

The Strategic Importance of the Didactic Primer for the Implementation of Sustainable Drainage Technology in Municipalities, case study Municipality of São José dos Campos-São Paulo- Brazil

L'importance stratégique du manuel didactique pour la mise en œuvre de technologies de drainage durables dans les municipalités, étude de cas : municipalité de São José dos Campos, São Paulo, Brésil

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RÉSUMÉ

Le processus d'urbanisation accéléré caractéristique des grandes villes brésiliennes a entraîné une augmentation de l'imperméabilisation des sols et une surcharge du système de macro-drainage, ce qui a conduit à des inondations plus fréquentes, ainsi qu'à une aggravation des processus d'érosion et de la pollution de l'eau due à des charges diffuses non assimilées. Pour lutter contre ces impacts, il est essentiel de combiner le drainage conventionnel avec des stratégies de contrôle à la source, telles que les solutions fondées sur la nature (NbS), afin d'accroître la résilience hydrologique urbaine. La mise en œuvre réussie de ces NbS dépend directement du soutien social, qui nécessite la démocratisation des connaissances techniques grâce à des stratégies d'engagement solides, telles que des ateliers et, surtout, l'élaboration de matériel explicatif. Cet article vise à présenter la structure d'un guide numérique sur le drainage durable, développé pour la municipalité brésilienne de São José dos Campos, mais conçu pour être universellement adaptable.

ABSTRACT

The accelerated urbanization process typical of large Brazilian cities has resulted in increased soil sealing and overloading of the macro-drainage system, leading to more frequent flooding, as well as worsening erosion processes and water pollution due to diffuse unassimilated loads. To combat these impacts, the combination of conventional drainage with source control strategies, such as Nature-based Solutions (NbS), is essential to increase urban hydrological resilience. The successful implementation of these NBS depends directly on social support, which requires the democratization of technical knowledge through robust engagement strategies, such as workshops and, crucially, the development of explanatory material. This article aims to present the structure of a Digital Sustainable Drainage Primer, developed for the Brazilian municipality of São José dos Campos, but designed to be universally adaptable.

KEYWORDS

Drainage, Hydraulic engineering, Sustainability, Water - Supply , Water - Supply - São José dos Campos (SP)

1 INTRODUCTION

Rapid and poorly planned urbanization in medium and large municipalities, such as São José dos Campos in the state of São Paulo, Brazil, has led to increased soil sealing, reducing natural water infiltration and intensifying surface runoff. This process results in more frequent flooding, erosion, and the transport of diffuse pollution to water bodies (TUCCI et al., 1995), processes that are accentuated in the context of climate change. In this context, the combination with models that use source control strategies, such as Nature-based Solutions (NBS), becomes fundamental for cities seeking greater hydrological resilience (BALLARD et al., 2015).

Social support is a determining factor for the successful implementation of these solutions. To ensure this support, it is essential that citizens acquire knowledge about the importance and benefits inherent in these techniques. The strategy for interaction between society and NBS must be robust, involving:

- Engagement Activities: Holding workshops and mini-courses with popular participation,
- Content Production: Preparation of explanatory material with a high illustrative content and ease of understanding, such as booklets.

The booklets play a crucial role in democratizing technical concepts, making complex topics such as Green Infrastructure, Low Impact Development (LID), Sustainable Urban Drainage Systems (SUDS), and Sustainable Stormwater Management accessible, as they promote the training of managers, technicians, and the general population, ensuring a uniform understanding of sustainable drainage practices and encouraging their effective adoption in public and private enterprises (ENAP, 2021).SBNs such as rain gardens, bioretention, green roofs, permeable pavements, infiltration ditches, and detention reservoirs at the basin level are internationally recognized as efficient and economically advantageous alternatives and need to be demonstrated to the population in a simple and assertive manner (SCIENTIFIC DIRECT, 2024; MDPI, 2024).

The main objective of this article is to present the structure of a Sustainable Drainage Primer. Initially developed for the municipality of São José dos Campos (Brazil), this structure was designed to be universally adaptable and replicable by any municipality in the world. Its unique feature lies in the way it democratizes technical information, transforming complex concepts into content that is easily accessible and understandable to the general population.

2 THE DIGITAL PRIMER AS A GOVERNANCE TOOL

The development of the São José dos Campos Digital Handbook on Sustainable Stormwater Management is an essential tool for improving stormwater management. The publication was designed based on the results obtained in Stage 2 of the Master Plan for Drainage and Rainwater Management (PDDMAP) (FCTH, 2024). Its purpose is to present to civil society key concepts on sustainable stormwater management and the different sustainable drainage techniques applicable in the municipality (FCTH and SÃO JOSÉ DOS CAMPOS, 2024).

The booklet allows for the democratization of technical knowledge and promotes the training of managers, technicians, and the population, fostering a uniform understanding of practices and encouraging their adoption in public and private works (BRAZIL, 2020).

The teaching material was structured in.

Table1 , which presents the main sections with details of the local context, challenges, and applicable technical solutions.

Table1 The Structural Content of the Booklet

Section	Title	Main Content
Introduction (p. 13)	Introduction	Explains the change in the water balance between the pre- and post-urbanization periods, where there is less infiltration and greater surface runoff after urban occupation (TUCCI; PORTO; BARROS, 1995).
Chapter 1 (p. 17)	Drainage and stormwater management in the municipality of São José dos Campos	Presents the municipality's water context and legal framework, highlighting municipal legislation such as the Master Plan and the Zoning Law .
Chapter 2 (p. 27)	Sustainable drainage	Details the concepts of micro-drainage and macro-drainage and the different project scales for the implementation of SBN: lot, neighborhood, valley-floodplain, and watershed (BALLARD et al., 2015).
Chapter 3 (p. 49)	Conclusion	Reinforces that the adoption of sustainable practices is crucial to address the challenges of urbanization and climate change (JOHNSON; GEISENDORF, 2019).

3 DETAILED SUSTAINABLE DRAINAGE TECHNIQUES

To facilitate understanding of SbN techniques, the booklet dedicates a section to presenting and illustrating the main types, providing schematic cross-sections and construction criteria. Among the detailed solutions, the following stand out:

A. Micro-drainage (lot and street scale)

- Closed bioretention and bioswales (BALLARD et al., 2015);
- Green roof (ABNT, 2008);
- Permeable pavement, such as interlocking drainage blocks (TUCCI; PORTO; BARROS, 1995);
- Infiltration trench and detention reservoir on the lot (FCTH and SÃO JOSÉ DOS CAMPOS, 2024, 2024).

B. Macrodrainage (basin scale)

- Vegetated detention basin and impermeable basin (JOHNSON; GEISENDORF, 2019);
- Sustainable canal (BALLARD et al., 2015);
- Linear park, integrating drainage and green areas;
- Multipurpose reservoir (TUCCI; PORTO; BARROS, 1995).

The application of these techniques promotes infiltration, reduces surface runoff, and improves water quality, directly contributing to mitigating the impacts of impermeable and strengthening urban climate resilience (BALLARD et al., 2015; FCTH and SÃO JOSÉ DOS CAMPOS, 2024).

4 CONCLUSION

The creation of an educational booklet on sustainable drainage is a strategic measure that supports water governance, strengthens urban planning, and expands the capacity of the Brazilian municipality of São José dos Campos to implement decentralized solutions and control surface runoff at the source. By democratizing the technical knowledge derived from the Master Plan for Drainage and Stormwater Management, the booklet plays a fundamental role in educating professionals and society to face the challenges of stormwater management and adaptation to climate change.

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