Addressing Environmental and Social Needs of Metropolitan Region of Curitiba: An integrated solution of the US-Brazil Sustainability Consortium

By:

Sara Wendelin, Master of Landscape Architecture Student
Ball State University

John Motloch, PhD ASLA AIA LEED™ Accredited Professional
Professor of Landscape Architecture; Director, Land Design Institute, Ball State University

Eloy F. Casagrande Jr., PhD in Mineral Engineering, Professor of Sustainable Development
Federal Center of Technological Education, Paraná, Brazil

Abstract

Curitiba, the capital of the state of Paraná, is claimed to be the ecological capital of Brazil, and is known in the planning field for its sustainable urban development. However, the high percentage of population growth concentrated in the outer rim of the metropolitan region has resulted in crises in these areas. One such crisis exists in the municipal of Piraquara, in the district of Guarituba, northeast of Curitiba. This community lacks basic infrastructure and threatens the water supply for the metropolitan region. The majority of the area is flat wetland with wet fluvial soils subject to flooding. The population density is well above what is suitable for this land type. Currently, the local agency for planning the metropolitan region (COMEC) is evaluating the area to plan for organized urbanization and help correct past mistakes. Part of this plan includes the preservation of wetland areas through creation of a park on unsettled land at the center of Guarituba. Through cooperation between COMEC and the US-Brazil Sustainability Consortium a concept park plan for this blighted area was developed. In this plan, the park gives the community a sense of dignity while its constructed wetlands serve as an educational tool, attract tourism, and help protect the important waters of the Iguassu watershed.

An introduction to sustainability and urban planning

Sustainable urban development is an oxymoron because cities are ecologically unsustainable. The phrase, however, is used widely among planning and design professionals to refer to development that moves toward a sustainable civilization. Throughout the world's history, people have tried to make their lives better by improving their surroundings and socio-cultural organization, and enhancing access to resources. This struggle for progress is usually referred to as development (Assadourian and Prugh 2003). Although many people equate development and growth, development does not necessarily imply growth. While there are no limits to development, there are limits to growth (Atkisson 1999).

Through the paradigm of sustainability, *development* closely correlates with improvement. Although there are many definitions of *sustainable development*, the most widely embraced came from the 1987 World Commission on the Environment and Development report, *Our Common Future*. This document, known as the "Brundtland Report", defines sustainable development as "..development [that] meets the needs of the present without compromising the

ability of future generations to meet their own needs." This definition is grounded in an understanding that actions and development decisions today affect the potential of future generations. Sustainable development is usually understood to have a *triple bottom line* wherein the future generations depend on our making choices that functionally integrate the three main sub-systems of our civilization: the economic system, environmental system, and social system.

Sustainable development can be seen from each of these three perspectives. Ecologic sustainability keeps our eco-system healthy so that it can support us and generations to come. Economic sustainability provides for the continued functioning of the economy, allowing us to make use of resources in order to support the population. Social sustainability is the just allotment of resources. Sustainable development embraces all three components and accepts limits that do not endanger future generations (Marten 2003).

Sustainable urban design depends on societal implementation of ecologically sustainable practices. To engage in these practices, the people must believe that decisions will contribute to a vibrant economy or that the decision will be otherwise beneficial to them. For the urban design to implement sustainable principles, the design must also be socially viable. This may be accomplished by fitting the design to society's current fluency in the language of sustainability, and by design that builds connections within and between social groups. A bottom-up approach helps the design take root (James 2002), and local level problem solving promotes sustainable solutions customized to the economy, culture, available resources and physical conditions of a specific area.

Sustainability challenges vary from one area to another. One city may be plagued with social strife or injustice. Another could have environmental problems; while another can be economically challenged. Design decisions that solve challenges in one city may prove to be unsustainable in another.

In both the U.S. and Brazil people who promote sustainability speak of the Triple Bottom Line: environmental responsibility, social equity and justice, and economic vitality. In each country they seek a balance between the three. In the U.S., however, there is a bias toward environmental responsibility while social justice and economic vitality have a reduced emphasis. In Brazil, sustainability focuses on social justice and economic vitality; while environmental responsibility is less emphasized.

The US-Brazil Sustainability Consortium

The US-Brazil Sustainability Consortium (USBSC) promotes understanding of the need to produce cities and communities that are environmentally, socially, and economically sustainable. It embraces the triple bottom line, and recognizes that people in developed countries focus on environmental responsibility, while those in developing ones focus on social and economic issues. It promotes cross-cultural dialogue that helps students address all three and the increased challenges of responsible design in environments, people, and economies different from their own. It helps students develop the ability to make sustainable decisions in diverse contexts in other countries as well as in unfamiliar contexts in their own country.

The USBSC immerses students in a hierarchical curriculum and project-based learning that build on the education they receive in their degree programs. It provides classroom, community-based, and international experiences that prepare students to work in diverse physical, cultural, and economic contexts. It integrates project-based learning in academic, formal community, and informal community contexts. USBSC goals include 1) educating students to lead their

professions and broader communities to sustainable solutions, 2) overcoming barriers to accessibility and mobility, 3) preparing students with academic, language and cultural skills, and 4) facilitating and providing support to students.

Context of the Guarituba Park Project

Curitiba is promoted as the ecological capital of Brazil, and is known in the planning and design disciplines for its sustainable urban development. Part of Curitiba's success as one of the world's great cities in terms of urban design is its sustainability oriented problem solving approach. Planners and politicians, like its long-time architect mayor, Jaime Lerner, helped Curitiba accomplish this by treating economic, social and ecological issues, not as competing problems, but rather as challenges whose solutions could be interlinked through a whole-systems approach. This integration of social, economic and environmental programs has created the positive urban synergy that makes Curitiba special (International Meeting of People Affected by Dams 1997).

However, despite Curitiba's many successful programs, there have also been failures as the sustainability of each new program has been tested through implementation. For example, Curitiba's celebrated greenway and park system with its "design with nature" theme saved the city money in flood-control and damage mitigation. However, the plan has faced programmatic breakdowns in recent years. Restrictions against construction along flood-ways and wetland areas have not been successfully enforced in many areas, including the district of Guarituba. Illegal settlement and lot partitioning over the last several decades in this district has created the need for the park project discussed herein.

Guarituba

The district of Guarituba is located in the municipal (similar to a U.S. county) of Piraquara (figure 1), northeast of the heart of Curitiba (figure 2) and within its metropolitan regional planning area. East of Guarituba lies the Serra do Mar mountain range with its forest reserves and wetlands that feed the Iguassu River. To the west is the Second Plateau of Paraná (figure 3 and 4), the state of which Curitiba is the capitol. To the south lies an area of flat terrain and hydromorphic soils. Steep hills with high potential for mining non-metallic minerals exist to the north.

The municipal of Piraquara has 59,000 inhabitants (approximately 2.18% of the metropolitan region), of which 48,000 live in the community of Guarituba. The majority of Guarituba's houses are on flat wetland soils unsuitable for such a dense population. Due to the poor drainage of these plains, the land stays wet the majority of the time and is subject to periodic flooding. Beyond this, the land is thickly covered with a hydromorphic alluvial soil, and the average water table depth is very close to the surface in the entire region (Mapeomento Geológico Geotecnico na Região do Alto Iguaçu). This wetland environment can sustainably support only minimal construction and human inhabitation.

Environmental conservation and management laws, which were part of the original planning program for the metropolitan area called for protecting Guarituba as a wetland area, with only sparse development. However, inappropriate and illegal settlement of the land occurred. The majority of land was parcelized in the mid 1950's. Population growth began to accelerate in the 70's as pressure for occupation strengthened, yielding a population of 21,253 by the late 1970's. Settlement and partitioning of lots further intensified in the 1980's. This illegal settlement was

part of a larger story where from 1991-1996 the municipals surrounding Curitiba increased by 326,149 inhabitants. Thus, the combination of this exploding population, a lack of housing programs for the lower class, and the economic recession of the 1980's and 1990's contributed to the formation of the problem of an overly dense population.

Today, 15,000 people in Guaritiba live on land they do not own. The others have paid for the land, but live on lots subdivided contrary to environmental restrictions, creating a population density well beyond what the land is capable of supporting. The problem continues to worsen, as families move in and construct houses little by little in the piecemeal fashion they can afford (figure 5). Considering the current settlement pattern, density is projected to reach approximately 26.18 inhabitants/hectare with a population of 77, 414 residents. This is well beyond the capacity of this wetland area, even using sophisticated green development technologies (COMEC 1999). Furthermore, this impoverished favela community is far from having many of the most basic conventional technologies.

Much of Guarituba lacks fundamental infrastructure, such as electricity, an immediate potable water supply, or a sanitary system. The district's internal circulation system, comprised primarily of dirt roads, is highly discontinuous and has no hierarchy. Along main roadways, a few of which are paved, one may find legal electric and water lines. However, these amenities occur in many parts of the rest of Guaritiba in an illegal, ad-hoc form. Clandestine connection to legal electric lines has caused numerous deaths in Guarituba. Occasionally, utility companies install illegal water line, despite restrictions, so the company can gain customers. Even when residents have the capacity to pay for utilities like water and electricity, they may be denied proper access to them because their residences are illegal.

The most pressing issue in this infrastructural chaos is the absence of a basic sanitary sewer system. This deficiency puts the health of Guarituba residents at risk, and due to the district's position in the High Iguassu watershed, untreated Guaritiba sewage threatens the water supply of the entire region. Guarituba is also an important outflow/discharge region for area aquifers, thereby contaminating the water harvested from an even larger region. In addition, an important canal, supplying drinking water for the metropolitan area of Curitiba, flows adjacent to Guarituba. Dense settlement backs up to this canal and some open drainage swales that carry untreated sewage and storm water along the roadways flow directly into this canal. The Iraí and Itaqui Rivers, which border Guarituba to the north and west, and to the south and west respectively, receive the rest of this untreated sewage. The water from these rivers flows westward across the state of Paraná, eventually reaching the Iguassu River that flows to the western border of the state. Thus, the ecologic problems in Guarituba are a concern not only for the metropolitan region of Curitiba, but also for the state of Paraná, with approximately 10,000,000 inhabitants. Considering the problem's gravity and magnitude, it is essential that environmental threats be addressed.

COMEC Role

COMEC (Coordenação da Região Metropolitana de Curitiba) is the agency that coordinates urban development projects within the entire Metropolitan Region of Curitiba. This includes the municipal of Curitiba and surrounding municipals like Piraquara, where Guarituba is located. Since it was founded the exact jurisdiction under which COMEC falls has been altered (the agency is now under the jurisdiction of the state), but its main purpose has changed little. It strives to "develop plans and programs with the objective of consolidating the proposal to

integrate the action of the public sector of the Metropolitan Region of Curitiba." (www.pr.gov.br/comec)

Recently passed state law 12.258/98 introduced the "System of Management and Protection of the Wetlands of the Metropolitan Region of Curitiba." This management and protection system focuses on amending zoning in the territorial units of Itaqui, Guarituba, Quartro Barras, Pinhais, Campo Magro and other areas. The approval of this state law launched the regularization process for land use in the wetland areas. The principal focus of this process is organization of territories to achieve population densities compatible with each area's capacity to handle storm and sanitary sewer outflow. The immediate results of this effort included new zoning laws. These laws are being applied in areas with pressure for urban occupation in protected wetland territories, and where established informal urban populations live in inferior conditions. Since use and occupation restrictions of past legislation (seen as highly-constraining) has been blamed as one cause of this type of occupation, state law 12.258/98 established that zoning should be adjusted to permit more flexibility for use and occupation of the land to keep the social demand for housing under control. Environmental sustainability concerns about overstepping the support capacity of the territory are not being left to the wayside, however. . (www.pr.gov.br/comec)

Guarituba history has shown that under extreme social pressures for land occupation, strategies for managing and protecting wetlands in the metropolitan area cannot be treated exclusively from the water resource perspective. Therefore, agencies involved in the new wetlands management efforts are seeking to link strategies to the general guidelines for metropolitan development. However, concerned that the model for wetlands management has absorbed too many metropolitan development strategies, COMEC is working on reformulation of a new "Integrated Development Plan," (PDI/RMC last revised in 1978) (www.pr.gov.br/comec/Planejamento.html). Through revision of this plan, they hope to harmonize the collective force of local and state agencies to produce concrete actions that will work toward sustainable improvements in the concerned areas. (www.pr.gov.br/comec/Mutirao%20Metropolitano.pdf)

COMEC recognizes that Guarituba as one of the most extreme cases in the group of territorial units under the wetlands management and protection legislation. In fact, extreme concern about the conditions in Guarituba helped push the wetlands protection and management law into existence. Thus, Guarituba has become a main focus in the COMEC planning department. Working toward solving Guarituba problems, COMEC has been coordinating with the Municipal Prefect of Piraquara, the Environmental Institute of Paraná (IAP), the sanitation company of Paraná, SANEPAR, and the Superintendent of the Development of Water Resources and Environmental Sanitation (SUDERHSA). In February 1999, this collective produced a document that outlined creation of the Territorial Planning Unit (UTP) of Guarituba, making it the first Territorial Planning Unit considered under the context of wetlands protection law. The purpose of creating the UTP of Guarituba was to coordinate protection of the environment and preservation of public wetlands with policies of land use and occupation and with socio-economic development, without excessively endangering multiple uses. Specific goals were to 1) secure environmental conditions to adequately preserve the wetlands, through the organization of the territory in areas with pressure for more occupation, 2) increase the organization of offering areas for urbanization, 3) define priority areas for the implementation of sanitation infrastructure, and 4) protect the river valley and critical areas subject to flooding (COMEC 1999).

In 2004, the COMEC planning department produced an interim report on the development of urban social and environmental planning recommendations for Guarituba. The central concerns stated in the 2004 Guarituba development plan include promoting the implementation of actions for the effective improvement of the population's quality of life, counteracting the degradation of the environment, and improving the water quality. The specific objectives of the project (COMEC 2004) are to implement a drainage system, implement a basic roadway system, implement an electricity infrastructure, implement a water supply system, implement a sanitary sewer system, recuperate degraded areas, provide the community with respectable living conditions, and implement recreation and leisure amenities for the community

The study area COMEC has defined for this zoning and development plan is bordered on the north by the Iraí River and on the south and west by the Itaqui River. The reservoir of the Piraquara River is on the east. State roadway PR-415 (Deputado Leopoldo Jacomel) passes to the north, connecting the area to Curitiba, 22 km to the west of Guarituba. The total area equals 225 square km or approximately 1.81 % of the metropolitan region of Curitiba. The entire area is located within the High Iguassu Watershed of the rivers of Iraí, Itaqui, and Piraquara, which are the headwaters of the Iguassu. The study of this area resulted, among other things, in the delineation of conceptual infrastructure plans for a drainage and sewer system, electricity and water supply lines, and a roadway hierarchy. Also included was a zoning plan for the study area, defining four zones of Regulated Occupation, one zone of Consolidated Urbanization and one zone of Restricted Occupation. The goal of these zoning areas is to minimize population density, maximize permeability of the soil, protect important areas, and minimize the cost of relocating residences (COMEC 2004).

Role of the U.S.-Brazil Sustainability Consortium Exchange

Through the FIPSE exchange program, coordination between COMEC and CEFET-PR (Centro Federal de Educação Tecnológica do Paraná) and Ball State University (BSU) funding, Sara Wendelin (BSU Master of Landscape Architecture student exchanging at CEFET) was able to join the COMEC planning team to contribute to the development planning of Guarituba. Her internship included bringing to the table sustainable development issues and approaches common in the United States while learning about issues in Brazil and integration of issues into a single design problem characteristic of Curitiban planning.

Proposed project area

The part of the project to which Ms. Wendelin was assigned involved a piece of land within COMEC's overall study area. This undeveloped land is located in the north central region of the community of Piraquara (figure 6). It is bordered on the south by Rua Andorinhas and the roadway designated as Collector 3 in the COMEC general planning project of Guarituba. A super-light airplane airport is located to the northeast of the site (as shown in the aerial view). The land to the east and west, as well as a small area to the south, is zoned as Consolidated Urbanization in the COMEC 2004 plan. Also a small area of the same category is located to the south of the site. Dense housing surrounds the area.
As part of the Guaritiba development plan, COMEC wished to design this area as a park. Two factors contributed to this decision. First, by placing a park on this land, COMEC hoped to be able to prevent further settlement in the area. Secondly, considering Guarituba currently has no recreational amenities or park space (not even as part of any of its three schools), it was believed the community as a whole would take ownership of the park. In turn the park could help protect

the area from illegal settlement. Thirdly, the park would provide a much needed amenity to the community, as it develops and improves.

Goals

The conceptual design of this park, developed through the consortium exchange, presents options for the environmental and social improvement of Guarituba. The proposed design includes a central recreational area around which the community can organize its social life, and which protects the wetlands from additional densities of buildings and population. The two principles objectives that influenced the park design were to address the current social and infrastructural needs of Guarituba and to address the limitations of the land. These objectives pursued goals of the existing development plan for the district of Guarituba, including: 1) improve resident quality of life, 2) give the community respectable living conditions, 3) implement sports and recreation equipment for the community, 4) improve water quality, 5) implement a drainage system, 6) contain environmental degradation of the area, and 7) secure environmental conditions adequate for preservation of the wetlands.

Taking inspiration from Curitiba's vision of its park system integrated with water resources management, the design includes ideas for incorporating the water drainage system into the recreational space. It also seeks to improve quality of life for inhabitants through beautification and environmental improvement that enhances resident health. In this way, the design encourages and plans for development of Guarituba towards a more sustainable end.

Site Opportunities and Constraints

The characteristics of the site for the proposed park do not differ greatly from the general description of Guarituba. The property is very flat with more than 80% of its area less than a 2.5% slope. The alluvial soil consists primarily of a sand-silt-clay mixture. Specifically, layers of gravel, fine gravel and sand of medium to course texture, with inclusions of angled and rounded quartz stone, are interspersed with gray plastic clays. The average water table depth is 90 cm (2.95 ft). Unlike other areas of Guarituba this part of the district never floods (Mapeomento Geológico Geotecnico na Região do Alto Iguaçu 1994).

Aside from residences in the Consolidated Urbanization Zones and the Zones of Regulated Occupation III, a few residences directly border the property. As can be seen in the figure 6, the area for the proposed park was carefully chosen to eliminate the need to relocate anyone to construct the park. Currently, the majority area for the proposed park is pasture for cattle and sheep (figure 7). The southwest portion of the site is periodically used for soccer games, evidence that the space is a good location for such activities.

Conceptual Plan

As stated in the goals for the park project, improvement of both the environmental and social conditions of Guarituba was the main goal of the design. These two needs were brought together through ideas for the integration of the water drainage system with the recreational space (figures 8 and 9). The park was designed to provide a wide variety of recreational spaces including sports fields and courts, walking trails through a variety of environments, an area for stretching and exercise, age specialized playgrounds, areas for barbeques and picnics, as well as a snack bar and community center (figure 10). However, woven into this recreational arrangement are elements that give the design more environmental value than just protecting the land from occupation. Two lines from the planned drainage system run through the park. By bringing

these lines to surface level and running the water through vegetated canals and staging and retention areas, the water quality is improved through aeration and nutrient uptake. Thus, ameliorating the pollution released directly into the adjacent rivers.

Conclusion

Through this project, the USBSC was able to bring the sustainability expertise that Ms. Wendelin had developed through her MLA degree at Ball State University and through the USBSC's sustainability curriculum to bear on the major sustainability issues in the Guaritiba district. This project was highly successful by all measures. In terms of addressing local needs, the conceptual design was well-received by both COMEC and SUDERHSA. The intent is to have this conceptual design serve as the concept to be developed in future phases for the park. The USBSC continues to work with COMEC in pursuit of funds for future USBSC exchange student participation in design development and implementation of the park project. From an educational end, the immersion community-based professional experiences provided by this project have contributed significantly as a capstone experience in Ms. Wendelin's sustainability and landscape architectural education. It met in every way the expectations of the US-Brazil Sustainability Consortium in providing unmatched learning experiences to Ball State students. It has set a high standard that can only benefit future USBSC immersion experiences.

Bibliography

Assadourian, E., and Prugh, T. *What is Sustainability, Anyway?* Excerpted from the September / October 2003 World Watch Magazine [ONLINE: www.worldwatch.org]

Atkisson, *Believing Casandra: An Optimist Looks at a Pessimists' World.* Chelsea Green Publishing, 1999.

Boles, D.D. (1992). Brazil's Modest Miracle. *Landscape Architecture*. **82**(6), 58-59

Brundtland, G.H. *Our Common Future.* Report of the World Commission on Environment and Development. (4 August, 1987). 1/ Official Record of the United Nations General Assembly, Forty-second Session, Supplement No. 25 (A/42/25). p 4,

COMEC (Coordenação da Região Metropolitana de Curitiba) *Guarituba: Plano de Desenvolvimento Social, Urbano, e Ambiental*. (2004). Curitiba, PR, Brazil

COMEC (Coordenação da Região Metropolitana de Curitiba). *Unidade Territorial de Planejamento: Guaratuba* (February 1999). Curitiba, PR, Brazil

Guardia, J., Valera, S. (2002). Urban social identity and sustainability in an urban suburb of Barcelona: adjustment to the city-identity-sustainability network structural model. *Environment and Behavior.* **31**(1), 67-80

Herbst, K. (1992). Brazil's Model City. *Planning*, **58**(9), 24-27

Hunt, J. (1994). The Urban Believer: a report on Jaime Lerner and the rise of Curitiba, Brazil. *Metropolis*. **13**(8), 66-67, 74-79

International Meeting of People Affected by Dams (1st : 1997 : Curitiba, Brazil). Proceedings : First International Meeting of People Affected by Dams : Curitiba, Brazil, March 11-14, 1997. Berkeley: International Rivers Network, 1997; 112 p.24.1 Z 1st

Jacobs, A. (1995). Are Planners Ready for a Changing World?. *Plan Canada*, **35**(1), 18-19

James, S. (2002). Eco-cities – the next Swedish export: across-the board sustainability is a way of life for a growing number of Sweden's cities and towns. *Planning.* **68**(5), 28-29

Mapeomento Geológico Geotecnico na Região do Alto Iguaçu, Volume II, TT.00339, Outubro/1994, Anex 3, Folha COMEC A105 [source for geologic, hydrologic and soil data about Guarituba]

Marten, G. G. (2003). Human Ecology: Basic concepts for sustainable development. Earthscan Publications, Ltd.: Sterling, VA

Ruano, M. (ed.). (1999). Ecourbanism, sustainable human settlements: 60 case studies. (Barcelona, Spain: Editorial Gustavo Gili, SA) 38-41

ONLINE:

http://www.pr.gov.br/comec
http://www.pr.gov.br/comec/Planejamento.html
http://www.pr.gov.br/comec/Mutirao%20Metropolitano.pdf

FIGURES:

Figures 1-4 have been modified from COMEC (2004) publication.
Aerial photograph source: COMEC

Figure 1

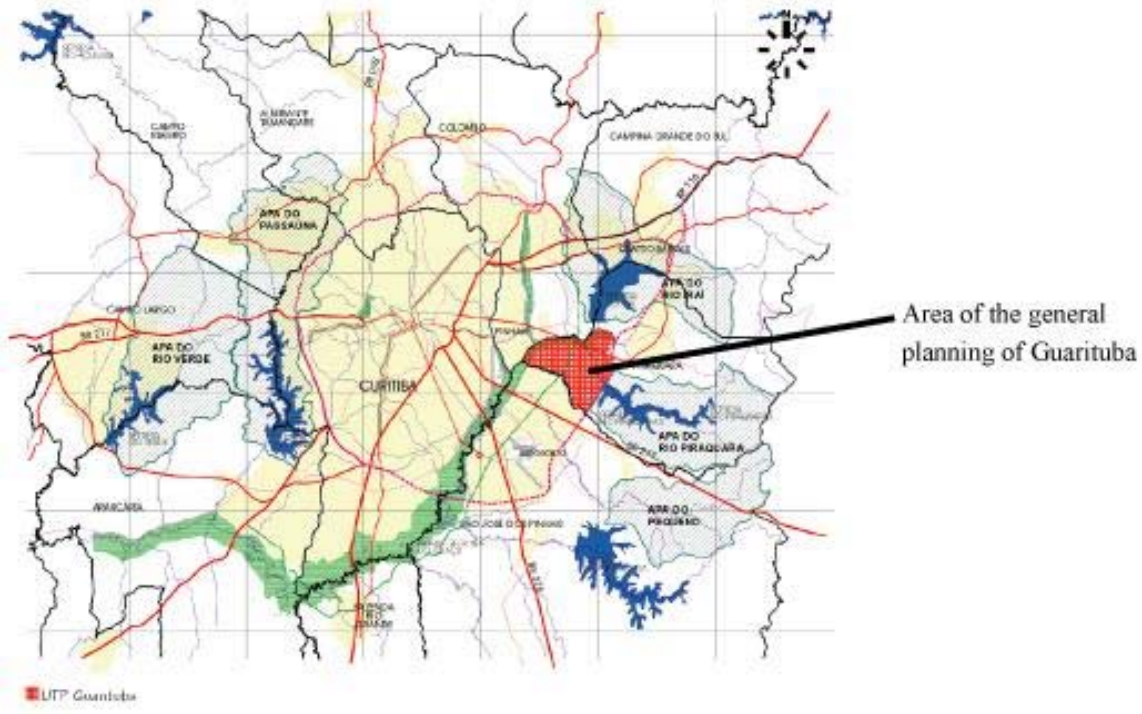

Figure 2

Metropolitan Region of Curitiba

Figure 3

The state of Paraná

Figure 4

South America

Figure 5

Figure 6

Figure 7

Figure 8

Figure 9

View of Proposed Pedestrian Bridge and Vegetated Drainage Way adjacent to soccer fields.

Figure 10

The figure below shows how the root systems secure the soil along the drainage canal.

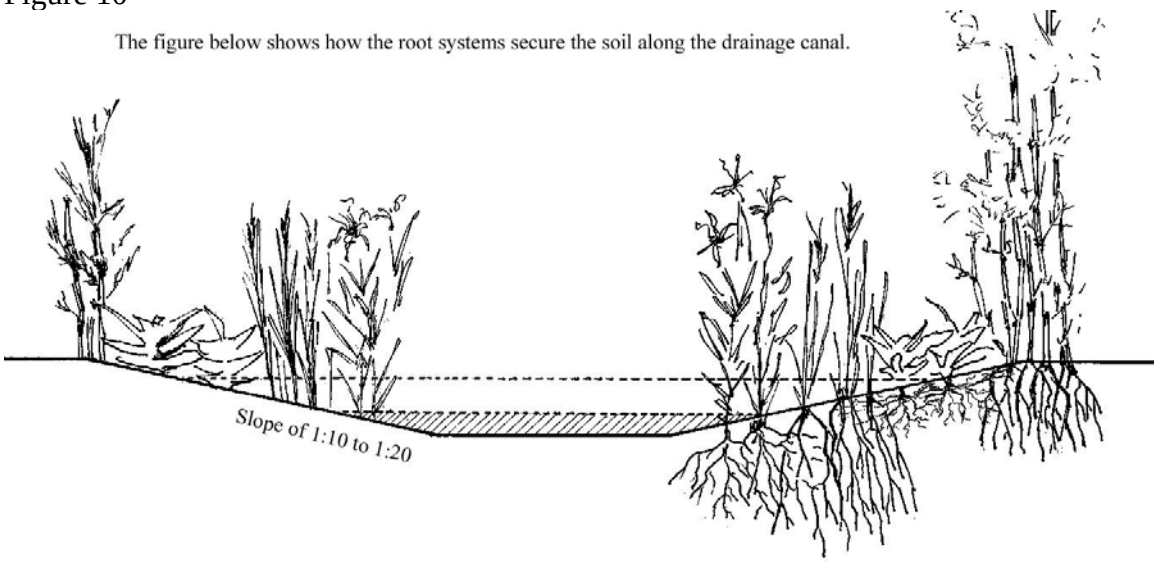

Figure 11


Proposed Guarituba Park Plan
Forest
Detention Basin
Road with Vegetated Drainage Canal
Courts
Playground 1
Recreation Field
Playground 2
Drainage Canal with Plants
Bridge
Bamboo Fence
Large Soccer Fields
Detention Basin