

## Development and Application of Sustainable Urban Drainage Systems (SUDS) to Optimize the Treatment of Diffuse Runoff and Localized Wastewater Discharges in Gran Canaria within the Framework of the NATALIE Project

Développement et application de systèmes de drainage urbain durable (SUDS) pour optimiser le traitement des eaux de ruissellement diffuses et des rejets d'eaux usées localisés à Grande Canarie dans le cadre du projet NATALIE

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### RÉSUMÉ

Le projet NATALIE, financé par l'Union européenne, encourage l'adoption de solutions fondées sur la nature (SFN) afin d'améliorer la résilience climatique à travers l'Europe. Il comprend huit études de cas visant à démontrer l'efficacité des SFN dans des contextes réels. L'étude de cas de Grande Canarie se concentre sur les défis liés au drainage urbain, en particulier la pollution diffuse provenant du ruissellement des eaux pluviales et des débordements des égouts unitaires qui affectent la réserve naturelle spéciale des dunes de Maspalomas. Une phase de surveillance initiale a utilisé des capteurs placés à des points clés du réseau de drainage afin de caractériser la qualité de l'eau et le transport des polluants. À partir de ces données, un modèle de drainage double 1D/2D est en cours d'élaboration afin de simuler les processus hydrologiques et hydrodynamiques ainsi que l'évolution de la qualité de l'eau dans le réseau d'égouts et les eaux de ruissellement. Les mesures d'atténuation proposées comprennent un fossé de drainage et un système de biorétention non infiltrant pour intercepter, filtrer et traiter les eaux pluviales avant qu'elles n'atteignent la zone humide. Les phases futures du projet évalueront l'efficacité de ces mesures dans le cadre de scénarios de changement climatique et évalueront les avantages sociaux, environnementaux et économiques connexes. Toutes les activités sont mises en œuvre dans le cadre d'un processus collaboratif impliquant les parties prenantes locales et les entités de gestion, garantissant une approche intégrée et participative alignée sur les objectifs de conservation de la zone protégée.

### ABSTRACT

The NATALIE project, funded by the European Union, promotes the adoption of Nature-based Solutions (NBS) to enhance climate resilience across Europe. It includes eight case studies designed to demonstrate NBS effectiveness in real-world contexts. The Gran Canaria case study focuses on urban drainage challenges, particularly diffuse pollution from stormwater runoff and combined sewer system overflows affecting the Maspalomas Dunes Special Nature Reserve. An initial monitoring phase used sensors at key points in the drainage network to characterize water quality and pollutant transport. Using these data, a dual 1D/2D drainage model is being developed to simulate hydrological and hydrodynamic processes and water quality evolution in both the sewer system and surface runoff. The proposed mitigation includes a draining swale and a non-infiltrating bioretention system to intercept, filter, and treat stormwater before it reaches the wetland. Future project phases will assess the effectiveness of these measures under climate change scenarios and evaluate social, environmental, and economic co-benefits. All activities are implemented through a collaborative process involving local stakeholders and management entities, ensuring an integrated, participatory approach aligned with the conservation objectives of the protected area.

### KEYWORDS

Climate resilience, Nature Based Solution (NBS), Stormwater management, Sustainable Urban Drainage Systems (SUDS), Water quality

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## 1 INTRODUCTION

The Maspalomas pond, located within the Maspalomas Dunes Special Nature Reserve, is a coastal wetland of high ecological value classified as Priority Habitat 1150 (Coastal Lagoons) under the EU Habitats Directive (European commission, 2015). Several studies and the Master plan of the Natural Area (Canary government, 2004), identify untreated urban runoff and occasional discharges from the sewer network as major pollution sources, carrying oils, greases, heavy metals, and other contaminants associated with urban and tourist activities.

Numerous stormwater connections discharging into the wastewater network cause system overloads during rainfall events, generating sewer overflows that travel along the roadway and enter street inlets directly connected to the wetland. One of the most critical locations is Oceanía Street, where overflows from two manholes are transported by gravity to an inlet that discharges into the Maspalomas pond, compromising water quality even during moderate rainfall.

To address this situation, the NATALIE project proposes an integrated approach combining monitoring, hydrological and hydrodynamic modelling, and co-creation processes. The development of a dual 1D/2D model will enable quantification of runoff volumes and pollutant loads associated with overflow events and will support the assessment of Sustainable Urban Drainage Systems (SUDS), such as vegetated swales and bioretention areas. These interventions are expected to significantly improve the quality of water entering the wetland and support its ecological conservation.

## 2 METHODOLOGY

The methodological framework combines field monitoring, advanced urban water cycle modelling, and stakeholder engagement. During the first phase, a monitoring campaign was conducted at several points of the urban drainage system using rain gauges, level sensors, and both manual and automatic samplers. These instruments enabled the characterization of flow generation and water quality evolution in different components of the system, including rooftops, street drains, sewer manholes, and stormwater inlets. Initial results confirmed significant contamination, where discharges into the wetland showed pollutant concentrations comparable to wastewater during low-intensity rainfall events.

Based on these observations, a 1D/2D hydrological–hydrodynamic model is being developed to simulate urban runoff generation, sewer overflows, and water quality evolution. This model will allow assessment of system behaviour under different rainfall scenarios, identification of critical pollutant entry points, and evaluation of proposed mitigation measures. Climate scenarios derived from the IPCC Sixth Assessment Report (AR6) and projections of future urban development will also be incorporated to examine how runoff patterns and pressure on the system may change in the coming decades.

Finally, the methodology includes a participatory process involving public authorities, environmental managers, experts, and local communities. This approach ensures that proposed interventions are both technically sound and socially viable, promoting sustainable planning and integrated water management across urban and natural environments.

## 3 CASE STUDY: MASPALOMAS POND (GRAN CANARIA)

The Maspalomas Dunes Special Nature Reserve is one of the most emblematic natural areas of Gran Canaria due to its geomorphological uniqueness and ecological relevance. Within it, the Maspalomas pond functions as a coastal lagoon that hosts sensitive species and relies heavily on the quality of the water it receives. However, the proximity of densely urbanized areas and high tourist pressure has increased the system's vulnerability to contamination associated with urban drainage processes.

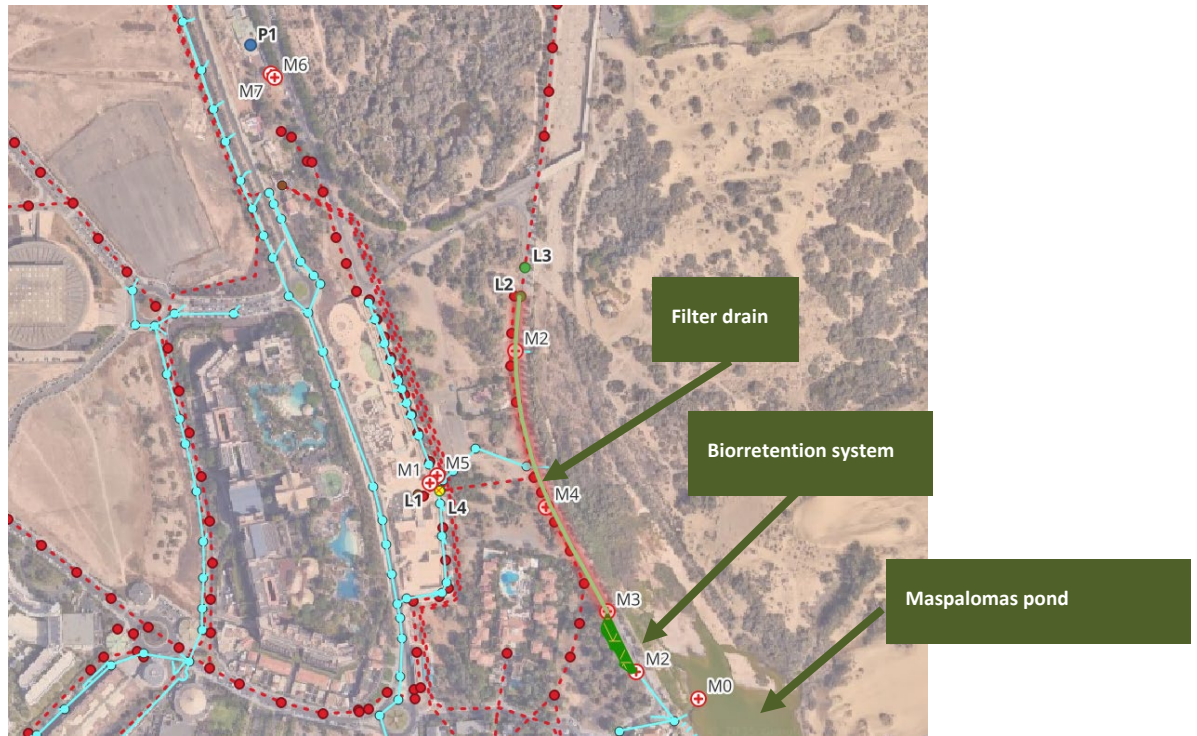


**Figure 1.** Maspalomas Dunes Special Nature Reserve

Analysis of the surrounding drainage network shows the presence of a complete wastewater network but an incomplete stormwater network, insufficient to manage runoff generated during intense rainfall events. This situation, combined with incorrect stormwater connections into the wastewater system, leads to frequent overflows. Once these overflows reach the road surface, they flow by gravity into inlets directly connected to the wetland, contributing to its degradation. Monitoring data reveal a progressive accumulation of pollutants throughout the system, including hydrocarbons, heavy metals, and organic matter (table 1). To mitigate these impacts, the project proposes the installation of a vegetated swale that captures road runoff and conveys it to a bioretention system designed to filter and treat the water before it reaches the lagoon. This intervention aims to reduce pollutant loads, increase urban permeability, and enhance system resilience during intense rainfall while also providing additional benefits such as improved landscape quality and biodiversity recovery.

<b>Rainfall event date</b>	<b>Sample point</b>	<b>Rainfall volume</b>	<b>Suspended solids</b>	<b>Total nitrogen</b>	<b>Total phosphorus</b>	<b>COD</b>	<b>BOD5</b>
		<b>(mm)</b>	<b>(mg/l)</b>	<b>(mg/l)</b>	<b>(mg/l)</b>	<b>(mg/l)</b>	<b>(mg/l)</b>
18/11/2024	M02	4.0	478	61.8	6.83	803	310
22/01/25	M02	2.7	344	4.96	0.54	325	200

**Table 1.** Pollutant discharge to Maspalomas pond in monitored rainfall events.



**Figure 2.** Monitoring campaign in Maspalomas and proposed solution to be implemented, consisting of a drainage ditch system and a bioretention system.

#### 4 CONCLUSIONS AND NEXT STEPS

The Maspalomas case study highlights the need to integrate NBS into urban drainage management to address current infrastructure limitations and reduce pollutant inputs into the Maspalomas pond. Evidence obtained through monitoring and system analysis demonstrates that the existing drainage configuration allows contaminated water to reach the wetland even during low-intensity rainfall. The proposed intervention, consisting of a vegetated swale and a bioretention system, represents an effective and sustainable technical solution to improve water quality and mitigate impacts on the ecosystem. The hydrological–hydrodynamic model under development will support validation and optimisation of the design prior to implementation. In the upcoming months, the project will continue model calibration, analyse future climate scenarios, and conduct a detailed evaluation of environmental, social, and economic co-benefits while implementation of the solution. The participatory process involving local stakeholders will ensure long-term acceptance and sustainability of the implemented measures.

#### ACKNOWLEDGEMENT

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