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ENVIRONMENTAL IMPACTS OF THE URBANIZATION AND INTENSE PRECIPITATION IN THE SHARP IGARAPÉ IN MANAUS

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ABSTRACT

The lack of planning, the city is building without the necessary infrastructure to meet the local demand, large areas occupied anyway, without projects to measure the damage caused in the long term, causing, in most cases, direct impacts troubled by misuse from soil. In order to characterize the study area, on-site visits will be carried out to obtain cross-sectional and depth measurements, where the igarapé meets the streets of the neighborhoods and where there is access through the streets, with the collected data a spreadsheet with the organoleptic aspect information of the environmental impacts of the study area. The sedimentation of streams and the alteration of their natural water quality characteristics are the main causes of flooding in these areas and diseases, respectively. The lack of basic sanitation infrastructure education policies towards the residents accelerates the degradation of the environment inserted in the study areas.

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INTRODUCTION

The accelerated and disorderly growth of cities, combined with population concentration, economic activities, technological patterns of industrial production, has reinforced a highly degraded environmental picture as a result of a style of development leading to the predatory use of urban natural resources (CHAFFUN, 1997, p28). As reported by Targa et. al., (2012), the need of man to occupy new spaces, whether for housing or for economic activities, has become increasingly larger. This fact has caused the phenomenon of irregular occupations, mainly in marginal areas of the waterways and, with this, generating negative impacts and creating environments hostile to human life. Lack of planning helps cities to build without the infrastructure needed to meet local demand, and large areas are occupied without projects to measure long-term damage.

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This reality, for the most part, entails direct impacts on the incorrect use of the soil. As a consequence, areas covered by primary forests suffer from spontaneous occupations (invasions) or occupied by authorized real estate developments, such as large condominiums with high standard of housing (OLIVEIRA E SCHOR, 2009). In urban basins the change of land use is definitive, the soil, and even the subsoil, are exposed to erosion in the time span between the beginning of the allotment and the end of the occupation. When the urban basin is completely occupied and the soil is practically impermeable, sediment production tends to decrease (TUCCI e COLLISCHONN, 1998). Changes in natural conditions, resulting from the removal of vegetation in favor of urban construction, reduce the potential for soil infiltration and, consequently, the recharge of underground aquifers, while increasing runoff. Impermeable surfaces, such as roofs, streets and paved parking lots, have a lower hydraulic roughness, increasing the speed at which surface runoff and associated transport (e.g., dragging of pollutants, water erosion) (MARTINS*et al.*, 2014). The waterproofing resulting from

urbanization changes the terrestrial phase of the hydrological cycle, increasing the volume and velocity of the surface flow. Due to reduced soil infiltration and greater hydraulic efficiency of drainage elements to conduct stormwater (CAMPOS-ARANDA, 2010). Thus, floods increase in frequency not only by increasing the flow, but also by the reduction of the flow capacity caused by the silting of conduits and channels. Impacts on urban water are generally tied to the strong urban density, as well as to climatic issues and the inconsequent practices of the population, such as: the discharge of untreated sewage into rivers; solid waste deposits which contaminate surface water and groundwater; the occupation of urban land without control of the impact on the water system; among others (TUCCI, 2008). According Archova (2005), deforestation, a serious example of incorrect soil management, can lead to the emergence of erosive features, silting up of rivers and reservoirs. The waterproofing, in turn, prevents the water infiltration, accentuating the problems of urban erosion and increasing flood spikes, favoring floods. Second Christofoletti (1980), the study of a river drainage network is of great relevance, since it is possible to clarify many questions of a geomorphological nature by analyzing the river and valley trajectory, as well as the relief morphology of a basin. In Brazil, extreme negative and positive rainfall events (droughts and floods) bring significant calamities, with great impacts on the physical environment, as well as on the social and economic life of the country. These phenomena are caused by arrhythmias of the meteorological systems, that is, they occur naturally, however the accumulated anthropic action over the years is contributing to increase the frequency, aggressiveness and areolar expansion (GONÇALVES, 2003).

The floods can be considered one of the consequences of the actuation and dynamics of natural systems on the terrestrial surface that greater alterations provoke in the geographic space. This dynamic is not only limited to the increase in the flow that leads to the flood, but also to the atmospheric movements, the geomorphological processes and, mainly, to the repercussions in the areas affected by the floods, especially in the urban areas located on the banks of the rivers, where they are frequent processes (WOLLMAN e SARTORI, 2008). Rainfall impacts have great significance in urban areas for the possibility of being flood-related. Such impacts can theoretically be classified in the category of extreme natural events or natural disasters (ZANELLA, 2006). With the soaked soil, the balance between the surface and subsurface runoff will give rise to the discharges of the base flow, that is, not infiltrating more water in the soil, which is the initial step for the occurrence of a flood, since water saturation soil, especially in the floodplain, and in humid climates, (STRAHLER, 1974). In view of this, we tried to test the hypothesis that, with increasing urbanization, intense rainfall events in the city increase, as well as the floods and the impacts caused, and that this problem is perceived in a differentiated way by the affected communities, by the press and by public managers, which influences the actions to be implemented in these areas. It also raises the question that the aspects experienced and perceived by the population of risk areas are often neglected when public interventions in their spaces. (ZANELLA, 2006). Therefore, this article aims to calculate the representative morphological parameters of the Cachoeirinha creek and the impact of intense rainfall in these areas. Note that the aspects arising from natural events or anthropic actions have had consequences that result from material damages to risks to public health as well as economic.

MATERIALS AND METHODS

For the characterization of the study area, on-site visits will be carried out to obtain cross-section and depth measurements, where the igarapé meets the streets of the neighborhoods and where there is street access, a visual database and the registration of geographical points by GPS of all the igarapés of the project area.

Channel Measurements: Measures of existing channels, where they exist, will be cataloged to monitor possible floods.The geographic locations were performed using Garmin eTrex GPS, measurements of water depth and channel dimensions were performed using Bosch GLM40 laser treadmill.With the collected data will be elaborated a spreadsheet with the information of organoléptico aspect of the environmental impacts of the study area.

RESULTS AND DISCUSSION

The area of Industrial District II, where one of the sources of the Igarapé do Mindu, commonly known as Igarapé da Sharp, was selected for analysis of this study, since it is a densely populated area. On May 24, a field visit was conducted to characterize the water bodies in the study area. Four water courses were characterized, one main one, hereinafter referred to as Igarapé 1 and three smaller water courses called Igarapé 2, 3 and 4, according to Figure 1. The points where the igarapés met the streets of the neighborhoods and where there was access through the streets, according to Figure 2. Some information was not collected because of the difficult access, because it is an area with ravines, high vegetation, garbage and agglomerated residences. The field surveys of the Water Courses and surveys made using geoprocessing tools are described below.

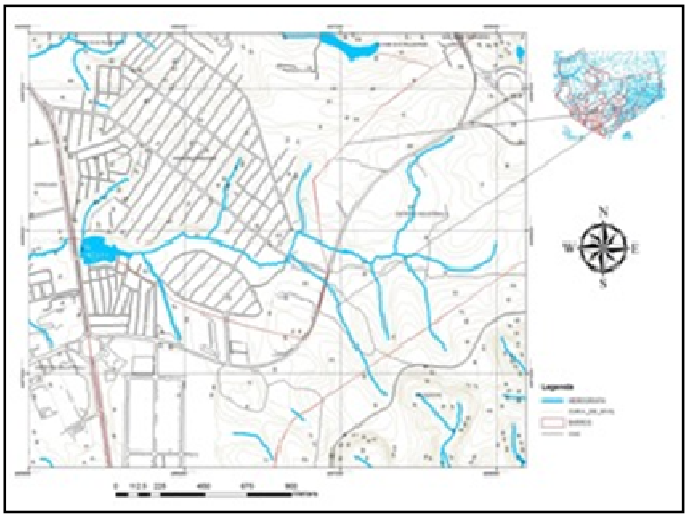

Figure 1. Location of the Igarapés of the project area

Igarapé 1 (one): The Igarapé denominated 1, is located in the East Zone of Manaus. It has an extension of 2,638.35m and a watershed area of 5,749,099.93 m². Its source is located in the District Industrial District 2, at elevation elevation of 62,599 meters, and geographical location of 59 ° 55'48.084 "W e3 ° 5'19.595" S. The mouth of igarapé 1 is located in the neighborhood Armando Mendes, with elevation of 24,711 meters and geographic location at 59 ° 56'50.067 "W and 3 ° 5'36.659" S. The location of the Igarapé1 is described in Figure 3 and the location of the Igarapé Basin 1 in Figure 4.

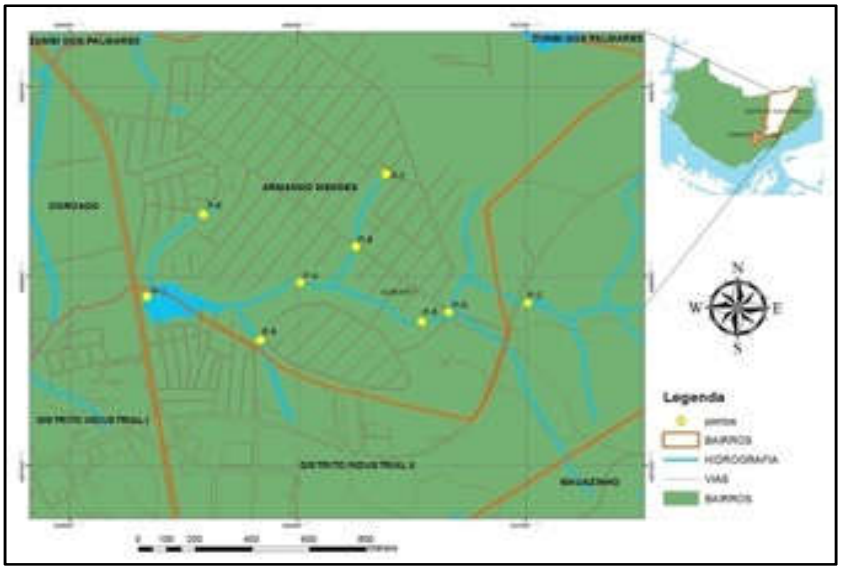

Figure 2. Information collection points

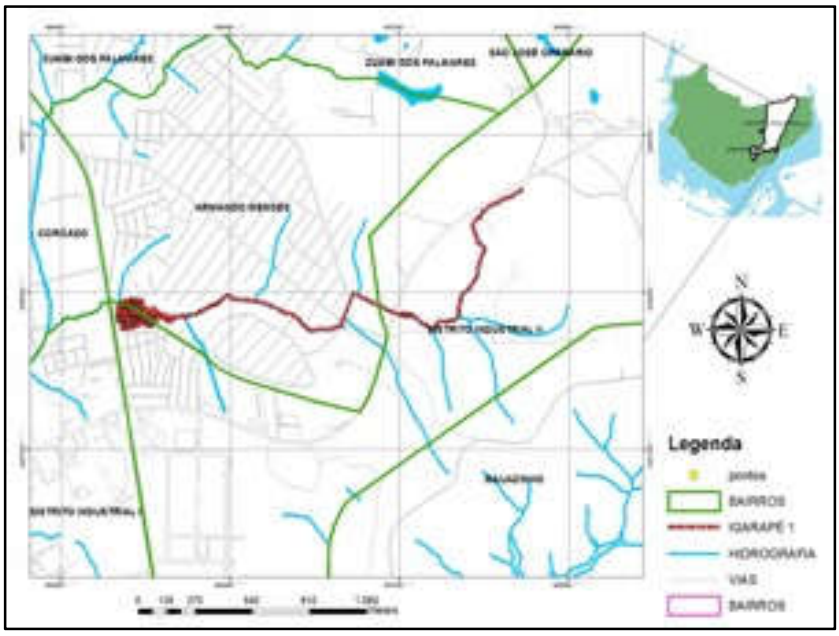

Figure 3. Location of Igarapé 1

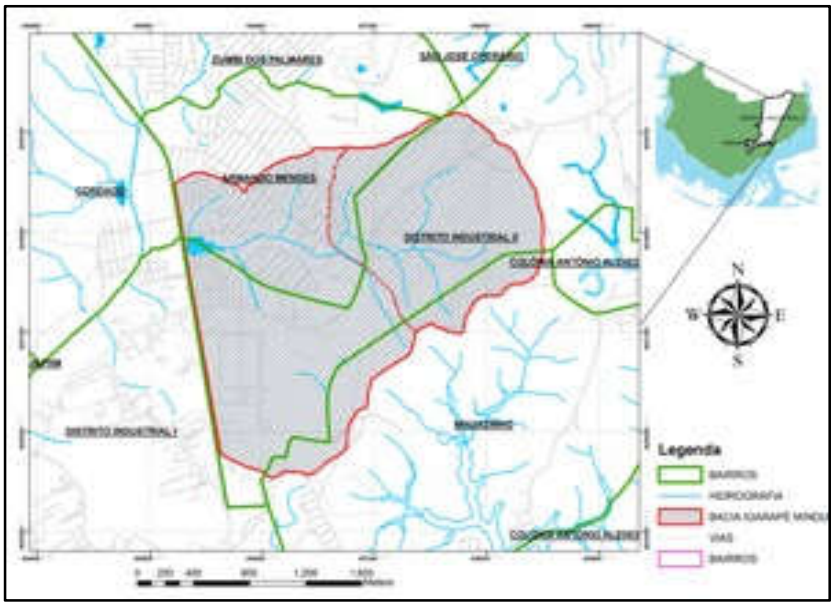

Figure 4. Location of the Igarapé Basin 1

Table 1. Specification of the Igarapé field survey 1

Specification	GeographicCoordinate	Visual Memory
Igarapé –1 **P-1** Point located downstream of Av. Grande Circular. The vegetation is native, that is, without interference of the man. At this point, it is observed, a work of art, that leads the water course under the Av. Grande Circular. A large quantity of garbage is observed in the bed of the igarapé and the discharge of untreated sewage.	3° 5'37.41"S 59°56'53.32"W	  Views on the right side of the Grande Circular Avenue  View from the left side Grande Circular Avenue
P-2 Balneário, located upstream of the project area. It isabandoned.	3° 5' 39.05"S 59°56' 8.88"W	
P-3 At this point the igarapé 1 has a width of 1,20m, and a depth of 0.20m. It is silted, that is, the sand is obstructing the passage of the stream. It has native vegetation, odor of sewage. It has microdrain piping thrown in its bed. It crosses the Av. Itacolomi with two pipes of Φ1000mm.	3° 5' 40.14"S 59°56' 17.05"W	 

…….continue

P-4 It has the width of 1.5 meters, and depth of 0.30 meters. It has native vegetation and we have residences located on the stream. Residents reported that when heavy precipitation occurs the lower houses are submerged, as are the access bridges of the residents.	5 - 3° 5' 37.259"S 59°56' 31.122"W	  
P-5 It has a width of 2.00 m and a depth of 0.8 m. It presents a native vegetation and we do not have residences located on the igarapé.	6 - 3° 5' 38.59"S 59°56' 26.70"W	 

The information collected in the field, according to the visit made on May 24, 2019, is described in Table 1. Five points, P-1 to P-5, were selected for information collection.

Igarapé 2

The Igarapé denominated 2, is located in the East Zone of Manaus, with an extension of 472.66m and a basin area of 143,909,49sqm. Its source is located in the district of Armando Mendes, at elevation elevation of 49,850 meters, and geographical location of 59 ° 56'42.078 "W 3 ° 5'26.487" S. The mouth of igarapé 2 is located in the district Armando Mendes, with elevation elevation of 25,298 meters and geographical location at 59 ° 56'50.067 "W and 3 ° 5'36.659" S. The location of Igarapé 2 is described in Figure 5 and the location of the Igarapé Basin 2 in Figure 6.

Due to the difficult access to Igarapé denominated 2, only one point, P-6, was chosen to collect information, because it is an area of dense accumulation of residences. The information collected is described in Table 2.

Igarapé 3

The Igarapé denominated 3, is located in the East Zone of Manaus, with an extension of 445.52m and a hydrographic basin area of 222,846.05sqm. Its source is located in the district of Armando Mendes, in the elevation elevation of 54,920 meters, with its geographic location of 59 ° 56'23.467 "W 3 ° 5'23.178" S. The mouth of igarapé 3 is located in the district of Armando Mendes, with a elevation of 27,618 meters and geographic location at 59 ° 56'29.019 "W 3 ° 5'35.789" S. The location and area of the Basin are depicted in Figures 7 and 8, respectively.

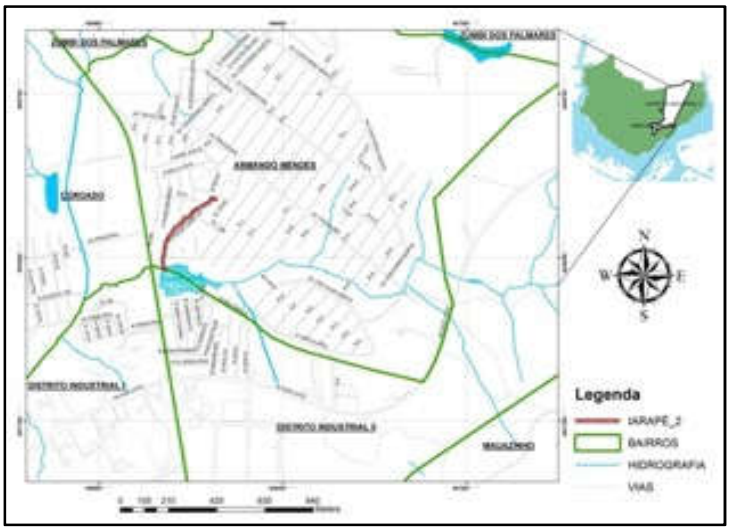

Figure 5. Location of Igarapé 2

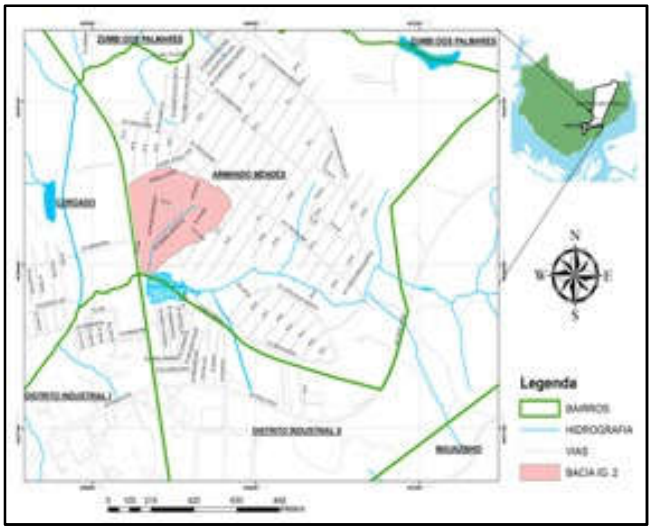

Figure 6. Location of the Hydrographic Basin

Table 2. Specification of the Igarapé field survey 2

Specification	Geographic Coordinate	Visual Memory
Igarapé – 2 *P-6* It has the width of 1.50 meters, and depth of 0.23 meters. It presents native vegetation and we do not have residences located on the igarapé, with discharge of wastewater and domestic waste.	3° 5' 29"S 59°56' 47"W	 

Source: Author.

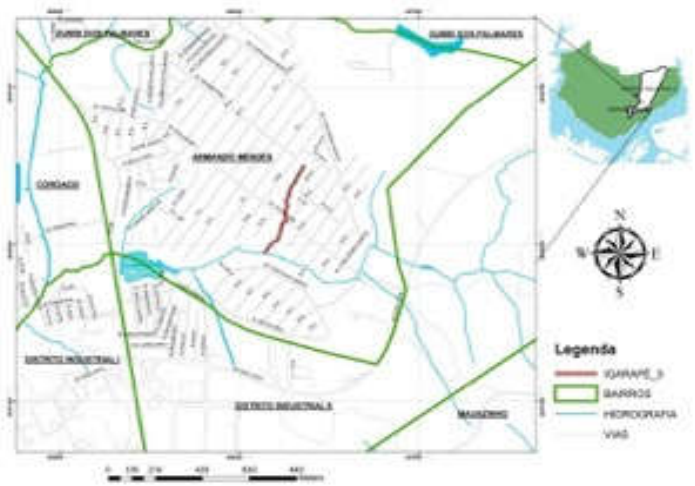

Figure 7. Location of Igarapé 3

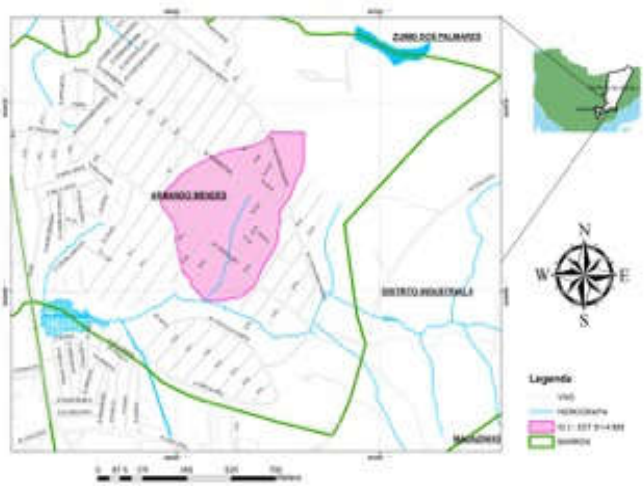

Figure 8. Location of the Hydrographic Basin

Table 3. Specification of the Igarapé field survey 3

Specification	Geographic Coordinate	Visual Memory
Igarapé 3 P-7 Source of Igarapé 3, ravine with microdrainage throwing in valley bottom. Beginning of igarapé, native vegetation. Houses around, but with small strip of preservation.	03°05'23,62" S 59°56'24.39" W	
P-8 At this point the Igarapé 3 is channeled through 1200mm tubing that leads the same under Av. Itacolomi. In the area there is a large presence of dwellings, making it impossible to access the igarapé 3.	3° 5' 31.77"S 59°56' 28.02"W	

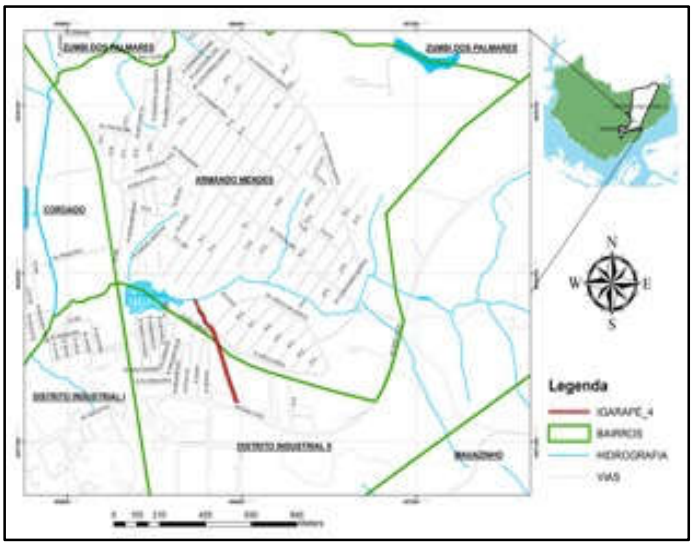

Figure 7. Location of Igarapé 4

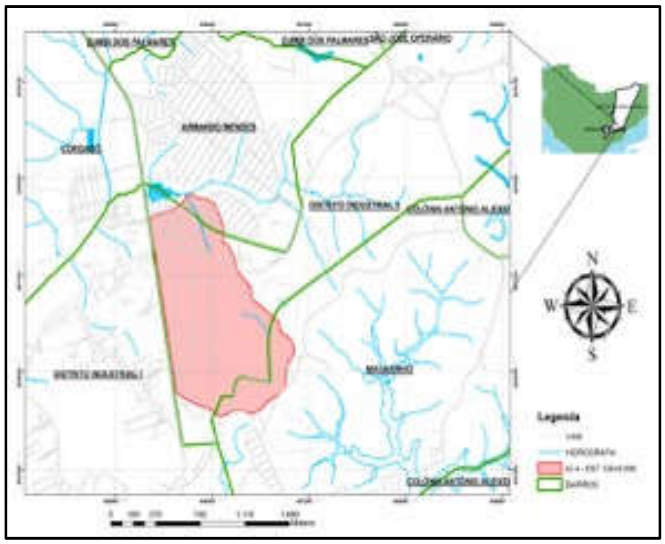

Figure 8. Location of the Hydrographic Basin

The information collected in the field, according to the visit made on January 24, 2013, is described in Table 3. Due to the difficulty of access to the site, only two points were chosen for data collection, P-7 and P-8.

Igarapé 4

The Igarapé denominated 4, is located in the East Zone of Manaus, with an extension of 495,99m and area of watershed of 1,154,006,30m². Its source is located in the district of Industrial District II, with elevation elevation of 71,254 meters and geographical location of 59 ° 56'33.517 "W - 3 ° 5'51.916" S. The mouth of igarapé 4 is located in the district Armando Mendes, with elevation elevation of 25,746 meters and geographical location at points 59 ° 56'39.644 "W - 3 ° 5'38.264" S. According to Figure 7 and Figure 8.

The Igarapé 4 has a large portion of area contained within private grounds, making it impossible to access. For this igarapé information was collected at a point P-9. The information collected is shown in Table 4.

Table 4. Specification of the Igarapé field survey 4

Specification	Geographic Coordinate	Visual Memory
Igarapé - 4 P-9 The Igarapé 4 has its natural shape changed by infrastructure. It has gabion side walls. Its width of 4 meters, and depth not verified. It shows the arrival of pipes and drainage and a native vegetation and we do not have residences located on the igarapé.	3° 5'43.75"S 59°56'38.79"W	 View from the left side of Multibrás Street  View from the right side of Multibrás Street
P-9 There is a large amount of sewage disposal in commercial premises and homes.	*3° 5'43.75"S* *59°56'38.79"W*	

Source: Author.

Final Considerations

The igarapés 1 and 4, where the watercourses are not in their natural bed, having infrastructure works, one can observe the great incidence of waste and sewage, but little sedimentation.In igarapés 2 and 3, with their natural bed, they are completely silted, having no height of water blade superior to 30cm. In the event of intense rainfall the houses of lower level are submerged, as well as the access bridges of the residents.The sedimentation of streams and the alteration of their natural water quality characteristics are the main causes of flooding in these areas and diseases, respectively.The lack of basic sanitation infrastructure education policies towards the residents accelerates the degradation of the environment inserted in the study areas.

REFERENCES

ARAÚJO, E.L. 2012. Estimativa e análise do crescimento da demanda de água considerando cenários de uso e ocupação do solo. Dissertação (Mestrado em Engenharia de Recursos Hídricos e Sanitária) – Universidade Federal de Campina Grande, Campina Grande.

CHAFFUN, N. Dinâmica global e desafio urbano. In: BONDUKI, N. (Org.). Habitat: as práticas bem sucedidas em habitação, meio ambiente e gestão urbana nas cidade brasileiras. São Paulo: Studio Nobel, 1997.

CHRISTOFOLETTI, A. Aplicabilidade do conhecimento geomorfológico nos projetos de planejamento. In: GUERRA, A. J. T.; CUNHA, S. B. Geomorfologia: uma atualização de bases e conceitos. 7. ed. Rio de Janeiro: Bertrand Brasil, 2007. p. 415□437. _____. Geomorfologia – 2ª ed. – São Paulo: Editora Blucher, 1980, p. 102□110.

DE INFORMAÇÕES HIDROLÓGICAS–HIDROWEB, ANA Sistemas. Agência Nacional de Águas. 2017. 2017.

GONÇALVES, N. M. S. Impactos Pluviais Desorganização do Espaço Urbano em Salvador. In: Monteiro, Carlos Augusto de Figueiredo; Mendonça, Francisco. Clima Urbano. São Paulo: Contexto, 2003.

INMET, INDEM. Banco de Dados Meteorológicos para Ensino e Pesquisa. 2012.

MARTINS, C. M. T.; MENDES, M. G. T.; ABREU, J. M.; ALMEIDA, J. P. L. de; LIMA, J. P. de; LIMA, I. P. de. Hidrologia urbana (Conceitos básicos).2010. 187p.

Município de Manaus. 2011. Secretaria Municipal de Infraestrutura, Plano Diretor de Drenagem Urbana de Manaus. Manaus, CONCREMAT Engenharia.

NETTO, Azevedo; Y FERNÁNDEZ, Miguel Fernández. Manual de hidráulica. Editora Blucher, 2018.

OLIVEIRA, José Aldemir de e SCHOR, Tatiana. 2009. Manaus: transformações e permanências, do forte a metrópole regional. In: Edna Castro (Org.). Cidades na Floresta. São Paulo: Annablume, 2009. 41-98.

TARGA, M. S.; BATISTA, G. T.; DINIZ, H. D.; DIAS, N. W.; MATOS, F. C. Urbanização e escoamento superficial na bacia hidrográfica do Igarapé Tucunduba, Belém, PA, Brasil. Ambi-Agua, Taubaté, v. 7, n. 2, p. 120-142, 2012.

TUCCI, C. E. M. Águas urbanas. Estudos Avançados. USP. Impresso.v. 22, p. 97- 112, 2008.

TUCCI, C.; COLLISCHONN, W. 1998. Drenagem urbana e Controle de Erosão. VI Simpósio nacional de Controle da erosão. Presidente Prudente, São Paulo, 1998.

WOLLMANN C. A. M. SARTORI, da G. B. O estudo das enchentes nas diferentes linhas de pesquisa da geografia física – uma revisão teórica. Anais do XIII SBGFA. 2008.

ZANELLA, M.A. Inundações Urbanas em Curitiba/PR: impactos, riscos e vulnerabilidade socioambiental no Bairro Cajuru. Tese de Doutorado. Meio Ambiente e Desenvolvimento - UFPR, 2006.

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