IMPACTO CIENTÍFICO EDITORA

PRELIMINARY ENVIRONMENTAL ASSESSMENT OF THE URBANIZATION OF THE ESPERANÇA STREAM, NOVA ESPERANÇA DO PIRIÁ, NORTHEAST OF PARÁ

AVALIAÇÃO AMBIENTAL PRELIMINAR DA URBANIZAÇÃO DO CÓRREGO ESPERANÇA, NOVA ESPERANÇA DO PIRIÁ, NORDESTE PARAENSE

EVALUACIÓN AMBIENTAL PRELIMINAR DE LA URBANIZACIÓN DEL ARROYO ESPERANÇA, NOVA ESPERANÇA DO PIRIÁ, NORESTE DE PARÁ

https://doi.org/10.56238/edimpacto2025.063-006

Antônio Pereira Júnior[1], Ellen Joevanna Lopes Barros[2], João Teodomiro da Silva[3], Larysse Amorim Nunes[4], Romila Conceição de Lima[5], Roniele Conceição de Lima[6], Ruanderson Silva Dias[7]

ABSTRACT

Urban growth in Brazilian municipalities causes environmental impacts, especially on water bodies that range from loss of protected areas to loss of depth. In Brazilian municipalities, such as Nova Esperança do Piriá, in southeastern Pará, there are still no studies identifying the negative effects of this type of growth. This gap led to the objective of this assessment and identification of the impacts and their classifications on the Esperança Stream in the urban area. The method employed was ex-post-facto research, combined with qualitative and quantitative scope and observational design. Data obtained during in-situ observation indicated that the stream's banks and channel were channeled, generating cumulative impacts in the directly and indirectly affected areas. In addition, it also caused vegetation suppression in the Permanent Protection Area (APP). Siltation and loss of depth are visible. The development and presence of macrophytes indicate water pollution. The cement layers used for the paving and sidewalks hinder soil recharge of the stream. The lack of trees on both banks indicates intense radiation, which can lead to health problems for the surrounding community, who only visit this area after sunset due to the drop in air temperature. There are

[1] Dr. in Environmental Sciences. Universidade do Estado do Pará.
E-mail: antonio.junior@uepa.br Lattes: http://lattes.cnpq.br/3239362677711162
Orcid: http://orcid.org/0000-0001-6241-985X
[2] Undergraduate in Environmental and Sanitary Engineering. Universidade do Estado do Pará.
E-mail: ellenjeovanna15@gmail.com Lattes: https://lattes.cnpq.br/2012812571825932
Orcid: https://orcid.org/0009-0003-9561-1380
[3] Undergraduate in Environmental and Sanitary Engineering. Universidade do Estado do Pará.
E-mail: joaoteodomirosilva@gmail.com Lattes: http://lattes.cnpq.br/5324349373179893
Orcid: https://orcid.org/0009-0004-2257-4168
[4] Undergraduate in Environmental and Sanitary Engineering. Universidade do Estado do Pará.
E-mail: amorimlarysse@gmail.com.br Lattes: http://lattes.cnpq.br/2554791576655144
Orcid: https://orcid.org/0009-0001-7163-249X
[5] Undergraduate in Environmental and Sanitary Engineering. Universidade do Estado do Pará.
E-mail: romilalima11@gmail.com Lattes: https://lattes.cnpq.br/4447182854234680
Orcid: https://orcid.org/0009-0008-7418-5489
[6] Undergraduate in Environmental and Sanitary Engineering. Universidade do Estado do Pará.
E-mail: ronielelima187582@gmail.com Lattes: https://lattes.cnpq.br/4616792640279337
Orcid: https://orcid.org/0009-0003-8156-5766
[7] Undergraduate in Environmental and Sanitary Engineering. Universidade do Estado do Pará.
E-mail: silvarudias@gmail.com Lattes: http://lattes.cnpq.br/854591751975774
Orcid: https://orcid.org/0009-0006-6353-2727

still no recreational facilities or leisure activities that would lead to increased community attendance. Therefore, the objective of paving the channel was not achieved, but the negative environmental impacts on the stream under analysis are evident.

Keywords: Environmental Impact Assessment. Urban Water Conservation. Urban Growth.

RESUMO

O crescimento urbano em municípios brasileiros causa impactos ambientais, especialmente em corpos hídricos que oscilam entre a perda da área de proteção ambiental e da profundidade. Em municípios brasileiros, como Nova Esperança do Piriá, sudeste paraense, ainda não há estudos que identifiquem as ações negativas deste tipo de crescimento. Esta lacuna gerou o objetivo desta avaliação e identificação dos impactos e suas classificações sobre o córrego Esperança na área urbana. O método empregado foi a da pesquisa ex-pós-facto, associado a abrangência qualiquantitativa, e natureza observativa. Os dados obtidos durante a observação in sito, indicaram que as margens e o canal deste córrego foram canalizados, o que gerou impactos cumulativos nas áreas diretamente e indiretamente afetada, além de ocasionar a supressão vegetal da Área de Proteção Permanente – APP, o assoreamento e a perda da profundidade é visível; o desenvolvimento e presença de macrófitas indicam poluição hídrica; as camadas cimentícias utilizadas para o calçamento e para o passeio, dificultam a recarga via solo do córrego; a ausência de vegetação arbórea em ambas as margens, denota uma radiação intensa; o que pode provocar alterações na saúde da comunidade do entorno que, só frequenta este local, após o pôr-do-sol, devido a diminuição da temperatura do ar. Ainda náo há oferta de recreações, e um lazer que conduza a um incremento na frequência da comunidade. Logo, o objetivo da pavimentação do canal não foi alcançado, mas os impactos ambientais negativos sobre o córrego em análise, são visíveis.

Palavras-chave: Avaliação de Impactos Ambientais. Conservação das Águas Urbanas. Crescimento Urbano.

RESUMEN

El crecimiento urbano en los municipios brasileños causa impactos ambientales, especialmente en los cuerpos de agua que van desde la pérdida de áreas protegidas hasta la pérdida de profundidad. En municipios brasileños, como Nova Esperança do Piriá, en el sureste de Pará, aún no hay estudios que identifiquen los efectos negativos de este tipo de crecimiento. Esta brecha condujo al objetivo de esta evaluación e identificación de los impactos y sus clasificaciones en el arroyo Esperança en el área urbana. El método empleado fue una investigación ex post facto, combinada con un alcance cualitativo y cuantitativo y un diseño observacional. Los datos obtenidos durante la observación in situ indicaron que las orillas y el cauce del arroyo fueron canalizados, generando impactos acumulativos en las áreas afectadas directa e indirectamente. Además, también causó la supresión de la vegetación en el Área de Protección Permanente (APP). La sedimentación y la pérdida de profundidad son visibles. El desarrollo y la presencia de macrófitas indican contaminación del agua. Las capas de cemento utilizadas para el pavimento y las aceras dificultan la recarga del suelo del arroyo. La falta de árboles en ambas orillas indica una intensa radiación, lo que puede ocasionar problemas de salud a la comunidad circundante, que solo visita esta zona después del atardecer debido al descenso de la temperatura. Aún no existen instalaciones recreativas ni actividades de ocio que permitan aumentar la

asistencia comunitaria. Por lo tanto, no se logró el objetivo de pavimentar el cauce, pero los impactos ambientales negativos en el arroyo analizado son evidentes.

Palabras clave: Evaluación de Impacto Ambiental. Conservación del Agua Urbana. Crecimiento Urbano.

1 INTRODUCTION

The urbanization of urban canals is one of the environmental problems with the highest incidence in relation to the environment in the 5,570 Brazilian municipalities (CASTRO; CEREZINI, 2023) as occurred in Nova Esperança do Piriá. Another problem with the urbanization of surface water in areas of this nature is the counter-purpose determined in goal number 11 (UN, 2025), target 11.7[8]. In general, these spaces, when urbanized, become polluted, due to the reception of gray water and the deposition of solid waste from the frequency of users with little environmental sensitivity (DE PAULA; OLIVEIRA JÚNIOR, 2024).

To assist in the identification of the problems arising from these actions, the environmental impact assessment (EIA) uses technical terms, the composition of a photographic memorial, and *in situ* observation. One of the most frequent impacts is related to the deficiency and even absence of basic sanitation, especially the treatment of gray water (TUCCI, 2008). This loss of environmental and water quality by urban streams, despite being part of urban landscaping, are degraded, despite belonging to the hydrological cycle as a whole, via water evaporation, they are still not conserved by communities and local managers (de SOUZA; TONIOLO, 2024).

Another loss of environmental quality is established when the Environmental Protection Areas (APPs) are removed, and the use and occupation of the land undergoes modifications and, when this is under the tutelage of the municipalities, the risk of reducing them is absurdly remarkable and can be present in the Lano Diretor of each locality (FATUCH; RUTKOWSKI, 2022). Urban expansion, that is, the production of the space-nature dichotomy, always has a socioeconomic mediation, whether by agricultural expansion or any other economic cycle, and this prevails in municipalities with more recent territorial emancipation, that is, up to 35 years (PINTO; MOREIRA, 2022).

Undoubtedly, it is of great importance to understand that any stream that passes through community areas has impacts on the community, on the political processes of managers and citizens who act as members of the environment in relation to the aquatic environment, which, after channeling, cannot have, among so many functions, the transmission of contagious diseases (SILVA, 2025). In addition, the cementitious layers used on the sides for the implementation of grouts and sidewalks act as soil waterproofing,

[8] By 2030, provide universal access to safe, inclusive, accessible and green public spaces, particularly for women and children, older people and persons with disabilities (UN, 2025).

compromising the recharge of the water body, and perhaps the watershed (JESUS *et al.,* 2023).

All these arguments justified this preliminary analysis, since, in the municipality of Nova Esperança do Piriá, the evolution and urban growth has occurred and affects the water bodies of this locality, and the impacts that this advance causes have not yet been evaluated. This fact increased the relevance of this assessment, whose objective was to identify *in situ* the main impacts, identify and conceptualize them in the standards of the Environmental Impact Assessment, in addition to generating current data about them for local municipal managers. In the end, seven recommendations were made to mitigate the impacts identified in the analyzed area.

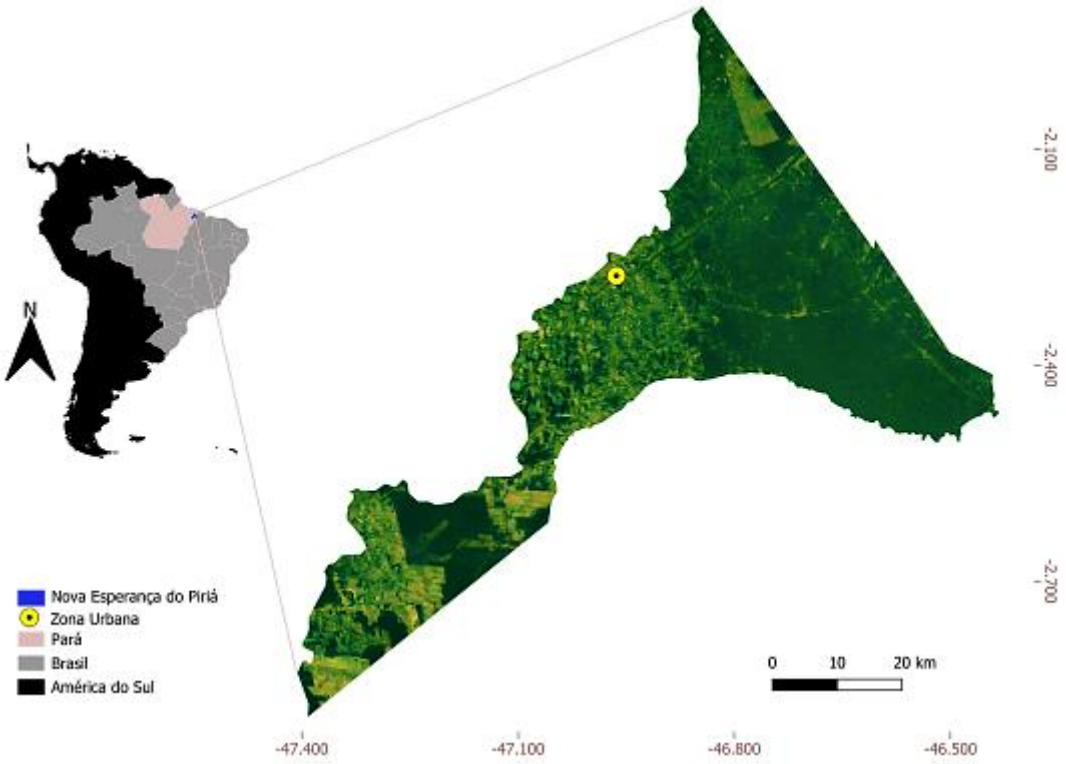
2 MATERIAL AND METHODS

2.1 PHYSIOGRAPHY OF THE MUNICIPALITY

The municipality of Nova Esperança do Piriá (Figure 1), with latitude of 02º16'04" S and longitude of 46º58'03" W), located in the northeast of Pará, in the micro-region of Guamá, has an area equal to 2,808.195 km2, of which 5.46 km2, are already urbanized, with 33 years of existence, currently has 21,259 inhabitants. Until 1970, this locality had only hunters as frequent visitors when pioneer families settled in and promoted the first subsistence agricultural crops such as rice (*Oriza sativa,* Poaceae family), beans (Phaseolus *sp,* Fabaceae family) and cassava, whose scientific name is *Manihot esculenta*, Crantz, belonging to the Euphorbiaceae family (IBGE, 2023).

Figure 1

Location map of the municipality of Nova Esperança do Piriá, northeast of Pará, Brazil



Source: Marques *et al* (2024).

The method used was that of *ex post-facto* research, with *in situ observation*, associated with quantitative and qualitative coverage, to evaluate the cause-effect relationship (RAMOS *et al.,* 2025), in the urbanization of the Esperança stream (Figure 2), on Avenida São Pedro, Vila Nova neighborhood.

Figure 2

Hope Stream on São Pedro Avenue, Vila Nova neighborhood. New hope from Piriá, northeast of Pará. Brazil

Source: authors (2025).

2.2 PRIMARY DATA COLLECTION

Data were collected on July 18, 2025, with electrometric instruments (Chart 1).

Table 1

Electrometric instruments used to obtain primary data from the Esperança stream. Nova Esperança do Piriá, northeast of Pará, Brazil

INSTRUMENTS	FUNCTION	BRAND	MODEL
Anemometer	Measure wind speed and direction	I.P. Apps	n.m.
Decibel meter	Measuring the noise level	Splend Apps	s/m
Diastimeter	Measure interpoint distance and depth	EGA Plast	s/m
GEO MAP	Obtaining Geographic Coordinates UTM	Y2 Tech	4.2.96
Smartphone	Composition of the photographic memorial	Motorola	Moto G45
Thermometer	Obtaining the Air Temperature	Fansipan Inc.	n.m.

Source: authors (2025).

The data obtained were tabulated according to the regulations established by the Brazilian Institute of Geography and Statistics (IBGE, 1993).

3 RESULTS

The first variable measured, in the collective point, is related to obtaining geographic coordinates. To this end, the *Global Positioning System* (GPS) was used at six points (Table 2).

Table 2

Geographic coordinates obtained for the six points of the collective study area. Nova Esperança do Piriá, Pará, Brazil

STITCHES		UTM		ALTITUDE (m)
1	Right Bank	X = 281534.803E	Y = 9749091.239N	59.7
2	Central Span	X = 281538.126E	Y = 9749101.566 N	56.5
3	Left bank	X = 281535.902E	Y = 9749101.01 N	56.6
	Area (m2)	314, 5	--	--
	Perimeter (m)	12,6	--	--
Environmental variables				
Variable measured	Unit	Hour	Measured value	
Noise	Db	10:25:00	77.0	
Air temperature	ºC	09:45:00	26,1	
Relative Unit	%	10:19:00	50.0	
Wind speed	m/s	10:19:00	20.3	

Source: authors (2025)

3.1 IDENTIFIED IMPACTS

The contribution of allochthonous material (sediments) on the right bank is primarily attributed to the construction of the concrete bridge as part of the road subsystem. The bidirectional vehicular flow over the bridge, together with deficiencies in the rainwater drainage system, contributes to the deposition of particulate matter in the stream bed. There is already siltation of 4.40 m on the right bank and 2.48 m on the left bank, evidencing a significant reduction in the flow capacity and the volume and storage of water from the Esperança stream, in the upstream-downstream direction, as described by Santana *et al.* (2023)

Despite the transparency of the water, the presence of suspended sediments deposited in the bed and, more worryingly, the discharge of untreated domestic effluents into the stream, suggest a potential microbiological and physicochemical contamination, directly

impacting the quality of the water (bathing) and the integrity of the aquatic ecosystem, especially the *habitat* of flora and fauna.

The banks of the stream, both to the right and to the left, upstream-downstream, are characterized by the presence of anthropogenic structures and herbaceous ruderal vegetation[9] (Figure 5). Although in *situ* observation was not to promote the identification of the complete floristic composition. To access the thalweg, it was necessary, from the right bank, to remove the vegetation from the right bank. This fact revealed the presence of ants (Order Hymenoptera, Family, Formicidae), suggesting a maintenance of soil fertility and a potential low degree of soil contamination.

Figure 3

Marginal ruderal vegetation. Hope Stream. Nova Esperança do Piriá, northeast of Pará, Brazil

Source: authors (2025).

The absence of Lepidoptera (Butterflies and Moths), avifauna and other larger faunal specimens was evidenced, which denotes an ecological imbalance and a reduction in local biodiversity, probably related to habitat fragmentation, loss of ecological connectivity and generalized pollution as already observed by Jorgiane, Lins and Oliveira (2007). Among the pollutions, noise stands out, with potential physiological impacts on the fauna and quality of

[9] plants that grow spontaneously in areas disturbed by human action, such as vacant lots, roadsides, urban areas and other places with altered soil.

life of the surrounding population, as hearing loss can develop in these communities, since the maximum value allowed by law is equivalent to 55 *dB*.

It was also observed that the structure of the concrete bridge (Length = 9.38 m) over the Esperança Stream, shows signs of structural compromise, because there is a slight deflection observed in its central section suggests a structural anomaly, which can potentially compromise the load capacity of the infrastructure and the operational safety of traffic. This condition suggests the need for an in-depth structural assessment by a qualified civil engineer and, if necessary, the execution of structural reinforcement or rehabilitation works.

In the area of direct influence (AID), the Esperança stream has a total absence of the Permanent Protection Area (APP), which characterizes significant **cumulative environmental impacts** resulting from intensive anthropization, It was observed a **direct impact** on the right bank from south to north and **indirect** on the left bank towards the north south, where the impermeabilization of the soil by the concrete surface of a building adjacent to the left bank configures a **permanent impact** on the fluvial hydrodynamics by the concrete structure.

This change in the hydrological regime and in the soil infiltration rate increases the potential for flood and flash flood events during seasonal periods of rainfall in the period from December to May, characterizing a hydrological and geomorphological disturbance. The water body has lotic characteristics, but with accelerated erosive processes on the banks, notably on the right bank, resulting in the impairment of the hydraulic section of the thalweg and the intensification of the silting process.

4 CONCLUSION

The Esperança stream and the adjacent areas such as residences now installed, are under strong anthropogenic pressure, resulting in **negative cumulative environmental impacts** on hydrology, geomorphology, water quality, biodiversity and civil infrastructure. The main impacts identified include severe siltation, increased risk of extreme hydrological events, water and noise pollution, loss of biodiversity and evidence of compromised structural integrity of the bridge.

5 PROPOSITIONS

The guidelines described in Gomes and Oliveira (2019), Pereira *et al.* (2021) and Silva *et al.* (2018), provide numerous propositions that can be applied in Nova Esperança do Piriá, specifically in the Esperança stream. Among them, seven are recommended:

1. Preparation and execution of a plan for the desilting of the riverbed, with adequate management of the dredged sediments.
2. Implementation of measures to control erosive processes and recovery of degraded areas on the banks, such as revegetation with native species (riparian) and soil bioengineering techniques.
3. Investigation and elimination of the sources of discharge of domestic effluents *in natura into the* stream, with the interconnection to the sanitary sewage collection network or implementation of decentralized treatment systems.
4. Continuous monitoring of water quality (physicochemical, microbiological and ecotoxicological parameters).
5. Carrying out a detailed structural assessment of the bridge by a specialist and, if applicable, carrying out reinforcement or replacement works on the structure.
6. Implementation of noise pollution control measures, such as noise barriers or Environmental Education (EE) programs for the use of vehicles to generate less noise. Elaboration of the Afforestation Plan, where the canopy and canopies act as acoustic barriers.
7. Development of EE programs, and awareness of the local community, aiming to sensitize the population about the importance of preserving water resources and the ecosystem, especially that of the object of study and adjacent areas, so that water can perform multiple functions (e.g., irrigation in organic gardens, sport fishing, recreational activity, among others), collaborating for the maintenance of human health and environmental quality.

REFERENCES

Castro, C. N., & Cerezini, M. T. (2023). Transposição do rio São Francisco: Território, potenciais impactos e políticas públicas complementares. Instituto de Pesquisa Econômica Aplicada.

Fatuch, J. C., & Rutkowski. (2024). Os impactos da Lei Federal 14.285/2021 na qualidade dos corpos d'água urbanos no Brasil. In 20º Simpósio Luso-Brasileiro de Engenharia Sanitária e Ambiental. Retrieved from

file:///D:/Nova%20Esperan%C3%A7a%20do%20Piri%C3%A1/Relatorio%20P.O/Artigos/Trabalho_Publicado.pdf

Gomes, R. C., & Oliveira, A. F. (2019). Revegetação de áreas degradadas: Práticas sustentáveis para zonas urbanas. Editora Ambiental.

Instituto Brasileiro de Geografia e Estatística. (1993). Normas de apresentação tabular (3rd ed.). IBGE.

Jesus, L. R. M., et al. (2023). Análise das condições ambientais em córregos urbanos na bacia hidrográfica do Córrego do Veado, em Presidente Prudente (São Paulo, Brasil). Revista Científica ANAP, 16(40).

Jorgiane, E., Lins, O., & Oliveira, U. (2007). Gradiente de urbanização e a biodiversidade de lepidópteros diurnos em áreas de Natal e Parnamirim, RM. In 8º Congresso de Ecologia do Brasil. Retrieved from https://www.seb-ecologia.org.br/revistas/indexar/anais/viiiceb/pdf/2037.pdf

Marques, E. Q., et al. (2024). Mapeamento de citros, dendê, e pimenta-do-reino no município de Nova Esperança do Piriá, Pará, Brasil. Universidade Federal Rural da Amazônia.

United Nations. (2025). Objetivos do Desenvolvimento Sustentável. Retrieved from https://brasil.un.org/pt-br/sdgs/11

De Paula, J. S. B. C., & Oliveira Júnior, E. S. (2024). Águas invisíveis: Estudo sobre os córregos urbanos no Brasil. In 15º Encontro Nacional de Águas Urbanas. Retrieved from https://files.abrhidro.org.br/Eventos/Trabalhos/238/XV-ENAU0100-1-20240610-211718.pdf

Pereira, A. J., et al. (2021). Impactos ambientais em ecossistemas urbanos ribeirinhos: Diagnóstico e medidas de mitigação. Revista Brasileira de Ciências Ambientais, 39(1), 12–26. https://doi.org/10.5327/Z2176-947820210901

Pinto, N. T., & Moreira, G. L. (2022). Expansão urbana e problemas ambientais: O caso do bairro Teotônio Vilela, Ilhéus, Bahia. Geopauta, 6, e10067. https://doi.org/10.12957/geopauta.2022.10067

Ramos, S. F., et al. (2025). Aprendizagem experimental na formação interprofissional em saúde sobre condições crônicas não transmissíveis: Uma avaliação ex-post-facto. Revista da Escola de Enfermagem da USP, (59), e30340300. https://doi.org/10.1590/1980-220X-REEUSP-2024-0300

Santana, M. L. T., et al. (2023). Impacts of land use changes on soil functions and water security: Insights from a three-year-long study in the Cantareira System, southeast of Brazil. Sustainability, 15(18), 13395. https://doi.org/10.3390/su151813395

Silva, C. Q. (2025). A cidade e a luta por dignidade: Diálogos num bairro de Salvador a partir de obras de esgotamento sanitário. In 15ª Reunião de Antropologia do Mercosul. Retrieved from

file:///D:/Nova%20Esperan%C3%A7a%20do%20Piri%C3%A1/Relatorio%20P.O/Artigos/CAIN%C3%83_RAM_2025.pdf

Silva, M. A., et al. (2018). Conservação do solo e recuperação de áreas degradadas. Empresa Brasileira de Pesquisa Agropecuária. Retrieved from https://ainfo.cnptia.embrapa.br/digital/bitstream/item/200926/1/Livro-Conservacao-Solo.pdf

De Sousa, L. H. C., & Toniolo, M. A. (2024). Da canalização à revitalização de córregos urbanos: Perspectivas sustentáveis para a infraestrutura urbana. In 28º Encontro Latino-Americano de Iniciação Científica. Retrieved from https://www.inicepg.univap.br/cd/INIC_2024/anais/arquivos/RE_0941_0658_02.pdf

Tucci, C. A. (2008). Águas urbanas. Estudos Avançados, 22(63), 97–112. https://doi.org/10.1590/S0103-40142008000200007