to recognize the benefits that these open spaces may offer to the protection of some key resources to ensure the biophysical and visual quality of the territory, and also the possibility of constructing urban occupation according to the presence of open spaces as their structural axis.

In this regard, proposals like the green ring of Vitoria-Gasteiz (Spain) (Plan General de Ordenación Urbana, 1999), the system of open spaces of Lleida (Spain) (Pla General de Lleida, 1995), the system of open spaces of Paris (Plan Vert Régional d'Ile-de-France, 1995) are concrete examples of the planning of open spaces that is being carried out and that propose the appropriate location of open spaces and its systematization, with there being influences in the surrounding areas. These proposals have been made on different scales, from the most general to the most local, and the developments followed procedures that made them feasible.

Among the procedures indicated by these plans to consolidate the system are the use of open spaces of the public domain, proposed negotiation with private owners when necessary, and a strict technical management. There is also a need for an economic and social profitability plan to ensure the viability of the system, the transformation and the structuring of its surrounding areas, and the preservation of open spaces as spaces having social value and an economic asset of the territory, according to long- and short-term proposals.

In this sense, proposing the planning and the physical consolidation of the system of open spaces as a guideline for spatial planning and a directive for restructuring the territory, implies the seeking of opportunities to use existing planning instruments in an alternative way, as well as seeking future possibilities to create new instruments according to the specific situation.

6.3.2 *Necessary Flexibility in Planning*

General concrete *project strategies*, proposed according to the guidelines of the *principles* and *actions* for planning the system of open spaces, will be implemented through the consolidation of each particular piece of the system; in this case, the open space tends to assume variable regulation and is developed under the demand of urbanization.

Thus, it is necessary to adapt urban legislation to the needs that may arise over the years for open spaces. The needs may relate to urban growth and new demands of the population, and changing lifestyles and housing, among other factors. Hence, there is a need for flexibility in planning. This flexibility must be in a manner that allows the consolidation of the system of open spaces according to the reality of the moment, which is difficult to predict.

In traditional planning models, there is a lack of instruments that can provide such flexibility. Some authors have addressed this flexibility issue in planning by proposing solutions that are more procedural and do not determine a preconceived final image. Thus, most territorial plans propose the following strategies, and most local plans would promote the implementation of these strategies and even offer other references for broader guidelines, through detailed analysis of the place. The analysis would corroborate or conflict with the results of previous studies, and it could suggest changes to previously established indications of territorial plans (Sabaté 2000; Font 2003, among others).¹

Flexibility in planning would imply the ability to adjust plans over the years, through the maintenance of key strategies and by clarifying conceptual bases for the proposal of future changes. This refers to determining the ground rules for the implementation of the system of open spaces and the regulation of urban occupation in accordance with the proposed flexibility of the plans within strict targets. This contrasts with the taking of immutable positions, which ultimately end up requiring a number of specific modifications and do not allow consideration of the whole.

In this context, it is possible to emphasize distinctions between stability and flexibility, terms that at first thought might seem incongruous if they are considered equivalent to the concepts of rigidity and instability. The stability of the plan relates

¹ We need new tools since the various tools already available are no longer able to work with long-term goals and processes and alternative scenarios. The plans may not be general but selective, seeking to multiply the effects of a few strategically chosen interventions. The processes proposed are more circular than linear, and more globally strategic than definitive. We have already become accustomed to working on hypotheses that are in continuous revision, rather than on assumptions that remain unchanged.

Maybe we need a new approach that comprises interactive methodology, project management, verification, and adjustment to address problems specific to each situation and to offer solutions and progressive context.

In spatial planning, one may need to take lessons offered by successful urban projects and differentiate essential structural elements from other proposals that evolve and adapt in time and are subject to redefinition by taking a closer view. (Sabaté 2000, p. 96, translated from the original)

mainly to the strictness of the planning and not to its rigidity, and to the establishment of inflexible points (i.e., pivots) around which territorial differences could be managed. On the other hand, flexibility in the planning refers to nuances of the stable plans, according to the heterogeneity of the territory when bringing together specific spatial, functional, and population characteristics in one single space, where the characteristics require their own determinations.

However, the issue of flexibility in planning and the creation of new instruments for spatial planning that, above all, enable the consolidation of the system of open spaces, constitutes an initial challenge to formulate alternatives that are more effective and efficient in democratic and instrumental terms. Achieving this will require a major change in consciousness and a belief that the approach provides territories that are more sustainable. To this end, it is worth pointing out the importance of involving social agents, in a broad sense, from investors and politicians to ordinary citizens. This implies the development of programs for citizen participation and public education on landscape issues.

Citizen participation in the process of defining, approving, and modifying plans leads to dialogue between administration representatives promoting the plan and civilians to gain political consensus and public support. This is an open process of social engagement that allows for differing opinions and the defense of the qualities of the territory. On the other hand, citizen participation plays an important role in technical formulations, if it presents the population's points of view without being a merely political means or a game of interests. Such participation provides data essential to thoroughly understanding the problem and establishing where local interest lies, and the most contentious issues can be resolved in this manner. To encourage participation, information can be distributed through usual channels, by covering city issues in newspaper and television news, encouraging participation in schools, neighborhood associations, government institutions, and nongovernmental organizations, and following a well-defined process of participation.

For fruitful dialogue, social agents should be present in parallel. In fact, education about landscape issues increasingly stands out for its urgency and encompassing of a broad audience that includes public sector officials, investors, architects, city planners, and the wider community. Moreover, traditional means of education, publicity of good and bad practices, public exhibitions, and other outreach measures can be effective in introducing the population to problems relating to daily living, determining the causes and consequences of such problems, and promoting daily practices that are more sustainable.

Flexibility and stability in planning will lead to more harmonious action between planning instruments, the physical reality, and the intentions of the population through which the instruments are applied, and may consolidate the system of open spaces that structures the territory and is included in local collective practices.

Conclusion

For a Renewed Urban Territory

The reality of current urban territories highlights the urgency for renewing the basis of the planning of such territories. Urban occupation is advancing into open spaces, be it through the construction of roadway infrastructure or through new areas of settlement, for reasons of territorial functioning rather than more properly directed reasons of the preservation and development of the territory's resources.

This situation raises the contradiction that the territory as a whole, including open and occupied spaces, represents by itself the possibility of maintaining exploitation activities and urban occupation, which if not limited, will contribute to the degradation of the territory.

The renewal of urban territories relates to the possibility of reversing the current fragmented framework of urban territories. In this context, the system of open spaces represents an important opportunity to offer something different to traditional thinking based on extensive occupation and to influence spatial planning, thus offering an alternative for the restructuring of the territory.

From this point of view, this book presents the possibility of restructuring the territory using current open spaces. According to the resources that the open spaces contain (be they biophysical or related to visual perception) and the roles they play in the urban context, open spaces can be planned, predicted, and transformed with a relatively wide margin of tolerance with regard to possible urban interventions, since they allow a wide range of settings. This provides the opportunity to create new strategies for acting on the territories.

This proposal offers a fresh take on open spaces. Open spaces would not be considered as simply spaces left over at the “bottom” of occupation (as is frequently evidenced by land that cannot be urbanized or that is not yet occupied), but instead be seen as spaces with the ability to reverse the occupied urban context, and structure it, as a guideline in spatial planning.

In this sense, the proposed system of open spaces goes beyond the traditional proposal of the configuration of spaces connected to each other. The focus is on the

essential structural functions of the open spaces, which integrate and provide another perspective for the structuring of urban construction.

Open spaces would thus be active elements in the composition of the artificial landscape (or human territory), and their contribution to spatial planning, through the planning of their system, would lead to a complex conception of this reality, allowing the phenomena of open and occupied spaces to be brought together and interrelated. In this way, the system of open spaces is important in the guidance of urban occupation, having structuring potential.

The developed method takes an approximation of the reality of open spaces in a specific territory in an attempt to plan the system of open spaces and propose concrete project strategies and their application. The elaborated reasoning emphasizes, above all, the need to propose project strategies that recognize, analyze, and evaluate open spaces, and relate the open spaces with the urban context, since it is important to know the characteristics, nuances, strengths, and weaknesses of a place when employing an approach that is so markedly proactive and practical. It is therefore critical to map the territory in detail and identify the most and least vulnerable open spaces, the urban context, and the conditions presented by the current plan, in a review process. Here it is necessary to observe the condition of each part of the territory from the most detailed view to the overall view.

This general framework allows the outlining of project strategies for the planning of the system of open spaces and the restructuring of the territory. The strategies are intended to be applicable to not only the particular area of the case study examined in this book but also other territories in which there are open spaces having the potential to be key elements in a new proposal for constructing the territory.

However, the renewal of urban territories based on the system of open spaces as the backbone of urban occupation faces challenges in its consolidation, in relation to both the establishment of planning instruments and their physical implementation, precisely because measures need to be taken to restructure current urban conditions. These measures include the modification of established standards of rights and duties. In this context, the importance of stability and flexibility in planning is noted. Such properties of planning assist in achieving the intended goals, gaining the trust of the population, the establishment of coherent and durable urban development policy, and the construction of the urban context by parts.

The book focuses on a certain spatial scale lying between local urban features and territorial features, and a given time, which imposes certain limitations on the analyses. In particular, there are limitations if one considers the artificialized landscape as a living entity that is constantly changing and includes phenomena that develop on different scales, where small and large scales can interfere with each other.

The observation of phenomena on different scales raises concerns that would lead to further investigation on the same topic from other perspectives; e.g., on a smaller or larger scale. Certainly, the challenges and other issues could be addressed employing other approaches and their analysis tools. These alternative approaches could advance the issue of the contributions of the system of open spaces to urban design and regional planning.

Based on the guidelines set on the scale adopted in this book, and in relation to urban design, the structuring potential of the system of open spaces can influence the territory on a wide range of scales from local planning to the construction of building and routes and projects in the open spaces themselves.

In this direction, beyond taking a traditional approach aimed at the preservation of natural and visual processes, the presented proposal affirms the interconnection of the system of open spaces and urban occupation, where consideration of the two together allows projects that can go beyond the configuration of open spaces alone, in intervention on a local scale. In the end, the local scale represents the reality in which events occur, although it may respond to more general guidelines, and it is closer to the daily needs of the population and the city.

On the other hand, the highlighted hypothesis, transposed to regional planning, could reveal the need for a more generic approach. Although the scale is different, the dynamics of the open spaces and the spatial and functional relationships among the open spaces and between the open spaces and their surrounding areas tend to remain. In this sense, the planning should be directed, like that at smaller scales, toward the maintenance and development of the elements and processes of the system of open spaces directly related to urban occupation as an argument for the proposals.

However, regional planning has other problems relating to the size of territories covered or the participation of different scales of administration, from the municipal to the state. The proposal of a system of open spaces as a restructuring element of the territory may suggest ways of organization that not only transform and relate the elements of the urban context but also promote spatial and functional relationships among municipalities through future cooperation agreements that should be established.

In conclusion, regardless of the scale of analysis and proposals, it is considered essential to clarify the basic principles, the recognition of the open spaces in a system and the urban dynamics in which they are involved, the analyses, evaluations, and intervention proposals, from the conception of the artificialized landscape as a plural reality with different meanings and with a strong interconnection between the elements. The segmented interpretation of this whole tends to disallow a more complete and deeper understanding, especially when trying to “reframe” the fragmented urban context, renew the landscape structurally, and attain more sustainable territories.

Overall, this book highlights what can be gained from the transformation of the meaning of open spaces from residual space to restructuring elements of the territory. This may lead to society becoming aware of the resources that the open spaces have and to the construction of an urban territory that is distinct from current territories, being more congruent in the planning of open and occupied spaces.

Appendix 1

Maps Made for the Book

Chapter 3

Map of the relief
Map of the hydrography
Map of vegetation
Map of roadway infrastructure
Map of land use and centralities
Map of urban occupation

Chapter 4

Urban occupation scheme in the case study until 1940
Urban occupation scheme in the case study until 1970
Urban occupation scheme in the case study until 2000
Map of the subdivision of open spaces
Map of current open spaces

Chapter 5

Map of vegetation and exploitation of resources
Map of the hydrology
Map of slope gradient
Map of the edaphology
Map of biophysical support attributes
Map of the final evaluation of biophysical attributes
Map of the final evaluation of visual perception attributes
Map of the final evaluation of accessibility
Map of macro-zones
Map of protected surfaces

Map of buildable surfaces and predicted land uses
Map of the final evaluation of protection parameters
Map of the synthesis of the evaluation

Chapter 6

Map of project actions

Appendix 2

Structure of the Interviews

Public Administration Officials

The structure of the interviews with the people responsible for planning and project implementation was specific to the plan or project. Plans included Urban Structuring Plans, which are provisions for new infrastructure and new settlements. The objective of the interviews was to understand the proposals and establish possible relationships among them and the open spaces. For this purpose, the following topics were considered.

- Physical characteristics, programs, and instruments for action of the proposals
- Protection instruments and management actions predicted for open spaces
- The theme of the insertion of open spaces in the elaboration of urban interventions for the area
- Possible consequences, direct or indirect, of the proposals in open spaces in relation to the biophysical and visual perception attributes
- If the plans or projects will increase accessibility to and create new settlements in open spaces
- Measures used to mitigate problems that can arise
- How public participation is considered in the definition of urban interventions
- Predictions for measures of environmental education

The objective of the interviews with the people responsible for public administration of the main parks (Pedra Branca State Park and Tijuca National Park) was to determine, mainly, how the management of parks was carried out, the main environmental problems of parks, and the character of the relationship between the parks and their surroundings. These interviews considered the following topics.

- Most relevant physical characteristics of the park
- Main access routes to the park
- Properties of land within the park and possible management problems for public and private land
- Existence of a management plan

- Main problems associated with natural or induced risk, including invasions of settlements, deforestation, landslides, fires, and contamination
- Current problems with management of the park
- Predicted exploitation activities within the park and its surroundings and problems caused by existing activities
- Existing or predicted environmental education programs and public participation in park conservation

Interviews with the people responsible for administrative regions sought information on the management of the study area as a whole, public actions in open spaces, existing infrastructure, and possible programs that would involve the population in the management of open spaces. The interviews considered the following topics.

- Management of open spaces within the public domain, including the conservation of open spaces, public security in open spaces, and the capacity to maintain oversight of open spaces
- Public transport conditions in the area
- Conditions of service infrastructure in the area
- Main centers of commerce and services considered by the public administration
- Actions that are carried out in relation to irregular occupation
- Possible effects of plans and projects predicted for the area in relation to open spaces
- Oversight of the public works of settlements and infrastructure with respect to the maintenance of the open spaces and their most significant attributes
- Regular and irregular exploitation activities in the area and their consequences for open spaces
- Current initiatives for the improvement of open spaces; e.g., reforestation, bike paths, gardens, and recuperation of degraded areas
- Environmental education programs and public participation in the management of open spaces

Community

The interviews with the representatives of existing resident associations in the study area sought to understand how people within the area relate to open spaces. Beyond this, they sought to identify the main problems and perspectives relating to the physical and social structures of the area. These interviews considered the following topics.

- Activities carried out by people within open spaces and the way in which open spaces affect the lives of people, including providing opportunities for leisure, production, and coexistence with nearby residences
- How people occupy open spaces and how they consider the component elements of these spaces (e.g., vegetation, water, and relief)

- How people move through the study area, whether by bike, bus, car, or other means of transport, and the conditions of public transportation within the study area, according to their points of view
- Physical aspects of open spaces within the area
- Participation of people in the conservation of open spaces of the area
- Conditions of services infrastructure within the area
- The existence of defense platforms and non-governmental organizations related to open spaces and their respective objectives

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