sociedade & natureza

DOI: 10.14393/SN-v32-2020-49531
Received: 07 julho 2019 | Accepted: 22 maio 2020

Papers

Legislation and management for risks reduction related to floods in São Paulo/SP, Brazil

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Keywords:
Risk management
Floods
Environmental legislation

Abstract
Flooding in urban areas causes problems related to traffic, damage in businesses and homes. Historically, although several environmental laws have restricted the use of river plains, many of these areas have been occupied and regularized by local governments. Inaccuracy and overlapping of laws also facilitated misinterpretations and violations. This article aims to analyze the risk management instruments provided for in Brazilian legislation and their application in areas frequently affected by floods. The case study was applied to the Ipiranga Stream Basin, in São Paulo/ SP, where occurred 82 flood events were observed over a 52-year period, predominantly between 2010 and 2017, with human, material and economic damage. The various structural measures employed so far have not been sufficient to solve the problems. Although some laws indicate readjustments of use in areas affected by floods, but these changes rarely occur. It is observed that over time, the legislation that involves the phenomenon of flooding presents a paradigm shift, where the initial focus on environmental protection of the areas of permanent preservation, migrates to disaster risk management.

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INTRODUCTION

Floods represent the most frequent natural disaster in the world, and cause human (death and homelessness) and financial losses. According to data from Swiss RE Institute (2017), the record of 327 natural disasters that occurred in the world in 2016 revealed that the total economic losses exceeded the data recorded since 2012, reversing the downward trend of the period. The economic losses were in the order of USD 175 billion, almost twice of what was recorded in 2015. In relation to social data, about 11 thousand people lost their lives or disappeared in the occurrence of these disasters.

> Floods are considered natural disasters when they cause disruption in the normal functioning of a community or society at any scale, and create conditions of exposure and vulnerability, with human, material, economic and environmental losses and impacts (UNISDR, 2017).

This article aims to evaluate the risk control and management instruments provided for in the legislation and their application in areas that are frequently affected by floods. Over the analyzed period, the focus of flood-related legislation has slowly shifted from environmental protection to disaster risk management. The Metropolitan Region of São Paulo (RMSP) presents, annually, especially in the summer, serious problems related to flooding on roads, marginal to rivers and streams, interrupting the flow of vehicles, in addition to residences, businesses and industries located close to the affected water courses.

In bibliographic reviews there are several concepts for flooding. For this work, it was decided to adopt the overbank flood or simply flood that represents the overflow of the waters of a watercourse, reaching the floodplain or lowland area (CARVALHO; MACEDO; OGURA, 2007; AMARAL; RIBEIRO, 2009). Flood occurrences, which are defined by the elevation of the water level in the drainage channel, due to the increase in flow, reaching the maximum level of the channel, without overflowing however, are not included in this analysis. Urban flooding, which represents a momentary accumulation of water in certain places due to deficiency in the drainage system and is not related to the dynamics of water courses, will not be considered in the analysis either.

Despite the existence of laws that restrict the use of river plains in all government instances, many of these areas have been occupied and are considered regular towards the municipalities, with tax collection and other duties, in addition to the provision of basic services, such as installation of water and electricity systems. However, there is no assistance or recognition for the reduction of taxes when flood events affect these properties.

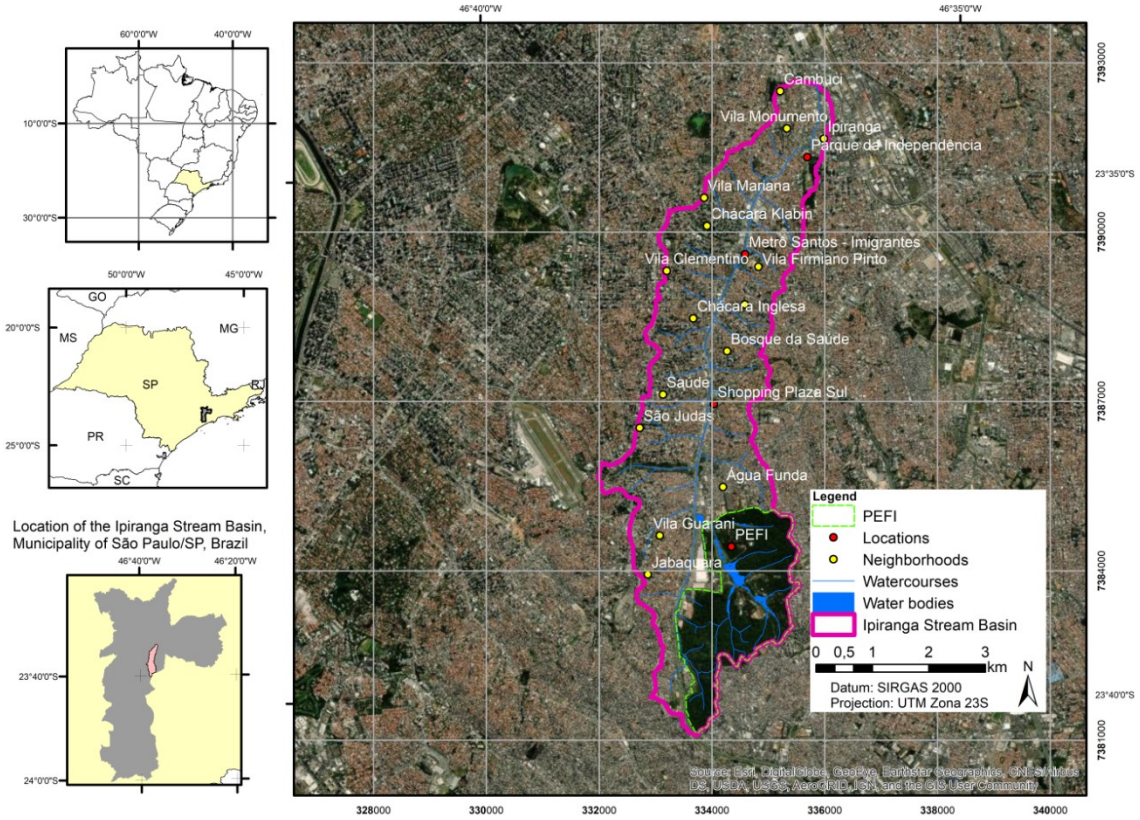
As a case study, the Ipiranga Stream Basin, located in the South Zone of the Municipality of São Paulo, will be portrayed as it suffers from flooding annually. Its approximate length is 11 km and its contribution area corresponds to 23 km². Of this total, about 80% is urbanized and the remaining 20% is represented by the remaining Atlantic Forest of the Fontes do Ipiranga State Park (PEFI), where a large portion of the springs of Ipiranga Stream is located (Figure 1).

THE CONTEXT OF CURRENT LEGISLATION

The use of floodplain areas is historical and it is linked to the great difficulty in the moving and transporting of goods in the past, when the river was used as the main means of transportation. Rivers were also used to obtain drinking water and to irrigate cultivation areas, as well as for waste disposal. Thus, cities developed preferentially on the banks of rivers and on the coast. The area to be occupied depended on the memory of the local inhabitants in relation to the extent and frequency with which the floods occurred. A sequence of years without flooding was a reason for society to advance occupation on the plains. (TUCCI, 1995; 2002; 2003; TAVARES; SILVA, 2008).

Federal Law Nr. 4,771/1965 - Forest Code (BRASIL, 1965) determined that the areas along the watercourses were intended for permanent preservation, and, obviously, unsuitable for urbanization.

Figure 1 - Location of the Ipiranga Stream Basin, Municipality of São Paulo/SP, Brazil.



Org: Authors, 2019.

However, the failure to comply with the law has given rise to countless areas subject to flooding and, consequently, to the risks to which its inhabitants are exposed. Likewise, the areas that were occupied in a period prior to that date became environmental liabilities, that is, areas that should have undergone a readjustment process to comply with the enacted environmental legislation, which did not occur.

In São Paulo, the process of occupation of floodplain areas began in the 1930s, with the rectification of the Tietê River, for the future implementation of marginal avenues and the use of central areas, motivated by sanitation and health issues; soon afterwards the rectification of the Pinheiros River takes place, to conduct the water to the Henry Borden Power Plant with the purpose of generating electricity. As a consequence, the rectifications freed up the floodplain areas and the meanders were grounded for real estate projects. Later, with the Avenues Plan, in the 1950s, this model was adopted in other areas. In the 1970s, floodplains and valley bottoms were institutionalized as axes for the expansion of urbanization by the governments at the time. Thus, the occupation of the floodplain areas of the water courses was not the only result of disorderly occupation, but also of an action of political incentives for real estate projects and for the installation of important road systems (SEABRA, 1987; ROLNIK, 1999; CUSTÓDIO, 2002; TRAVASSOS, 2004; KANASHIRO, 2013; ANELLI, 2015).

All these interventions, combined with the vertiginous population growth, caused the current problems of the urban territorial ordering regarding the management of water courses and plains, mainly linked to the risk of floods and the preservation of water resources (RODRIGUES, 2015).

After the demand for occupation of the floodplains in the 1970s, several other laws reaffirmed the inadequacy of the occupation of these areas from an environmental point of view, subject to various sanctions. However, contradictions and divergences have accumulated in the overlapping of laws, as pointed out by Travassos (2004) and Rodrigues (2015).

Federal Law Nr. 6,766/1979 - Lehmann Law (BRAZIL, 1979), which dealt with issues related to the division of urban land, stated that along the running and dormant waters a non-buildable strip of 15 meters on each side was mandatory. With this new definition, a disparity

was created with the Forest Code, which established protection strips of 30 meters along water courses, and the question arises about the different application of laws in rural and urban areas.

Federal Law No. 6,938/1981 (BRAZIL, 1981), which dispose the National Environmental Policy, provides for in its Article 4, among some of its objectives, the preservation and restoration of environmental resources to maintain the ecological balance conducive to life and the imposition on the polluter and the predator, the obligation to recover and/or indemnify the damages caused to the ecological balance.

Federal Law No. 9,605/1998 (BRAZIL, 1998) considers as an environmental crime (Art. 38) the destruction or damage to the forest of permanent preservation, even if it is in formation, or to use it in breach of the protection rules. The crime is subject to detention or a fine, or both cumulatively.

CONAMA Resolution No. 303/2002 (BRAZIL, 2002) reinforces the importance of what had already been established by the Forest Code and considers the permanent preservation areas as instruments of relevant environmental interest, which integrate sustainable development, without differentiating the application of legislation in urban or in rural areas.

But even so, the areas marginal to watercourses continued to be occupied, and in many cases, illegally regulated by municipal governments. So, the laws turned to the management of the risks already established and no longer with a view to environmental protection and prevention to the riverside populations.

With the occupation of the river plains, an important environmental service is affected: the absorption of extreme flows. This environmental service has been replaced by structural measures, such as the construction of reservoirs, replacing natural hydrological features (RODRIGUES, 2015).

Research shows that structural actions are necessary, but not sufficient to reduce flood-related damage. There is a need for these measures to be implemented in conjunction with non-structural measures and for the population to develop resilience to disasters, that is, the ability to react collectively, in such a way that the socioeconomic impacts of a disaster are kept to a minimum. On the other hand, it is observed that the role of civil defense agencies has been slowly changing from disaster management to risk management, as this approach is more effective, since it acts before the disaster occurs, saving lives and property (CUNHA, 2012; JHA; BLOCH; LAMOND, 2012).

Understanding the types and causes of floods, the probabilities of occurrence, their impact in terms of extent, duration, depth (height of the water body in meters) and speed is essential for planning measures and solutions. It is also important to know the frequency of floods, the characteristics of the population that occupies the potentially affected areas and their degree of vulnerability. This is critical to define the need, urgency and priority in implementing the flood risk management measures (JHA; BLOCH; LAMOND, 2012).

According to Federal Law No. 12,608/2012 (BRASIL, 2012), which institutes the National Policy for Protection and Civil Defense (PNPDEC), it is the duty of the Union, States and Municipalities to adopt the necessary measures to reduce the risks of disasters. This policy includes a systemic approach to prevention, mitigation, preparedness, response and disaster recovery actions aimed at civil protection and defense. The law recommends that when the risk is related to flooding, research should adopt the watershed as an analysis unit.

Within the scope of the State of São Paulo, the State Law nº 13,798/2009 - State Policy on Climate Change (PEMC) (SÃO PAULO - ESTADO, 2009) establishes principles, guidelines and instruments to be adopted by government agencies to guarantee sustainable development and disciplining land use through the Ecological Economic Zoning (EEZ) and responding to extreme weather events that may cause public calamity, identifying and mapping existing vulnerabilities in municipalities, in order to serve as a basis for policies to adapt to the impacts of climate changes.

State Decree nº 57,512/2011 (SÃO PAULO - ESTADO, 2011) that institutes the State Program for the Prevention of Natural Disasters and Reduction of Geological Risks (PDN), also seeks to articulate strategies and executive actions of the various instances and state institutions with attributions or with training to act in the various stages and activities necessary to prevent natural disasters.

Some instruments are used to prevent and mitigate risks. Brollo and Ferreira (2016) discussed the main instruments that have been systematically applied and monitored in the State of São Paulo and the specifics of each:

a) Mapping of areas at risk of landslides, floods and erosion. These studies began in 2003

with the aim of minimizing and preventing accidents and disasters and offer recommendations to the municipal authorities to reduce social and economic losses.

b) Municipal Risk Reduction Plan (PMRR). These plans have been elaborated by city halls since 2004, according to the principles of the Ministry of Cities.

> The PMRR's work involves: I) training municipal agents to elaborate diagnosis, prevention and risk management, including mapping risk areas in areas of irregular occupation in the municipality; II) financial support to the municipality for the elaboration of the risk reduction plan. This planning instrument includes the risk diagnosis, the necessary security measures, the estimate of necessary resources, the establishment of priorities and compatibility with the slum urbanization and land title regularization programs; and III) financial support for the elaboration of structural slope containment projects in risk areas considered priority in the Municipal Risk Reduction Plans. (BROLLO; FERREIRA, 2016, p.21)

In this step, the analysis, characterization and dimensioning of the areas at risk of flooding, landslides and undermining are carried out, classified according to the type and degree of risk, as well as the analysis, quantification and characterization of the families living in those areas, according to demographic, socioeconomic and housing profiles (SÃO PAULO - CIDADE, 2014).

c) High and very high risk sectorization.

> As of 2012, it started at the national level (...) aiming to subsidize the alarm and alert systems of the municipalities and meet the demands of federal agencies (...). In the State of São Paulo, these works have been prepared by the Mineral Resources Research Company (CPRM) and the State Civil Defense Coordination (CEDEC) (BROLLO; FERREIRA, 2016, p.21).

d) Mapping of Landslide and Flood Susceptibility.

> The PNPDEC changed the Statute of Cities, making it mandatory to prepare a geotechnical map as a tool for urban planning, infrastructure, water resources management and land use occupation. (...) The susceptibility charts to mass gravitational movements and the generated floods show a relative classification (high, medium, low) supported by a model of approach under development, based initially on predisposing factors related to land, spatializable and obtained through the compilation and treatment of secondary data (BROLLO; FERREIRA, 2016, p.21).

e) Preventive Civil Defense Plan (PPDC) and Contingency Plans aimed at landslides and floods.

> This Plan (the PPDC) comes into operation annually, in the period of four summer months (December to March) and involves actions of monitoring total rainfall and weather forecast, in addition to field surveys and emergency calls with technical surveys at risk areas. Its main objective is to prevent the occurrence of deaths, with the preventive and temporary removal of the population that occupies the risk areas, before the landslides reach their homes. (...) Contingency Plans are action instruments, which establish the procedures to be adopted by the institutions involved in responding to emergencies and disasters when acting directly or indirectly in events related to these natural disasters. (...) The operation of the plans is regulated by Resolutions of the Military House, published annually, which specify all regions and municipalities that operate the plan (BROLLO ; FERREIRA, 2016, p.22).

f) Campaign “Building Resilient Cities”.

> A resilient city is one that has the capacity to resist, absorb and recover efficiently from the effects of a disaster and in an organized manner to prevent lives and property from being lost. (...) This campaign, launched in Brazil in 2013, is part of the International Strategy for Disaster Reduction (ISDR), of the United Nations (UN). Its objective is to increase the degree of awareness and commitment around sustainable development practices, as a way of reducing vulnerabilities and promoting the well-being and security of citizens. (...) In Brazil it is an initiative of the National Secretariat of Civil Defense (SEDEC), of the Ministry of National Integration (MI), to raise awareness among governments and

> citizens about the benefits of reducing risks through the implementation of 10 steps to build resilient cities. (...) In the State of São Paulo, CEDEC has encouraged the municipalities to join this campaign and, together with the Secretariat of the Environment, it has been increasing the adhesion to the Campaign via the Municipality Green Blue Program, which annually promotes the measurement of the efficiency of environmental management in the cities of São Paulo (BROLLO; FERREIRA, 2016, p.23).

Brollo and Ferreira (2016) also assessed that the risk management instruments used by municipalities in the State of São Paulo have been evolving over the past 15 years. Currently 402 municipalities (62% of the state's municipalities) have already been served by any of the existing management instruments.

Municipalities must prepare, based on their Master Plan, the mapping of areas susceptible to the occurrence of natural disasters, as well as the contingency plan for risk reduction. These are the instruments that allow to plan, diagnose and seek to minimize problems in those areas.

São Paulo municipality master plan

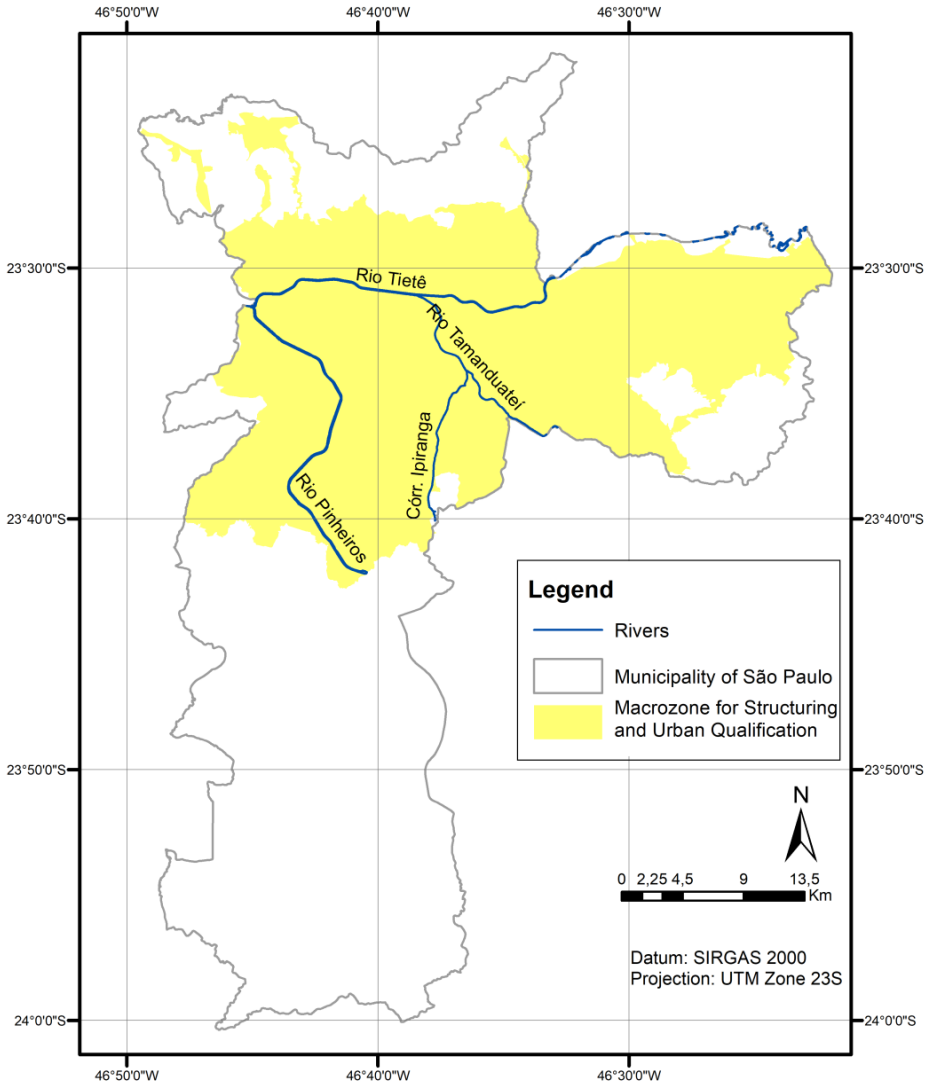
The Strategic Master Plan for the Municipality of São Paulo, Municipal Law nº 16.050/2014 (SÃO PAULO - CIDADE, 2014) provides objectives and strategies for spatial planning for homogeneous areas defined as macrozones and macro-areas. The Urban Structuring and Qualification Macrozones encompass most of the urbanized area, and the fluvial plains of the Tietê, Pinheiros and Tamanduateí rivers, of which the Ipiranga Stream is an affluent (Figure 2). Among the general objectives of this area, Art. 10, § 2, I stand out:

> the promotion of a more balanced coexistence between urbanization and environmental conservation, between structural changes arising from large public and private works and the living conditions of residents.

When referring to the municipality's water network, Art. 25 mentions strategic urban and environmental objectives related to its recovery and protection:

> I – to progressively expand the permeable areas along the floodplains and headwaters, significant green areas and afforestation, especially in the Urban Structuring and Qualification Macrozone, to minimize erosion processes, floods and heat islands;
> II – to expand urban and linear parks to balance the relationship between the built environment and green and free areas; and guarantee leisure and recreation spaces for the population;
> III – to integrate areas of significant vegetation of ecological and landscape interest, protected or not, in order to guarantee and strengthen their protection and preservation and create ecological corridors;
> IV - to protect springs, drainage headwaters and alluvial plains;
> V - to recover degraded areas, qualifying them for adequate uses;
> VI – to articulate, through pedestrian paths and cycle paths, preferably at the bottom of the valley, significant green areas, free spaces and urban and linear parks;
> VII – to promote, in conjunction with the State Government, strategies and mechanisms for disciplining groundwater drainage.

Figure 2 - Location of the Macrozone for Structuring and Urban Qualification the Tietê, Pinheiros and Tamanduateí rivers, in the municipality of São Paulo / SP.



Org: Authors, 2020.

In the chapter dealing with the regulation of subdivision, use and occupation of land and the urban landscape (Art. 27), the following objectives stand out:

> (...) IV – to establish parameters and mechanisms related to rainwater drainage, which avoid overloading the networks, urban floods and floods;
> V – to create land occupation parameters related to geological, geotechnical and hydrological aspects; (...)

It also highlights the need to present strategies (Art. 29) for the control of:

> (...) XII – the environmental fragility and physical aptitude for urbanization, especially for areas susceptible to the occurrence of landslides, floods or related geological and hydrological processes that are indicated in the Mapping of Risk Areas and in the Geotechnical Charter of the Municipality of São Paulo; (...)
> XIV - permanent preservation areas; (...)

Thus, it is assessed that the Municipality Master Plan provides possibilities for the readjustment of areas at risk of flooding, mentioned in several articles.

THE OCCUPATION OF FLOODPLAINS AND FLOODS IN THE IPIRANGA STREAM BASIN

In the Ipiranga Stream Basin, the first recorded interventions date from the period between 1910 and 1920, following the gardening plan works of Parque da Independência that date from 1907, when the open channeling of the downstream stretch was completed, as part of the commemorative works for the Independence Centenary, in areas close to the Paulista Museum, also known as Museu do Ipiranga, located in Parque da Independência (Figure 3). In the 1930s, in addition to these interventions, the stretch between Chácara Inglesa and Bosque da Saúde neighborhoods, in the middle course, also had rectification and road crossings over the stream.

Figure 3 – The works for rectification of Ipiranga Stream (1910-1920) In the picture in the background is the Paulista Museum, popularly known as the Ipiranga Museum.

Source: Museum of the City of São Paulo Photographic Collection. PMSP (2018).

Travassos (2004) points out that the Plan of Avenues of the Municipality of São Paulo, dated 1957, determined the occupation of floodplains by road systems, and indicated the channeling of several streams, among which, the Ipiranga Stream. The Plan did not included any works for flood control and there was no proposal for the use of margin areas.

The intervention took place in the 1960s and 1970s, with the rectification and the open channeling of the total extension of the main course for the installation of Avenida Água Funda on both banks of the stream, which opened in 1967 (Figure 4). Today the avenue is called Av. Dr. Ricardo Jafet in the stretch between Parque da Independência and Chácara Inglesa neighborhood. From that section, it is called Av. Abraão de Morais up to the beginning of Imigrantes Highway.

At each stretch in which the stream was rectified and channeled, the urban occupation became denser and consolidated in the surroundings a few years later. Between the decades of 1910 and 1970, practically the entire main course was channeled on the surface and the areas were regularized. The tributaries were channeled underground and only the tributaries in the area inside the PEFI maintained their original conditions.

Figure 4 – An aerial view of the works for the opening of Avenida Água Funda (now Av. Dr. Ricardo Jafet), and the rectification of the Ipiranga Stream, in the section that cuts through Vila São José neighborhood. View taken towards Vila Monumento neighborhood, 1970, São Paulo/SP.

Source: Museum of the City of São Paulo Photographic Collection, PMSP (2018).

It is noteworthy that in the basin there is only one area with irregular occupation in a public area, bordering a small stretch of a non channeled tributary at the limit with the PEFI, but the area does not register official data on the occurrence of floods. In the rest of the basin, where there is the occurrence of occupations on the open channel margins and on the underground channeled tributaries, the subdivisions are regular. All flood records are in the vicinity of the main channel, in the stretch that is between the middle course and downstream.

Flood points and damage records

According to the data survey carried out by Santos and Amaral (2017), 82 flood events were recorded in the basin in the period stretching from 1965 to 2017, which amounts to 52 years. Thus, on average, more than one flood per year occurred in the area of the Ipiranga Stream Basin. No news was found prior to 1965, since there was no urban occupation on the banks of the stream.

For data collection, the digital collections of the newspapers Ipiranga News, Jabaquara News, Folha de São Paulo and the State of São Paulo were consulted, in addition to the institutional data obtained from the Emergency Management Center of the City of São Paulo (CGE/PMSP) and the São Paulo State Flood Alert System, Department of Water and Electricity, Fundação Centro Tecnológico de Hidráulica (SAISP / DAEE / FCTH). The data were tabulated on a standard form, adapted from IG (2009). After statistical analysis, the locations were inserted on the map of the location of the flood points, identified at 31 addresses or road intersections (Figure 5).

The damage and losses recorded per decade are shown in Table 1.

Table 1. Damages and losses recorded in the media, from 1965 to July 2017, in the Ipiranga Stream Basin, São Paulo/SP.

Decade	Period	Quantity of events	News source	Reported damage and loss
1960	1965 a 1969 (5 years)	7	Estadão	Water invades stores and residences, hindering store trade
1970	1970 a 1979 (10 years)	6	Folha de São Paulo	150 homeless families Traffic of vehicles interrupted Industrial activity standstill
1980	1980 a 1989 (10 years)	3	Estadão	60 homeless people
1990	1990 a 1999 (10 years)	10	Folha de São Paulo	Impassable streets, closed avenues Loss in industry 16 thousand people without electricity
2000	2000 a 2009 (10 years)	10	Folha de São Paulo	1 death Cars dragged by water Closed avenues
2010	2010 a 2017* (7,5 years)	46	Ipiranga News CGE	Water invades houses, residents lose furniture and documents Submerged cars Impassable avenues

Org.: Authors (2019).

In the interval of almost 30 years, between the 1980s and 2010, approximately R$ 114.6 million (non-updated amounts) were spent on structural measures in the Ipiranga Stream Basin.

In 2017, works to contain floods began with the construction of reservoirs with two compartments and a storage capacity of 200 thousand m³ and the silting of a pond for a flood reservoir with a storage capacity of 100 thousand m³. The works are budgeted at R$ 160 million, with completion initially scheduled for 2019.

According to studies by PMSP (2014), these reservoirs were designed with the function of decreasing flood flows in the middle course stretch of the Ipiranga Stream, which has presented greater flood recurrences in recent years. However, the study also points out that, due to the occupation of the floodplain by the avenues and the dense urbanization, other areas that could minimize the flow in the downstream stretch without the expropriation of private areas were not found.

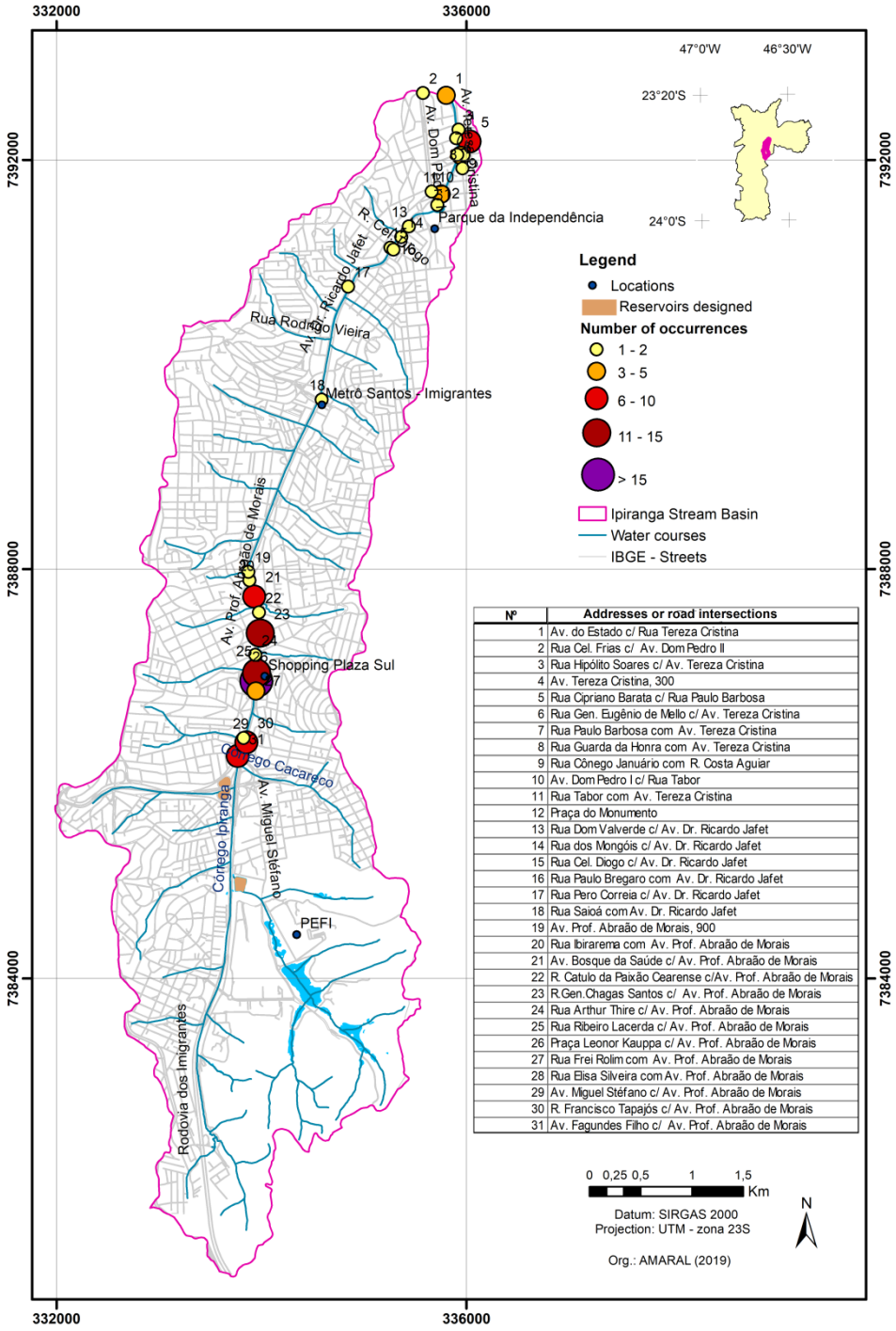
It is observed that the middle course stretch also has a greater economic impact from floods on urban mobility and commercial activities, which predominate in the area.

FINAL CONSIDERATIONS

As assessed in the case study, flooding in the basin has been occurring since the 1960s, when the Ipiranga Stream was rectified and channeled. At the same time, with the inauguration of Avenida Água Funda, currently Av. Dr. Ricardo Jafet, which connects the Center to the South Zone, built on the banks of the stream, the surrounding areas were occupied and led to the installation of stores, industries and residences, considered as environmental liabilities based on the Forest Code (Law No. 4,771 / 1965).

The various structural measures employed to date have not been sufficient to prevent accidents and losses. In some places, floods occur even more than once a year and material losses and health-related damage are recorded. There were no non-structural measures in the basin, such as: bioretention systems or the use of permeable pavements.

Figure 5 - Flood points in the Ipiranga Stream Basin, Municipality of São Paulo / SP.



Nº	Addresses or road intersections
1	Av. do Estado c/ Rua Tereza Cristina
2	Rua Cel. Frias c/ Av. Dom Pedro II
3	Rua Hipólito Soares c/ Av. Tereza Cristina
4	Av. Tereza Cristina, 300
5	Rua Cipriano Barata c/ Rua Paulo Barbosa
6	Rua Gen. Eugênio de Mello c/ Av. Tereza Cristina
7	Rua Paulo Barbosa com Av. Tereza Cristina
8	Rua Guarda da Honra com Av. Tereza Cristina
9	Rua Cônego Januário com R. Costa Aguiar
10	Av. Dom Pedro I c/ Rua Tabor
11	Rua Tabor com Av. Tereza Cristina
12	Praça do Monumento
13	Rua Dom Valverde c/ Av. Dr. Ricardo Jafet
14	Rua dos Mongóis c/ Av. Dr. Ricardo Jafet
15	Rua Cel. Diogo c/ Av. Dr. Ricardo Jafet
16	Rua Paulo Bregaro com Av. Dr. Ricardo Jafet
17	Rua Pero Correia c/ Av. Dr. Ricardo Jafet
18	Rua Saioá com Av. Dr. Ricardo Jafet
19	Av. Prof. Abraão de Morais, 900
20	Rua Ibirarema com Av. Prof. Abraão de Morais
21	Av. Bosque da Saúde c/ Av. Prof. Abraão de Morais
22	R. Catulo da Paixão Cearense c/Av. Prof. Abraão de Morais
23	R.Gen.Chagas Santos c/ Av. Prof. Abraão de Morais
24	Rua Arthur Thire c/ Av. Prof. Abraão de Morais
25	Rua Ribeiro Lacerda c/ Av. Prof. Abraão de Morais
26	Praça Leonor Kauppa c/ Av. Prof. Abraão de Morais
27	Rua Frei Rolim com Av. Prof. Abraão de Morais
28	Rua Elisa Silveira com Av. Prof. Abraão de Morais
29	Av. Miguel Stéfano c/ Av. Prof. Abraão de Morais
30	R. Francisco Tapajós c/ Av. Prof. Abraão de Morais
31	Av. Fagundes Filho c/ Av. Prof. Abraão de Morais

Org .: Authors (2019).

Thus, it is considered that non-structural measures can be used concurrently with the structural measures already underway in the Ipiranga Stream Basin, in order to minimize economic, environmental and social problems, and also to instruct the population about living with risk so that they can avoid further loss of life and property.

Despite the existence of legislation that prohibited urban occupation in areas of permanent preservation along water courses, the floodplains and valley bottoms were occupied and became regularized areas.

The overlapping of legislation, which questioned its proper application in urban areas, also constituted a vulnerability that allowed the advance to the occupation of the plains. The implementation of the Avenues Plan in São Paulo made feasible and did not regulate restrictions on the use of valley bottoms.

Therefore, with each rectified or channeled watercourse, new land was released for occupation, which occurred quickly. The flood risk areas arose from the occupation of the floodplains. The legislation was adapted to deal with the then risk management, creating instruments and bodies that seek to identify and mitigate the associated problems. However, no legislation has necessarily sought to readjust the floodplain areas to their original function, which is to store the waters in flood events to later promote runoff.

One of the general objectives of the São Paulo Municipality Master Plan is to promote a more balanced coexistence between urbanization and environmental conservation. Since the areas are already occupied, from an economic point of view, there will be hardly any change in use. However, it must be recognized that, from the point of view of their natural function, the floodplains will always be areas subject to flooding.

Current risk management instruments have been based on prevention and planning. In areas that are recurrently affected, it is important that river basin studies indicate as an intervention the evacuation of areas that expose vulnerable populations and that propose changes in use in areas under constant flood danger. It should be noted that these areas, if disoccupied, must soon have a proposal for new use, or they will be occupied again unduly by the population. For that, it is necessary that all levels of government are obliged to execute the measures indicated by the studies. In choosing environmental measures, improvements in quality of life are also promoted.

However, this alternative has a high cost of economic implementation, in addition to causing social problems, due to the need of reallocating real estate, businesses and high traffic. Therefore, the solutions are much more complex and can show a new vision of strategic planning, not only to solve locally, but regionally.

ACKNOWLEDGEMENTS

The authors are grateful to CGE/PMSP, SAISP/DAEE/FCTH and the Meteorological Station of IAG/USP for making available the data that enabled the analyses carried out in this work.

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