

Analysis of the Impact of Implementation of a Risk-Flood Retention Basin

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Abstract— The increase of urban population in Boa Vista/RR is occurring fast and disorderly manner, generating large urban conglomerates modifying the environment, modifying the water cycle as soil sealing. So, to check the impact of the implementation of a retention basin to reduce flood risk, this research has qualitative, bibliographical, documentary with dialogue with the community and gathering spot data, and document data from existing projects associated with the analysis of the remaining impact areas. Analyzing the study area in the neighborhood Senator Helio fields in which the residents suffer water rationing the dry period, it was noted that of these, 78% regularly suffer from a lack of water, 17% spend up to three days without supply and only 5% do not suffer water rationing. Reinforcing the idea of the need for legislative framework, the occupation and use of water resources, avoiding disorderly interventions often result from urban pressures.

Keywords— Flood control; Urban drainage; Sustainability.

Resumo— O aumento da população urbana em Boa Vista/RR vem ocorrendo de forma rápida e desordenada, gerando grandes conglomerados urbanos que alteraram o meio ambiente, modificando o ciclo hidrológico como a impermeabilização do solo. Assim, para verificar os impactos da implantação de uma bacia de retenção para a redução do risco de inundação, a presente pesquisa possui caráter qualitativo, bibliográfico, documental com diálogo com a comunidade e coleta de dados in loco, além de dados documentais de projetos existentes associados à análise de áreas de impacto remanescentes. Analisando a área de estudo no bairro Senador Hélio Campos, no qual os moradores sofrem racionamento de água no período de seca, observou-se que destes, 78% sofrem periodicamente com a falta de água, 17% passam por até três dias sem abastecimento e somente 5% não sofrem racionamento de água. Reforçando a ideia da necessidade de enquadramento legislativo, à ocupação e utilização do recurso hídrico, evitando, intervenções desordenadas frequentemente resultantes das pressões urbanísticas.

Palavras-chave— Controle de cheias; Drenagem urbana; Sustentabilidade.

I. INTRODUCTION

The problem of the increase of urban population in Boa Vista/RR is occurring fast and disorderly manner, generating large urban conglomerates modifying the environment, modifying the water cycle as waterproofing of soil. Added to this, there is the fact that the public policy of sanitation used palliative and ineffective measures to solve this problem, causing risks to human health and huge economic losses associated with the lack of concern about the urban drainage behavior and decrease infiltration area.

Faced with the above exposed problem, evaluates the implementation of a retention basin in Senator Hélio

Campos neighborhood because of its flooding history, production losses, causing tangible and intangible damage to the local population. In addition to the desire of residents by efficient measures and improved quality of life.

Today, the emergence of new flows of control measures aims to circumvent the changes in hydrological cycles, trying to match the pre-existing conditions (BAPTISTA, et al., 2005). One such alternative is the storage reservoir, which retains the excess runoff during the rainy season, to further make its return to the beds of streams and rivers. One of the many types of this reservoir

is called the retention basin open sky, which will be addressed in this work.

In this context, the objective of this research includes the analysis of the impacts of the implementation of a retention basin to reduce flood risk in the city of Boa Vista/RR, precisely at a lake located in the urban area in the boundary region between the districts Senator Hélio Campos and Laura Moreira. Search in particular, as well as conduct a historical study of the identified area; examine the use of existing pipelines in order to generate flow into the basin; consider the implementation of the basin from the perspective of sustainability and evaluate the inconvenience caused to local people by the absence of an effective drainage system.

Finally, highlighting the need for a master plan for major drainage with long-term planning, since small micro drainage projects have been implemented so that it can be supplied merely a temporary need.

II. THEORETICAL REFERENCE

Sustainable Urban Drainage

According to Pereira (2018) is another approach to urban drainage solutions being related to the concept of SUDS (Sustainable Urban Drainage System). In this case, it takes into account in the drainage system design process, the vision of sustainable development, another words, the impacts of drainage solutions should not be transferred in space or time, should be provided for measures to reduce the influence of urbanization on the hydrological cycle.

Contributing to sustainable development, drainage systems can be developed to improve the urban layout, improving the built environment. The Sustainable Urban Drainage System aims to reduce quality of life issues, as well as maximizing opportunities revitalization of urban space and increasing biodiversity (CIRIA, 2007).

Sustainable urban drainage system is tried to approach the most of the hydrological cycle of the later characteristics of the urbanization process. Making small interventions throughout the watershed that replace in part the traditional system of urban drainage (PEREIRA, 2018).

And to analyze the report of Tucci (2003) which says that the channeling of flows is inefficient, as only transfers to downstream flooding. As well as the irrationality of the projects leads to unsustainable costs and represents an extremely high damage to society as a whole over time. This further justifies this project.

Given the above, it was thought in the modern concept of urban drainage that is grounded in alternative technologies or compensatory and aims to counteract the effects of urbanization on the hydrological processes (Souza, 2008). In addition, the developed countries have

sought to avoid this type of solution and encouraged a new concept of drainage, concerned about public health and environmental issues (DRUMOND, 2012).

Flood control measures

According Port and ZahedFilho (2004) the main benefits of urban drainage control measures are reducing human losses and water binding diseases, reduction of losses from downtime and disorders resulting from reduced costs for rebuilding the affected areas, more opportunities recreation, increased green spaces and urban areas, improving the protection of margins and less siltation.

For Nascimento and Baptista (2009), compensatory techniques can be no structural techniques which include the principles of prevention and the environmental education. And structural compensatory techniques refer to engineering constructions to offset the increased runoff generated by waterproofing of soil.

Thus, the above authors as they can be classified into three according to the operating principle, infiltration, retention or location of the control device, and arrest them for micro reservoir of retention, filtration tracks; Trenching infiltration; infiltration basin; retention basin; detention basins; Trenches filtration; infiltration devices, among others.

The choice of the types of techniques to be adopted depend on urban, social, economic and environmental factors. The ideal situation for the use of this type of solution occurs when the study leads to choosing the most suitable techniques are done at the same time develops the urbanization project of a new development area, allowing greater flexibility for choosing and the adjustment of compensatory techniques to the urban project (NASCIMENTOAND BAPTIST, 2009).

Legislation Related to Urban Drainage

According to Marques (2006), drainage structures and other control measures contribute to urban water management. And the precepts to be implemented depend fundamentally on the current legislation.

According to Law 10.257/2001 also known as the City Statute, which aims to guarantee the right of access to cities environmental sanitation, including urban drainage, as a basic requirement for achieving a sustainable urban environment.

As for the environmental licensing, Resolution n° 237/1997 of CONAMA (National Environment Council) regulates the activities subject to license by the competent environmental agency, and civil works such as drainage must be licensed. Similarly, the CONAMA Resolution 01/86, which provides for the environmental impact

assessment sets out in Article 2°, section VII, the preparation of an environmental impact study for sanitation activities, and drainage.

However, Cruz Souza and Tucci (2007) argue that the management of urban rainwater in most municipalities is still performed in a fragmented way and this has generated significant impacts in a way harmful to urban sustainability.

Regarding the urban drainage service, is conceptualized by Law 11,445/2007 as the activities of infrastructure and operating facilities for rainwater drainage, transportation, detention or retention for damping floods, including the treatment and disposal of drained water.

As Drumond (2012) it is clear that there is a concern on the part of the legislation to prevent the population of the drainage problems that may arise due to the incorrect occupation of urban areas.

Retention basin

Therefore, Tucci (2008) reports that although the responsibility for stormwater management within the urban area is the municipal administration, it is recognized that the vast majority of municipalities do not have staff trained to administer the urban drainage system, and less to address the control of rainwater at the source.

Given this context, he thought of the retention basin, since according to Matias (2006) retention basins a structure that aims to stabilize the tributaries rainwater flow rates, enabling the refund downstream flows compatible with the previous limit set or tax the flow capacity of an existing collector or to build.

The integration of the retention basin into the drainage system, when properly designed, contribute the following benefits: improved drainage system behavior by storage capacity and consequently decrease the flood risk; creating water reserves to do in the face of agricultural needs, occurrence of industrial and municipal fire and activities such as cleaning streets; investment costs, lower will the expansion of the existing network; and faster and simpler construction (DIAS AND ANTUNES, 2010).

Thus thought of studying the basin in the open, generally they are built on land with slopes or embankments reinforced with side shields. This type of bowl is usually linked to landscape integration concerns and appreciation of leisure time and recreational areas.

Finally, among the source control techniques constitute a key instrument for reducing the flood peak flow. Although there is legislation that does not allow a new development causes rainwater flow rates higher than those occurring before construction. This comes clearly reinforce the idea of using retention basins as a legislative measure for this purpose.

III. METHODOLOGY

The research was conducted in Senator Hélio Campos neighborhood, shown in Figure 1, focusing on the HC-13 street, parallel to the study of the lake, being the only one in the area to present a process of drainage and paving, which during the rainy season It did not meet the local flow needs, creating flooding in several locations. Featuring an area of approximately 730,90m², which is the threshold area for contribution of the basin, whereas other areas have proper place for disposal, may be lakes or streams in the area nearby.

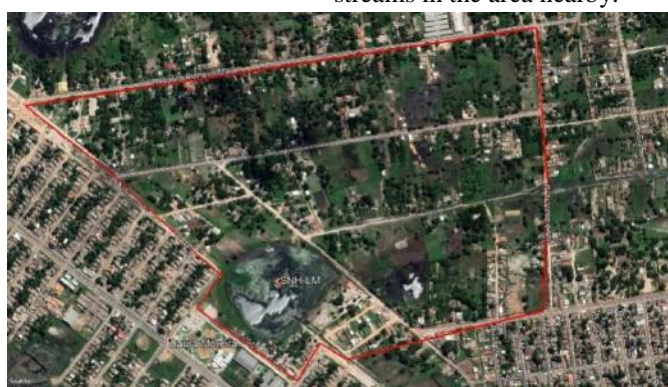


Fig.1: Studyarea

Source: Google Earth (2019)

Thus, the research lasting about 06 months has qualitative approach, bibliographical, documentary and applying data collection techniques: dialogue with the community, on-site data collection, documentary data

through existing projects and analysis of remaining impact areas.

In search of the need to build continuous water supply insufficient during the dry period was set to bowl being open and level of permanent water, with a view

preliminary findings: low rate of infiltration, presence of lakes in the region, high water table level, vegetation surrounding the basin.

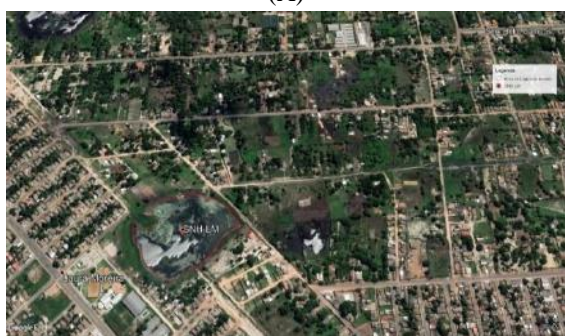
Obtaining given drainage projects by Municipality of Boa Vista/RR - PMBV promoted the observation of the destinations of the drainage and the study of areas of the region which will be the analysis, associated with the flooding map of Boa Vista/RR created in 2011, where the state was affected by high rainfall, with the level Branco river 10,2m above its normal height, flooding some areas.

IV. RESULTS AND DISCUSSION

In order to demonstrate the possibility of implementing a retention basin will open, it made necessary the historical analysis of the occupied area. As in Figure 2 (A), its natural vegetation of savannah, regionally known as *drawn up*, with plenty of features on water, being by lakes, streams or rivers. Such a location study presents a region of lakes, which is responsible for the source of some streams running through Boa Vista/RR.



(A)



(B)

Fig.2: A - Image of the region in 2002; B- image of the region in 2019.

Source: Google Earth (2019)

Thus it is observed in Figure 2 (B), with the uncontrolled growth in the neighborhood Senator Hélio Campos Boa Vista/RR, led to the grounding of the lower regions, not redistributing its natural storage. This is consistent with Sousa (2011) as the streams are supplied by small lakes that form springs, and today more than 90% of the lakes have disappeared because they were grounded, and the neighborhoods that have major flooding problems are in places that had the grounded lakes.

For Staeve (2011) the reason for the degradation is the settlement to the stream banks, after the emergence of new locations considered neighborhoods by the local population, construction of condominiums and structures erected on the banks of the creek. Thus, the vegetation has been extinguished, the urban solid waste dumped began to be more frequently in the waters and the impact became apparent.

It was noted in on-site visit this interference, in the flows of the most important rivers for Roraima drainage network Tacutu, Uraricoera and Branco river, a characteristic that best highlighted by the complex system of networks lake supplied by groundwater and the peaks rainfall in the rainy season.

These observations are consistent with Meneses et al. (2007), Carvalho and Carvalho (2012) to approach that during this same period, the number of lakes form on plowed one interconnected wetlands system and during the great drought period of these lakes disappear (temporary), leaving only those perennial that last all year.

Before this problem above, the study sought to determine whether the region suffering from some kind of water rationing during the dry period in Figure 1, it was observed that 49% of the weekly residents suffer from lack of water; 29% say they suffer daily with lack of water at specific times; 17% of absence of up to 3 days; 5% which does not suffer from the ration of water.

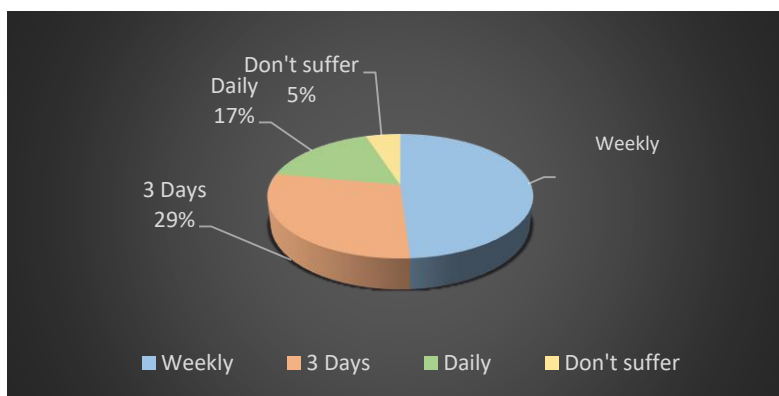
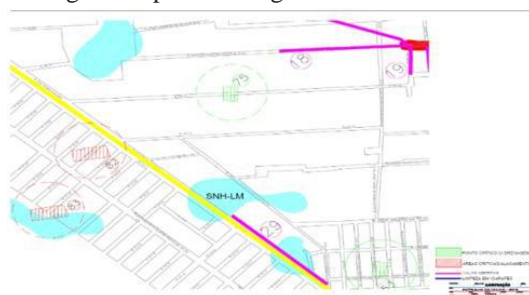


Chart 1: Rationing water during the dry period.

Source: Author (2019).

Analyzing the accounts of residents who claim that often can water on your property only in lower taps, while others stating that they do not suffer from any rationing because wells have on their properties, regardless of the distribution system. Just as there is a government policy to address and prevent the consequences of drought during the severe drought Roraima, so does the rainy season, severely punishing the poorest people, especially those living in the poorest neighborhoods.



(A)



(B)

Fig.3: A - Points of critical drainage flooding; B - HC-13 rains street.

Source: Operation Patrol Rain (2011). Source: Newspaper of Boa Vista (2019).

Thus it can be seen in Figure 3 (A) four points in their surroundings, two of inefficiency of the identified

drainage green and two flooding by red, identifying the region as being prone to flooding. At these points, enabling the implementation of a retention basin, which has availability to work together with the lakes in its vicinity. May contain and then seep river network, avoiding problems with flooding in other regions, preventing the rapid flow of water to the water body.

Seen the documentary analysis of Rain Patrol operation (2011), you can see the study of lake identified on the map by SNH-LM codename in Figure 3 (A), pierced the way, invading adjacent land to it, not indifferent to the absence of information about the flooding in HC-13, mostly residential street with more than 50 households consisting of homes, houses or similar.

In the interview with residents in the study area, it can be reported that they suffer long periods by a lack of effective drainage, as shown in Figure 3 (B), the Boa Vista sheet (2019) that during the period matter already had existing drainage, the same reporting previously have an open trench of the route to the temporary flow, softening the rainy season in the region, but with enough negatives.

Subsequently, the HC-13 busy street by drainage network in place of the ditch, relocated its volume, not having the same efficiency to accomplish infiltration, transferring the problem to another ditch at the end of the street, who with his full, overflowing into the street .

For residents, the situation is not new and is repeated annually without any response from the government to provide improvements to the site. Amid the hole, a ditch covered the open sky garbage extends the HC-13 Street, which has no type of flow and gives off a strong odor

(NEWSPAPER OF BOA VISTA, 2018).

In order to assess the inconvenience caused to the local population due to the absence of a drainage system, wondered in chart 2 on the flooding frequency on their properties, whose study area had 57 land, of which 41

residents answered the questionnaires, which 56% report annually suffer from flooding when it rains a lot in a short time; 39% report who sometimes suffer when the rainy season is rigorous; 5% report that they never suffered from flooding, but they took care with the ground grounding, drainage system, among others.

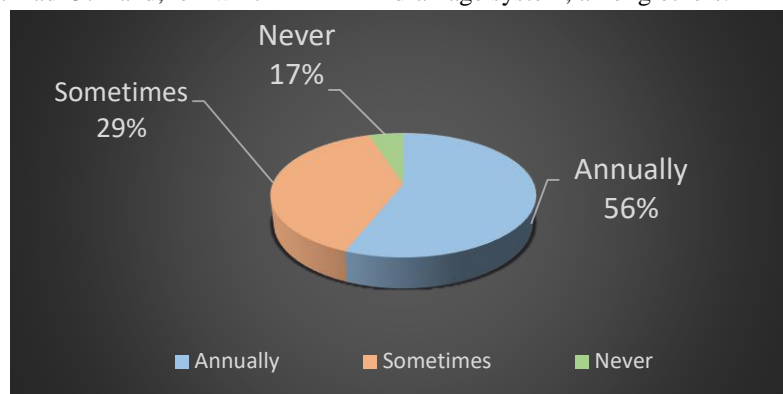


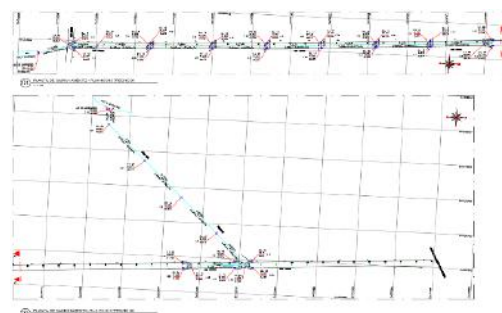
Chart 2: Frequency of flooding on their properties.

Source: Author (2019).

It was observe that some residents are afraid to recurrent flooding in the region, and end up seeking alternatives to try to circumvent the situation, reserving a place on their land with lower quota for temporary storage, others creating a system of channels that eliminate the accumulation water as quickly as possible, taking the fastest route to.

These results are in agreement with Farias, Veras and Paixão (2012) because the physical conditions qualitatively influenced the conditions of use and occupation, since Boa Vista/RR has a gently undulating flat geomorphology, with dissection ranging from weak to very weak, developed on sedimentary rocks, which constitute the formation of the municipality, with elevations averaging 70-80 m, ie, low slope, which favors the flooding.

Through this it became existing drainage analysis, and results obtained by the projects assigned by the city Boa Vista/RR (2018) found that in the region of Senator Hélio Campos neighborhood, only one route has existing drainage, HC-13 street, one with an interconnected part of the lake study. In Laura Moreira neighborhood has drainage and is interconnected to the lake, but it was not available for study.



(A)



(B)

Fig.4: A-Drainage system in the study of lake; B - System map applied.

Source: Author (2019)

With implementation in March 2019, the network collects the drainage of HC-13 street works in two parts: a generating flow for the study of lake, Network 1, one for an existing ditch contained at the end of the route network 2, in all their route on the main tubing DN concrete pipe (nominal diameter) 600mm and route manhole to ward

launch DN 800mm. In the collection system, concrete pipes DN 400mm, with interconnection in manholes. Information on the dimensions of wolves mouths were not available.

The tubing 1 generates flow of the lake with a total length 361,54m and having slope of 0,2%, according to Botelho (2011) as a standard minimum velocity 0.7m/s and 5m/s maximum, provides since a good relationship for the diameter of pipe slope is 0,11%.

This tubing has a system of collect of 6wolves mouths that serves as an indicator of operating and preliminary assessment of the lake's behavior initially with visiting rock bottom quota 80,905 and ward launch Lake 80,150, with a difference of 75,5cm.

In the tubing 2, second project ceded by Municipality of Boa Vista/RR - PMBV (2018) showed a slope of 0,25%, extension 533,25m, which presents a drowned launch, for that to be at certain times below the ditch water level. His height difference of the first manhole until the release wing is 1,315m.

Note that the difference in elevation and slope are not very disparate, so one can establish the use of mixed way, sometimes collecting and generating flow to basin, sometimes using for its flow to the ditch, as its surplus that can be infiltrated and / or covering your way to the nearest stream. Since the study of Lake quota is 80,150 and the dimension of the trench is 79,520, visiting pit 1,40m deep.

Future constructions in the study area, the Senator Hélio Campos neighborhood, can be designed to meet the needs of the basin, leaving free to the designers the ability to generate drainage flow to it. Alerting the possibility of linking the lakes next to Laura Moreira neighborhood, contributing to streams spring unidentified by name.

By seeking to propose a retention basin, analyzed the lake, which has an area of 38,98m², despite being a low value area since the total area of study, there being able to work with lakes in the area for redistribution of flow, and to a larger lake to its natural seepage or fracturing his return to the streams that previously received them, restoring its natural characteristics.

Seeking alternatives for sustainable drainage bring many benefits, it has been applied to study the retention basin the sky opened with level of permanent water, ensuring its natural storage, implemented in the existing lake, increasing its water supply capacity and approaching the maximum of particularities of the lake.

However its operation capacity is comprehensive, with the main reason to rid the flooding region, retaining water from local drainage systems. It can be used in various ways in dry period: the softening effect of water rationing, the region which is greatly affected; use the fire-fighting, very recurrent in the region; aid in family

plantations that surround the lakes, especially agriculture of vegetables; supply of the water table; designing a piscicultures in small areas.

Once succeeding in their execution, such containment model in origin, could become a model for other lakes in the region, with the maximum utilization of the drainage structure and standardization of services. Having ability of investment and private capital generation to the capitation resources retention basin and use of existing drainage.

These results are in agreement with Meneses et al. (2007) that due to the rapid and unplanned urban expansion, the city of Boa Vista/RR has suffered serious environmental impacts including premature extinction of many lakes and swamps and compromised quality of lake water through anthropogenic practices such as the washing clothes and launching indiscriminate wastewater in their basins.

Therefore, the pollutant control is one of key points of retention basin, whereas during the initial periods of rain, there is a "washing" roads and land, thereby bringing drainage and solid fats for the same. And one of the negative factors brought by region population of Boa Vista disinformation is the wrong use of the drainage system, mingling with the sewer system, bringing direct waste to the water system without having any treatment, a barrier would be the basin, with observation deliver a preview of the drainage system.

Envisioning greater security, its operation must comply with a very strict quality control, constant maintenance, quality control of water and pollutants, among others. It must work together with guidelines and laws, for although there the master plan in Boa Vista/RR, with legal directives about the protection of the environment, there was no master plan of the macro drainage.

Finally, it is suggested constructing a retention basin for this purpose, which may be a solution to the problem of flooding in the study area, with an additional advantage of allowing treatment of rainwater.

And it is suggested that all urban settlements and / or waterproofing causing exceed the flow coefficient of the basin or part thereof, to seek alternatives to cushion the full flow edge.

Furthermore, it is suggested further work on further deepening the impact and scale of this basin, determining the maximum output rate of the allowed retention basin; sizing the discharge device is made based on this flow.

V. CONCLUSION

It is concluded that the implementation of this basin, when properly implemented and operated, can provide sustainable solutions, in the sense that there will be no transfer downstream to problems, thus minimizing the direct impact on the lives of those present families as it will bring many benefits reducing problems in the dry period and contributing to the drainage during the rainy season.

Highlighting the impacts of urban drainage are a direct consequence of irregular practices of land use, because if well planned and executed, will bring improved sanitation, allocating better quality of life for residents.

This study reinforces the idea of the need for legislative framework related to the occupation and use of water resources, thus avoiding the disorderly interventions, often resulting from urban pressures.

Finally, as a reference to new projects and implementation of innovative ideas drainage, it is stated that the work presented an analysis of the retention basin.

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