

Redesigning the city through its water bodies: The case of Ribeirão das Cruzes in Araraquara-SP

Redesenhando a cidade a partir dos corpos d'água. O caso do Ribeirão das Cruzes em Araraquara-SP

Rediseño de la ciudad a partir de los cuerpos de agua: El caso del Ribeirão das Cruzes en Araraquara-SP

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Abstract

This article investigates the landscape functions of urban water bodies, aiming to propose guidelines and mechanisms for their revitalization and management in consolidated urban areas. It recognizes that, despite their significant potential, many



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urban water bodies have been altered, becoming sources of threat, vulnerability, and risk for surrounding populations. The research emphasizes the need for an approach that integrates environmental and cultural dimensions into urban management and planning interventions. This integrated strategy seeks to revitalize these areas and strengthen the population's sense of belonging toward urban water bodies. Understanding the attributes of these elements within the landscape and the urban fabric is essential for advancing sustainable development. The methodology combines theoretical, documentary, and empirical approaches. The results present guidelines and actions for the sustainable urban management of riverbanks and adjacent areas, aiming to promote their revitalization and landscape enhancement.

Keywords: Urban water bodies; Sustainable development; Urban land use and occupation; Urban landscape.

Resumo

O artigo investiga a função paisagística dos corpos d'água em ambientes urbanos, buscando propor diretrizes e mecanismos para sua requalificação e gestão em áreas urbanas consolidadas. Reconhece-se que, apesar de seu grande potencial, muitos corpos d'água urbanos foram transformados, tornando-se fontes de ameaça, vulnerabilidade e risco para as populações adjacentes. A pesquisa enfatiza a necessidade de uma abordagem que concilie questões ambientais e culturais com a gestão e intervenções urbanas, a fim de revitalizar essas regiões e resgatar o sentimento de pertencimento da população em relação aos corpos d'água. Compreender as atribuições desses elementos na paisagem e na cidade é crucial para uma estratégia de desenvolvimento sustentável. A metodologia empregada incluiu referencial teórico, documental e empírico. Os resultados apresentados consistem em propostas de diretrizes e ações para a gestão urbana sustentável das margens e do entorno desses corpos d'água, visando à sua requalificação e valorização paisagística.

Palavras-chave: Corpos d'água urbanos; Desenvolvimento sustentável; Projeto urbano; Uso e ocupação do solo urbano; Paisagem urbana.

Resumen

Este artículo investiga la función paisajística de los cuerpos de agua en entornos urbanos, con el objetivo de proponer directrices y mecanismos para su recalificación y gestión en áreas urbanas consolidadas. Se reconoce que, a pesar de su gran potencial, muchos cuerpos de agua urbanos han sido transformados, convirtiéndose en fuentes de amenaza, vulnerabilidad y riesgo para las poblaciones adyacentes. La investigación enfatiza la necesidad de un enfoque que concilie las cuestiones ambientales y culturales con la gestión e intervenciones urbanas. Esta estrategia integrada busca revitalizar estas regiones y fomentar un sentido de pertenencia entre la población con respecto a estos cuerpos de agua. Comprender los atributos de estos elementos dentro del paisaje y la ciudad es crucial para una estrategia de desarrollo sostenible. La metodología empleada abarcó marcos teóricos, documentales y empíricos. Los



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resultados presentados consisten en propuestas de directrices y acciones para la gestión urbana sostenible de los márgenes y áreas circundantes de estos cuerpos de agua, con el fin último de su recalificación y valorización paisajística.

Palabras clave: Cuerpos de agua urbanos; Desarrollo sostenible; Deseño urbano; Uso y ocupación del suelo urbano; Paisaje urbano.

INTRODUCTION

Historically, bodies of water have played a decisive role in the occupation and consolidation of cities—not only in economic and environmental terms but also as defining features of the landscape, serving as territorial landmarks and points of reference. As Seabra notes, “A river is a reference of place and space; it is integral to the identity of a people. When it is lost, as in our case, it is a significant absence [...]”(Seabra, 2010,, as cited in GORSKI, 2010, p. 17).

Disorderly urban growth has transformed rivers, distancing them from the city. Although they have retained functions such as drainage, they have lost their social significance, becoming mere sewage channels, an issue aggravated by inadequate sanitation, pollution, and irregular land occupation (Gorski, 2010). In this context, Sakai and Frota (2014) argue that urban waterways should be approached in an integrated manner, considering both their social and environmental dimensions, and promoting a safe and high-quality environment for all, rather than merely a “purified green space.”

For intervention proposals aimed at rebuilding urban landscapes by integrating water bodies through plans and projects, it is essential to understand how the environments are represented. The goal is to restore their identity, bringing them closer to society to foster a sense of belonging and, consequently, encourage their preservation through sustainable use.

To understand the transformations of urban water landscapes and the cultural relationship between people and nature, this study focuses on the Ribeirão das Cruzes landscape in the city of Araraquara, São Paulo, Brazil. It aims to interpret this dynamic process of transformation and to offer reflections and analyses that can inform urban interventions, which should consider both the physical-spatial aspects and the population’s lived experience.

Objectives

The text discusses the importance of integrating water bodies into the urban landscape to revitalize these areas and restore the community’s sense of connection and belonging to the rivers.



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The overall objective of this research is to investigate the landscape functions of these water bodies. Based on this analysis, the study seeks to propose guidelines and actions to reintegrate rivers into the urban landscape, aiming at their conservation and the reconciliation of nature, landscape, and public use.

Specific objectives include:

- To understand and propose new strategies for integrating water bodies into the urban environment.
- To base the analysis on a case study in Araraquara, São Paulo, Brazil, recognizing the dynamics of the landscape.
- To reconsider the harmonization and revitalization of consolidated urban areas through non-structural measures (guidelines and strategies/actions) and structural measures (engineering works such as dams and reservoirs, riverbed restoration, reforestation of riparian areas, and the creation of linear urban parks).

Methodology

The research adopts a methodological approach that is bibliographic, documentary, and empirical in nature.

The bibliographic research explored the theoretical and conceptual frameworks related to urban water bodies, drawing on authors such as Gauzin-Muller (2011), Gorski (2008), Jacobs (2000), Sakai (2014), and Saraiva (1999). Its objective was to understand the conflicts between water bodies and urban environments, the relevance and identity of rivers in the urban landscape, and their relationship to management and sustainable development.

The documentary research focused on the case study of Ribeirão das Cruzes, located in Araraquara, São Paulo. The site was selected for its multiple functions—environmental, landscape, recreational, and as a water source—its partially urbanized watershed containing green areas with potential for park development, and its classification as an Urban Structuring Corridor (*Corredor Estruturador Urbano*, CEU) in the Master Plan (Araraquara, 2014). This stage involved analyzing cartographic data (including physical, environmental, landscape, vegetation, and land-use aspects), as well as socioeconomic and environmental data and maps from the Municipal Master Plan.

The empirical research consisted of a field survey of an upstream stretch of the Ribeirão das Cruzes (Stretch 1) to characterize land use and landscape features, observing their effects and transformations. The results of this phase included photographs, reports, and situational analyses. For this analysis, Table 2 was prepared to describe the interrelationships among the attributes, functions, and



indicators of Stretch 1, based on Table 1 of the study and Mello's (2008) dissertation, while incorporating the environmental and urban characteristics observed on site.

Urban water bodies and their relationship to cities

Historically, rivers played a fundamental role in urban development by providing water, transportation, and protection. In the 19th century, however, many cities began channeling and diverting them in response to health and pollution concerns. Therefore, understanding the process of urbanization requires examining the relationship between cities and water bodies.

Figure 1, which shows the Aare River in Bern, Switzerland, clearly illustrates how urban water bodies shape cities. The river serves not only as a physical boundary but also as a central axis of the urban landscape, defining the city's spatial configuration. Its banks, rich in green areas, contrast with the built environment, enhancing both environmental and aesthetic quality while functioning as ecological corridors and leisure spaces for residents.

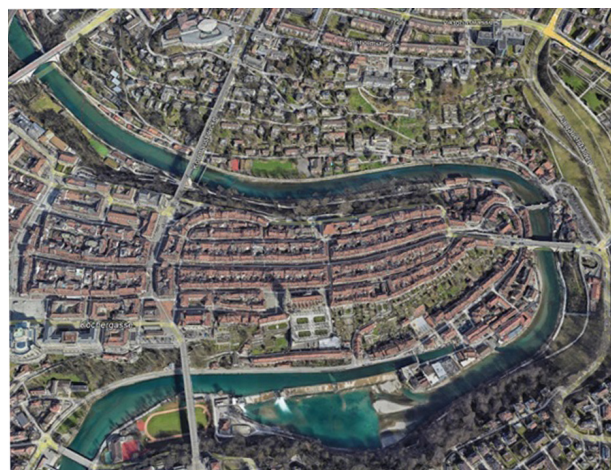


Figure 1: Aare River.
Source: Google Earth, 2025.

The interaction between rivers and cities is dynamic, influenced by factors such as economic activity, transportation, communication, urban planning, and human behavior. According to Coy (2013), this relationship has undergone through cycles of degradation and renewal over the decades, especially in European cities.

Rivers, streams, lakes, lagoons, and even artificial canals—collectively referred to in this study as water bodies—have always been essential to urban development. They have provided, and continue to provide, water for supply, consumption, and irrigation, as well as means of transportation and the integration of the urban landscape, giving many cities their distinctive identities.



Urbanization transforms the relationship between cities and their water bodies, which structure cities through alternating zones of preservation and intervention, resulting in dynamic and multifunctional spaces. As Leite (as cited in Porath, 2003) observes, landscape values evolve alongside cultural patterns, rooted in the ongoing interaction between nature and culture.

However, in Brazil, most urban rivers are treated as waste, frequently altered, channeled, or filled in, while their banks and riparian forests are degraded. This severs their connection with the urban environment, leading to neglect, pollution, and the devaluation of these vital natural elements.

According to Tundisi (2011), the impacts of human activities on the hydrological cycle—and consequently on water quality—result from different patterns of land use and occupation, calling for the integrated and adaptive management of watersheds. As the author emphasizes, “A single river, lake, or reservoir can be subject to different uses along its course or on its shores and surrounding regions”. (Tundisi, 2011, p. 32).

For instance, the Araraquara Master Plan proposes a territorial organization based on planning regions structured according to river basins, referred to as Environmental Planning Regions (*Regiões de Planejamento Ambiental*, RPAs). Figure 2 (Araraquara, 2014) shows the division of these planning regions by microbasins, highlighting RPA 1, which corresponds to Ribeirão das Cruzes basin.

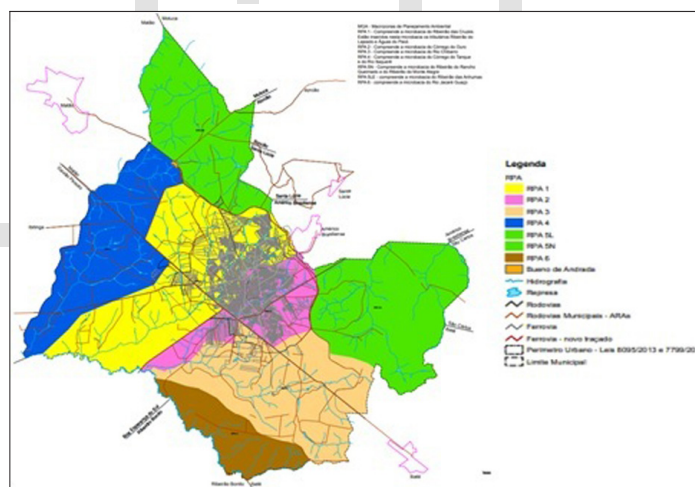


Figure 2: Environment Planning Regions, RPA.

Source: Araraquara, 2014.

Recognizing the urban landscape through the lens of watershed organization provides a more comprehensive understanding of the territory and reinforces the role of rivers as ecological and functional management units.

Currently, several initiatives seek to restore water bodies within urban landscapes, creating public spaces that integrate nature and foster a sense of belonging through the sensory and aesthetic experiences provided by water and vegetation.



Reestablishing people's connection with water is essential for rehabilitating urban rivers and improving environmental quality, the landscape, and overall well-being.

A notable example of water reclamation is the Emscher River in Germany's Ruhr region. As Alves (2003, p. 1) notes, this basin-wide project represents an "emblematic case of recovery from a profoundly impacted condition" (free translation). Integrated into a broader regional landscape restoration effort, the Emscher rehabilitation pursues ambitious ecological objectives aimed at revaluing and revitalizing the river and its surroundings. The Emscher River has become an international reference in river and landscape restoration, encompassing not only ecological recovery but also the economic, environmental, and urban revitalization of the Ruhr Valley. Beyond its ecological and landscape goals, the project fulfills an important social function by providing leisure opportunities through parks and green corridors interconnected by pedestrian and cycling paths.

Another noteworthy example is the proposed rehabilitation of the Dona Eugênia River in Rio de Janeiro, Brazil. Lourenço (2024) describes the Dona Eugênia sub-basin, part of the Iguaçu-Sarapuí River Basin, as a project that envisions the creation of a multifunctional park. The river, which extends for approximately six kilometers within urban areas, originates in an Environmental Protection Area (Área de Proteção Ambiental, APA) and traverses a significant portion of the city.

Rivers, vegetation, and physical components

The physical components, in turn, present specific characteristics and variations depending on the location, size, and morphology of each watercourse, which influence how water manifests itself and how the banks of water bodies are occupied.

According to Gorski (2010, p. 47), the physical components of watercourses include "the vegetation along the banks; the riverbed (low and high water levels) with its width and depth characteristics; pools or depressions; riffles; meanders; floodplains; and wetlands".

Riparian vegetation plays a crucial role in protecting urban rivers. Its presence significantly improves air quality and contributes to thermal and hygrometric regulation. In the soil, it helps retain and stabilize essential nutrients. At the watershed scale, vegetation filters and purifies water, traps sediments, and reduces the speed and impact of waves on riverbanks (Mello, 2008).

Likewise, riparian vegetation has an important function in the landscape as the way watercourse banks are occupied determines the degree of impact on both the urban landscape and the natural environment.

The banks of urban water bodies are spaces with great potential to transform the landscape and foster social interaction. As Chapman (2019, p. 185) observes,



“Riverside public spaces offer a natural and neutral meeting point for all members of the community, where the river acts as both a physical and metaphorical mediator”.

Functions of water bodies in urban environments

Urban water bodies perform a variety of functions interconnected with their surroundings. They fulfill environmental (protection, natural maintenance), functional (drainage), and social (leisure, environmental education, and social cohesion) purposes. Moreover, they play a structuring role in the urban fabric and act as economic, political, and multifunctional corridors.

Rivers, streams, lakes, lagoons, and even urban surface canals perform several important functions, as summarized in Table 1.

Functions or uses of urban water bodies
Infrastructure
Public water supply in urban areas
Drainage
Sanitation
Urban cleaning of surrounding areas (solid waste management)
Economic
Industrial use (various purposes)
Navigation for large-scale transportation;
Fishing and fish farming
Aquaculture and hydroelectric power generation
Irrigation using surface and groundwater
Recreation and Tourism
Leisure – contemplation and enjoyment
Canoeing
Swimming
Sport fishing
Environmental
Provide habitat for local flora and fauna
Contribute to local climate regulation, by reducing temperature and air pollution
Cultural
Population identity
Legibility and visibility of the water body
Formal characteristics and aesthetic aspects

Table 1: Functions of urban water bodies.
Source: Authors (2024), based on Tundisi (2011).



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Among their many functions, urban water bodies connect landscapes and communities, fostering cultural interaction between people and the natural environment. This role is intrinsically linked to the cultural development of societies and to the diverse ways in which water is used.

The reintegration of urban water bodies into the landscape and the redefinition of residents' relationships with them can be achieved through an integrated approach that considers their multiple functions and interrelationships with environmental attributes.

To understand the presence and significance of urban water bodies within the landscape, it is essential to analyze the interrelationships between their attributes and functions. Attributes such as physical and environmental characteristics, and functions such as drainage, recreation, or biodiversity, influence one another.

Assessing the performance of water bodies in the urban landscape—and their appreciation by the population—requires identifying their functions and attributes, as well as the degree of interrelationship between them, based on perception parameters such as strong/intense, moderate/fair, or weak/scarcely.

According to Mello (2008), throughout urban history, water bodies have performed multiple functions encompassing the following aspects:

- Functional: The diversity of roles they perform.
- Economic: Real estate development along waterfronts and urban expansion into riverside areas.
- Symbolic: Their centrality in cultural manifestations and rituals, with waterfronts often occupying a prominent place in collective memory and imagination.
- Affective: The capacity to evoke a range of emotions and sensations, such as tranquility, dynamism, relaxation, excitement, involvement, or even aversion.

Urban water bodies enhance the landscape and play crucial roles in cities by shaping identity, serving as spatial landmarks, and improving the microclimate. They can also carry symbolic meanings and support activities such as ceremonies, transportation, commerce, recreation, and leisure, thereby fulfilling an important social function. Their integration is essential for creating landscapes that embody cultural and environmental values (Alves, 2003).

Water quality is closely linked to most functions of urban water bodies. For sociocultural functions, such as recreation, tourism, landscaping, and symbolism, this relationship is particularly strong, as higher water quality significantly enhances the community's connection with and appreciation of these environments.



Moreover, optimized spatial design along urban water bodies, featuring morphologies that encourage social interaction and coexistence, fosters a sense of belonging within the community, transforming it into a steward of these spaces. According to Mello (2008, p. 53), “The set formed by water bodies and their banks has the potential to perform well in all the aforementioned aspects, involving diverse relationships between people and the environment”.

The built environment strongly influences the functions of urban water bodies, shaping sociocultural activities such as recreation, tourism, landscaping, and symbolism. This close interrelationship demonstrates how the configuration of urban space affects both water functions and community life, highlighting the interdependence between natural and sociocultural factors.

The attribute of arboreal vegetation is closely related to most functions of urban water bodies, contributing to both environmental and landscape dimensions. Its presence along riverbanks calls for an integrated approach that considers the multiple roles it plays in maintaining environmental quality and structuring the urban landscape.

From a legal standpoint, the Permanent Preservation Area (*Área de Preservação Permanente*, APP) is a key designation established along the riverbanks and streams. Although current legislation recognizes the importance of vegetation in protecting water resources, its application often imposes restrictions on public access to these water bodies. In this regard, Mello (2008, p. 36) observes: “The formulation expresses what I call the principle of intangibility, embedded in the concept of a Permanent Preservation Area—the prohibition not only of vegetation removal but of any form of use and occupation”.

Legal and juridical aspects

Legislation plays a crucial role in shaping land use and urban morphology. Aligning urban planning with the integrated environmental management of river basins enables the implementation of policies and interventions that account for physical, environmental, spatial, sociocultural, and economic dimensions, thereby promoting urban and environmental landscapes with minimal negative impact.

Although the Forest Code (Federal Law No. 12,651/2012) and São Paulo State legislation restrict the use of Permanent Preservation Areas (*Áreas de Preservação Permanente*, APPs) along urban rivers to protect water resources and biodiversity, public access remains possible. Achieving this, however, requires compliance with legal guidelines and the adoption of measures that ensure environmental preservation and user safety, in accordance with local regulations.

Most municipalities adopt different parameters to adapt to local conditions. In the case of Araraquara, its Master Plan establishes that urban APPs must have



a minimum width of 30 meters, plus an additional 50 meters designated as an Ecological Integration Corridor (Corredor de Integração Ecológica, CIECO), which serves as a transition zone between the urbanized area and the APP.

Ribeirão das Cruzes

Ribeirão das Cruzes is classified as a Corridor and Urban Structural Hub (*Corredor e Polo Estrutural de Urbanidade*, CEU) and is also a CIECO. It borders Parque Ribeirão das Cruzes Avenue, indicating that it should be the focus of a sectoral Master Plan encompassing its immediate surroundings.

The Ribeirão das Cruzes watershed is the city's principal watershed, supplying a significant portion of its water and making it a strategic element for urban planning and management (Figure 3).

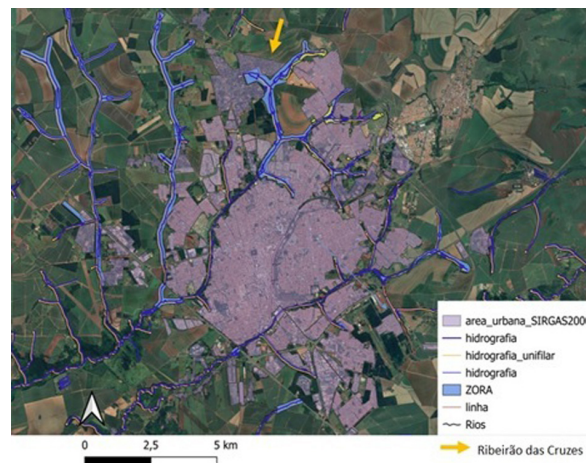


Figure 3: General map of the city with urban rivers.

Source: Authors, 2025.

Ribeirão das Cruzes, located in the northwestern part of the city, comprises a 173 km² sub-basin within the urban perimeter and receives inflows from the Marivan, Serralhal, Cupim, Paiol, Laranjal, and Ribeirão do Lajeado streams. It accounts for approximately 30% of the city's public water supply and flows directly into the Jacaré-Guaçu River, a tributary of the Tietê River (Araraquara City Hall, 2023). Over the years, land occupation along its course has become diverse and heterogeneous.

It is important to note that Ribeirão das Cruzes is not a large river but rather a smaller-scale watercourse—technically classified as a stream—characterized by the presence of multiple springs, a swamp forest ecosystem, and a supply reservoir maintained by the Autonomous Department of Water and Sewage of Araraquara (Departamento Autônomo de Água e Esgotos de Araraquara, DAAE). Despite its modest size, this water system holds considerable significance within the local landscape and in the collective memory of the population.



The analysis will be conducted from a landscape-function perspective, seeking to establish connections between the banks of Ribeirão das Cruzes and the city. Based on the attributes and functions of this urban water body, as well as the effectiveness of these functions, the study aims to understand how its interactions with the community and urban space are structured.

Due to the extensive length of the Ribeirão das Cruzes banks and the diversity of land use along its course, the area was subdivided into five distinct stretches.

In each analyzed stretch, the study seeks to identify and understand the stream's attributes and functions within the landscape, as well as its relationship with the surrounding neighborhoods. To this end, maps were produced using QGIS 3.34.11 software, based on the SIRGAS 2000/UTM Zone 22S reference system, together with the Table of Interrelationships between Environmental Attributes and Systems/Functions of Ribeirão das Cruzes.

Studied Stretch - Stretch 1

Stretch 1 of the Ribeirão das Cruzes, located in the northern region of the city, extends from its source to the public water intake. Its Class 2 classification (CONAMA Resolution No. 357/2005) is justified by its position upstream of the reservoir and the presence of springs.

Figure 4 refers to Stretch 1 and presents a map of green and public areas—including APPs, the CIECO, leisure systems, and institutional areas—aimed at identifying the potential and presence (or absence) of these elements within the urban structure, as well as the degree of integration between the natural environment (stream banks) and the population.

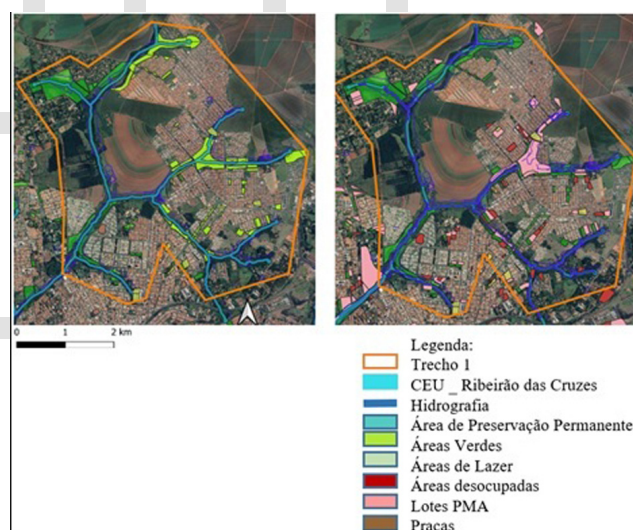


Figure 4: Map of green and public areas in Stretch 1 of the Ribeirão das Cruzes

Source: Authors, 2024.



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Figure 5 presents photographs illustrating the relationship between environmental attributes, the banks of Ribeirão das Cruzes, and the urban landscape. The images highlight the proximity of the road system to the APPs, the accumulation of solid waste, and the prevailing sense of neglect and lack of community belonging.



Figure 5: Photos along Stretch 1.

Source: Authors, 2024

Over the years, this stretch of Ribeirão das Cruzes has been progressively occupied by several subdivisions with varying urban configurations. Despite the diversity of land uses, residential purposes predominate, particularly those associated with affordable housing.

The area features a water system with strong potential for the development of green and public spaces, supported by the presence of tributaries such as the Tanquinho, Serralhal, and Marivan streams, as well as lagoons. This natural configuration promotes ecological connectivity and integration between natural and urban environments, facilitating the reintegration of water bodies into the population's daily life and the preservation of their multiple functions.

These functions include infrastructure (supply and drainage), environmental functions (characterized by a strong interrelationship between their attributes and the territory), and sociocultural functions, expressed in spaces such as fishing ponds, recreation and tourism areas, as well as APPs and CIECOs.

Although infrastructure and environmental functions exhibit a strong interrelationship with the territory, the population's sociocultural perception remains more limited. The connection with the water body as a symbolic and scenic element is concentrated in specific areas, such as springs and swamp forests, but tends to be weak or absent along the rest of its course. This indicates a fragile relationship between the built environment and the dimensions of contemplation, enjoyment, and cultural identity associated with the stream and its banks.

Below is the general framework of the interrelationships between attributes and systems/functions related to urban water bodies, as applied to Ribeirão das Cruzes (Table 2). The table classifies the interrelationships as weak/scarce (1), moderate/fair (2), or strong/intense (3).



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		ENVIRONMENTAL SYSTEMS/FUNCTIONS																
		INFRASTRUTURE / SANITATION SERVICES				ECONOMIC				ENVIROMENTAL		SOCIO-CULTURAL						
		Public water supply	Sewage Drainage	Drainage	Urban cleaning of surrounding areas	Industrial and other non-public uses	Navigation	Irrigation	Fishing and Fish Farming	Habitat for aquatic and terrestrial flora and fauna	Regulation of local microclimate	Recreation / Tourism				Landscaping/ Symbolism		
												Contemplation/enjoyment	Canoeing	Swimming	Sport fishing	Visibility / perception of the water body	Formal characteristics and aesthetic aspects	Population identity
ENVIRONMENTAL ATTRIBUTES	Water quality	3	3	3	3	*	*	*	*	3	3	3	*	*	3	2	3	3
	Water amount	3	2	3	*	*	*	*	*	2	*	2	*	*	3	2	2	2
	Geomorphology	2	3	3	*	*	*	*	*	3	1	2	*	*	2	3	3	3
	Built environment (land use and occupation)	3	3	3	2	*	*	*	*	3	3	1	*	*	3	1	2	1
	Non-built environment	1	1	2	1	*	*	*	*	3	2	1	*	*	1	2	2	1
	Tree vegetation	3	2	3	3	*	*	*	*	3	3	2	*	*	3	1	3	1
	Non-tree vegetation	2	1	3	2	*	*	*	*	2	2	2	*	*	2	2	2	1

Notes: 3- Strong/Intense interrelationship; 2- Moderate/Fair interrelationship; 1 - Weak/Slight interrelationship. * - Not applicable

Table 2 – Interrelationship of attributes and environmental systems/functions_Stretch 1 Ribeirão das Cruzes.

Source: Authors (2024).

The analysis of environmental attributes and functions in Stretch 1 indicates that, although there is significant potential to strengthen the sociocultural system, the current conditions reveal little or no interrelationship.



Proposals for guidelines and actions for Araraquara

Urban riverbanks, which often serve as road corridors, can either integrate or fragment the city. From a cultural perspective, the river's morphology, its banks, and its bridges contribute to a distinct urban identity, enhancing both the spatial and cultural value of the area.

It is essential that these bodies of water be regarded as integrated elements of the landscape rather than as obstacles. Transforming them into spaces for social interaction and leisure enriches the urban environment and improves quality of life. To achieve this, non-structural measures are crucial: Master Plans, sectoral plans, zoning regulations, building codes, and urban design projects must acknowledge the cultural significance of water resources and foster a more harmonious relationship between the city and its rivers.

Thus, in addition to planning for the route along the stream and its banks, it is necessary to consider actions that address the entire watershed, thereby encompassing the urban, neighborhood, and lot scales.

The integration of multipurpose corridors and linear parks at the city scale, as proposed by Cunha (2019), aims to make streams visible and to promote interaction with their banks, fostering greater understanding and protection of natural cycles. This approach facilitates the reintegration of the population with nature.

At the neighborhood scale, incorporating green systems such as rain gardens and bioretention areas along streets, together with urban trees, contributes to the creation of more connected and sustainable cities.

At the lot scale, it is essential to implement urban planning indicators and mitigation measures that enhance spatial quality and optimize drainage and permeability.

For sociocultural purposes, sustainable urban management guidelines for riverbanks and adjacent areas should rehabilitate and enhance the landscape, as well as restore degraded areas. The main structural strategy for achieving this is the development of green infrastructure, with particular emphasis on establishing linear parks along rivers.

Stretch 1 of the Ribeirão das Cruzes, including its banks (APPs and CIECOs), fulfills multiple functions and is surrounded by heterogeneous land uses that support a variety of activities. Nevertheless, its environmental function remains predominant along its entire course.

This segment presents significant potential for the creation of a park that would encompass not only the stream's banks but also its tributaries, such as the Marivan Stream. Combined with existing green areas, leisure systems, and institutional spaces, this initiative would create a green corridor permeating the neighborhood.



Based on the guidelines for the environmental and functional qualification of Stretch 1 of the Ribeirão das Cruzes, a sectorization proposal was developed. This proposal organizes uses and activities along the river, its banks, tributaries, and immediate surroundings, with the aim of implementing appropriate park typologies. The objective is to reconcile different levels of intervention with environmental preservation and the enhancement of public space. Table 3 presents this proposal, detailing the typologies, use zones, characteristics, structural elements, and planned infrastructure for each stretch.

Typology	Area of use	Characteristics	Elements and planned Infrastructures	Illustrative Reference
RIPARIAN FOREST AND LOW-INTERVENTION WOODLAND	Ecological park	High native vegetation cover; minimal human intervention; focus on conservation.	Trails; Lookouts; Educational signage; Areas for observation and contemplation; Reforestation with native species; Constructed wetlands.	Stretch on the Orge River  Source: Mello, 2008
FORESTED RIPARIAN FOREST WITH FACILITIES	Low-intervention recreation area	Located near neighborhoods; focus on contemplation and social interaction.	Walking trails; Street furniture; Bicycle paths; contemplative and community gathering areas; Pavilions; Environmental education center; System of green-blue corridors connecting vegetated areas and water bodies.	Rhine River – Germany. View of the park along the Rhine River in Mannheim, Germany.  Source: Mannheim (2024).
RIPARIAN FOREST + LEISURE PARK	Leisure Park with Facilities	Recreational and sports uses; major structural interventions.	Pavilions; Open spaces for activities; Restaurant/café; Sports courts and common areas; Bicycle paths; Street furniture.	Stretch of the Orge River promenade  Source: Mello, 2008
ROADWAY REMODELING	Connectivity and Integration	Urban, ecological, and social integration between riverbanks, neighborhoods, and public spaces.	Green walkways; Ecological corridors; Integrated Road design; Bicycle paths; Sidewalks with rain gardens and redesigned paving; Street furniture; Distinctive surfacing; Tree planting.	Proposed Urban Integration Model
GENERAL GUIDELINES		Structural framework for the entire linear park.	Preservation of riparian vegetation; Use of native species; Walkability and universal accessibility; Sustainable water management; Educational centers.	Conceptual Framework for the Linear Park

Table 3: Land use and occupation guidelines for Ribeirão das Cruzes – Stretch 1.
Source: Authors, 2025



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Figure 6 presents the guidelines for the conceptual design of the park in Stretch 1 of Ribeirão das Cruzes. These guidelines are organized by use zones, defined according to the territorial vocations of each stretch and identified by structuring axes and intervention typologies. Although the three proposed typologies, low-intervention preservation, forested areas with infrastructure, and a leisure park, are applicable throughout the entire stream, each stretch possesses distinct environmental, urban, and social characteristics that determine how they are applied.

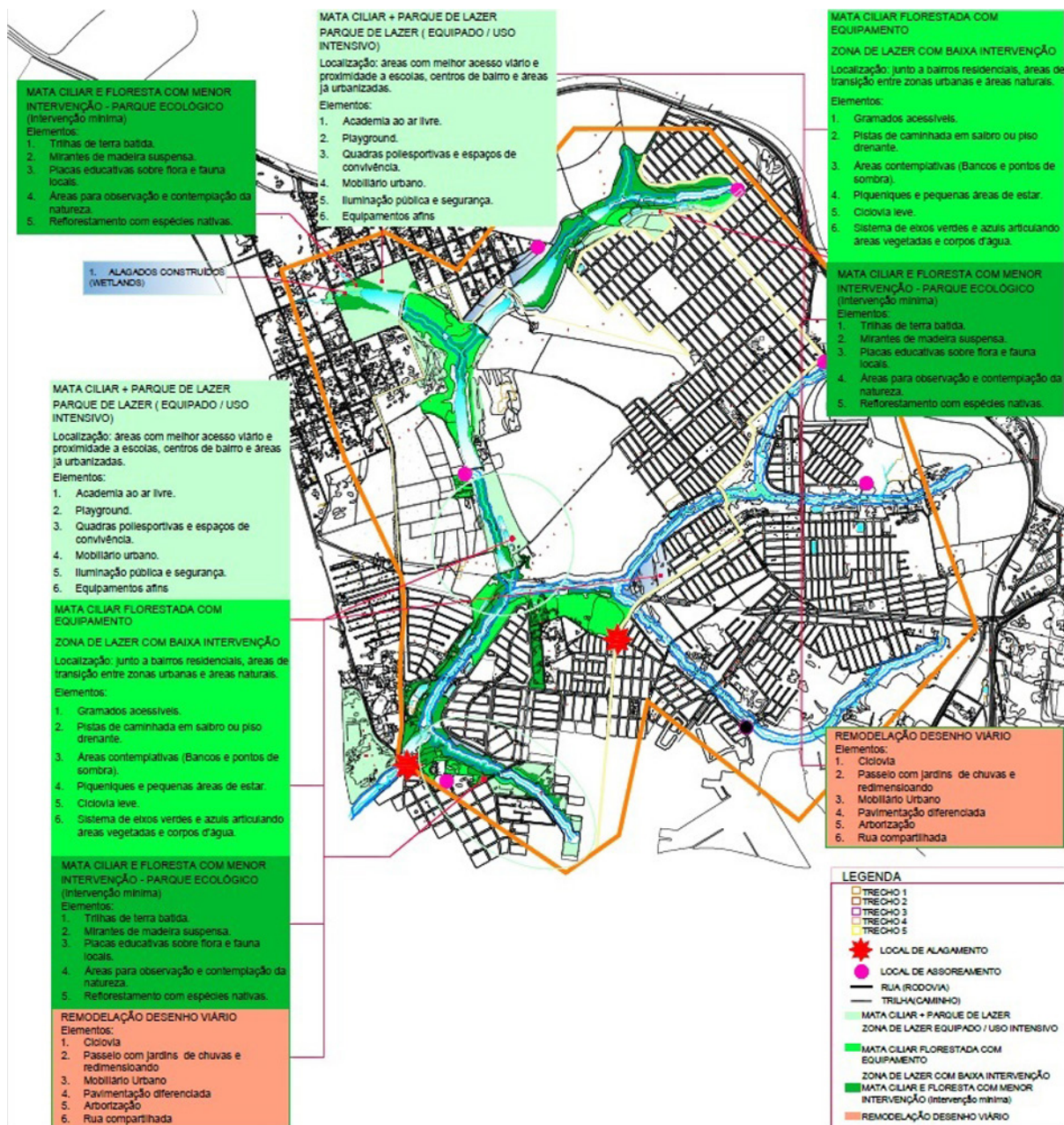


Figure 6: Guidelines map conceptual design of the park in Stretch 1.

Source: Authors, 2025



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FINAL CONSIDERATIONS

Integrating water bodies into the urban landscape and strengthening the population's sense of belonging can be achieved through both non-structural measures (public policies and legislation) and structural measures (creation of open spaces and linear parks). A holistic and systemic approach is essential for revaluing these elements.

Environmental urban planning should prioritize the watershed as a fundamental unit, recognizing rivers and streams as structuring components of the landscape. Measures such as river renaturalization and the development of green infrastructure, particularly green corridors, are crucial to promoting continuity and synergy between the natural and built environments.

It is essential to redesign cities around their waterways to create more sustainable environments that enhance quality of life and reinforce cultural connections. Integrating green infrastructure with leisure and sports facilities should be a priority, particularly in areas where such amenities are lacking.

The implementation of a linear park along Ribeirão das Cruzes and its tributaries (Tanquinho, Serrahal, and Marivan), incorporating green areas and public spaces in Stretch 1, exemplifies this approach. This initiative broadens landscape functions and strengthens green systems, allowing water bodies to become central elements in the urban spatial structure.

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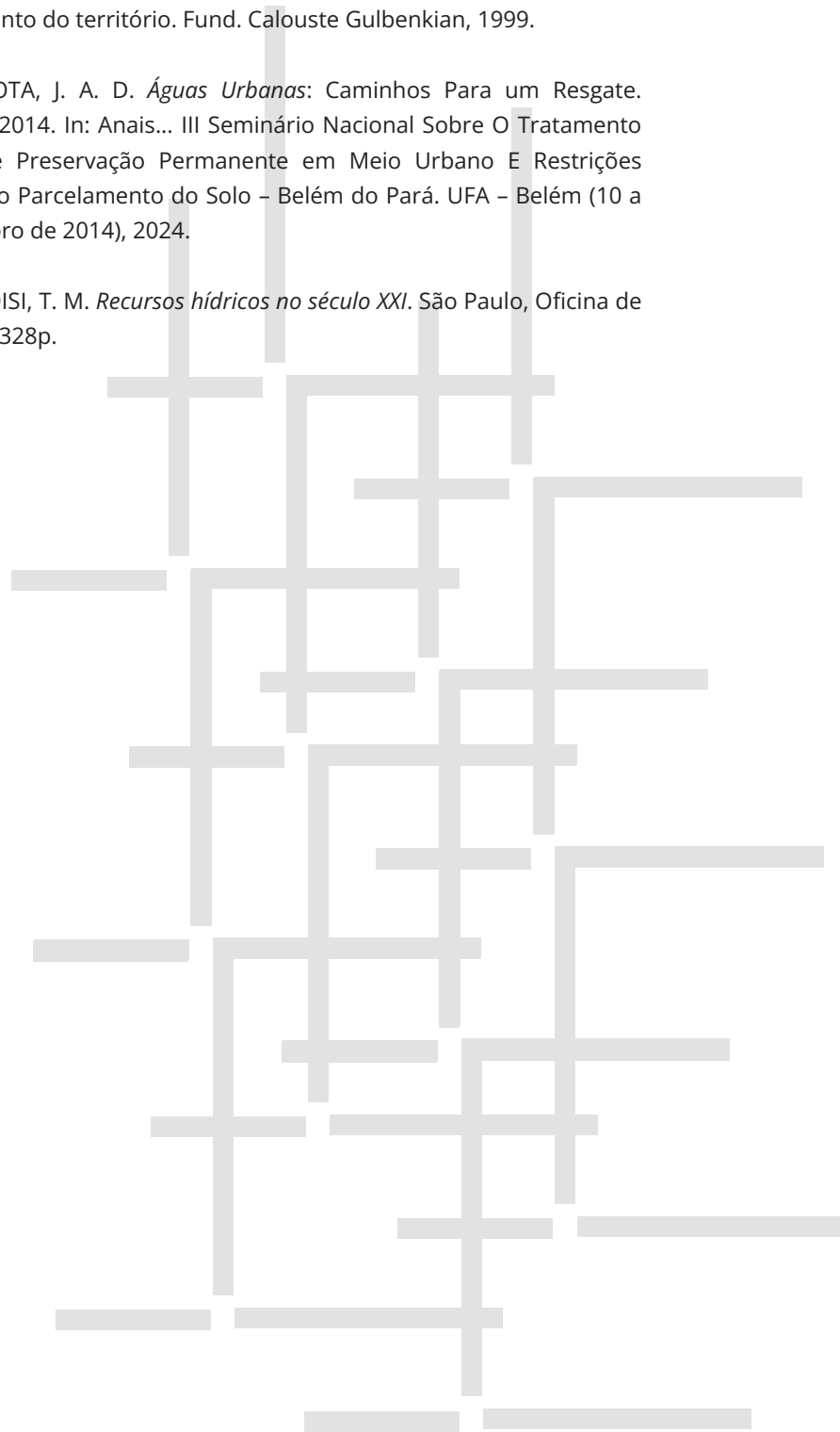


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