



# Monitoring Strategy for Nature-based Solutions impact assessment in cities

Green cities for climate and water  
resilience, sustainable economic growth,  
healthy citizens and environments

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This document outlines the key components to build a robust Monitoring Strategy for cities to assess the impact of Nature-based Solution (NbS) projects.

The main goal of this document is providing guidance to the stakeholders that are facing the challenge of implementing NbS in cities on how to monitor and assess the impact of NbS. The information presented in the following paragraphs is the result of the lesson learned that emerged from the GrowGreen monitoring activities combined with the Task Forces

that are activated by the European Commission to gather and transfer the knowledge generated by the different European Projects devoted to NbS.

This document falls under one of the expected outcomes of the GrowGreen project which is to provide monitoring results to build evidence around the positive impacts of NbS, not only in relation to climate resilience, but also to other environmental and social co-benefits.

## The GrowGreen Monitoring Framework

GrowGreen defines a comprehensive Monitoring Framework to assess the impact of NbS, which has a number of common variables being monitored across all partner cities (i.e. Manchester, Valencia and Wroclaw). At the same time, it has been optimised to respond to each city specificities. The GrowGreen Monitoring Framework contributes to the European Commission's aim of providing evidences of NbS benefits and co-benefits from different projects and situations in European cities.

The definition of the GrowGreen Monitoring Framework builds on the following foundations:

- Cities driven approach: ensuring that it is practically useful as part of implementing the NBS city strategy and responds to the citizens real- life challenges, goals and expectations.
- Tailor made approach: building on the basis of existing EU frameworks (i.e. Eklipse Framework<sup>1</sup>, EC Evaluating the impact of Nature-based Solutions: a handbook for practitioners<sup>2</sup>) and, at the same time, co-created with a wider range of stakeholders, in order to adapt the Key Performance Indicators (KPI) considered at the European level to the city`s circumstances and real possibilities. The EU frameworks provide
- references that should be customised for monitoring considering the NbS features and characteristics in terms of scale and technical specifications.
- Fit for purpose strategy: establishing a coherent scope at different spatial and temporal scales, with a common pool of KPIs so as to contribute to the reporting on the impacts, benefits and co-benefits of the NbS and facilitate the comparative assessment of different interventions and scenarios within the city and with a more general European framework.
- On-going and dynamic process: allowing the system of monitoring KPIs to be enriched, enlarged, and updated with new challenges, indicators, metrics, variables, methods etc. to respond to the city's needs.
- Harmonized monitoring and evaluation units and values, towards the development of a European evidence base for NbS.
- Integration with city platforms, smart city data systems, in line with international best practice and standards.

1 [https://www.eclipse-mechanism.eu/nbs\\_report](https://www.eclipse-mechanism.eu/nbs_report)

2 [https://ec.europa.eu/info/news/evaluating-impact-nature-based-solutions-handbook-practitioners-2021-may-06\\_en](https://ec.europa.eu/info/news/evaluating-impact-nature-based-solutions-handbook-practitioners-2021-may-06_en)

## Why should monitoring be part of NbS projects?

The primary goal of defining a NbS Monitoring Strategy is having evidence of the NbS impacts and effectiveness to achieve cities' goals, aligned with both climate and non-climate related challenges.

The assessment of the NbS impacts is dedicated to providing relevant information to be applied at different levels that will influence cities' policies:

- Highlighting the added value for NbS implementation versus traditional/grey solutions to promote nature in the city in alignment with the EU Biodiversity Strategy for 2030.
- Considering the impact assessment of the solutions that have been implemented for decision making at different scales: urban design and urban planning.
- Engaging citizens and increasing the awareness about NbS and the benefits of urban nature.
- Attracting investment of the private sector for NbS interventions and maintenance considering the cost-effectiveness of these solutions.
- Connecting different city's strategies around NbS: NbS could be an enabler and facilitator to mainstream climate change mitigation and adaptation into public policies and planning, as highlighted by the Urban Agenda 2030. As it is mentioned by IUCN in their Global Standard

for Nature-based Solutions, the sustainable deployment of natural capital has an important role in achieving the United Nations' Sustainable Development Goals (SDGs). The more direct benefit is linked with the SDG 13 about climate action (as it is considered in GrowGreen) but the potential benefits of NbS for other SDGs are also relevant depending on the NbS functionalities.

The monitoring results will contribute to build a narrative around NbS and their benefits in a local context. Monitoring strategies are key to provide the evidence of their relevance to feed into all city's plans and to create a well-informed, engaged, community around urban nature.

Having a robust monitoring and evaluation framework contributes to:

- Better informed decisions and planning processes
- Tracking the impact of NBS interventions over time
- Better reporting in cities to engage citizens, attract investment, and align cities' policies.
- Increasing the awareness of the benefits of NbS for citizens, politicians and other key stakeholders.

## Main components of a successful NbS Monitoring Strategy

- A comprehensive and co-created Local Monitoring System with Key Performance Indicators (KPIs) to evaluate the impact of NbS projects against the main challenges, vision and objectives of the city.
- Operational groups to co-create and deploy the Monitoring Strategy:
  - Thematic Experts
  - Inclusive Local Monitoring Team including a wide range of stakeholders involved in the NbS project delivery.
- A co-created Local Monitoring Plan tailored to each city specificities, vision and challenges.
- An NbS impact assessment and reporting for decision making.

## Comprehensive and co-created Local Monitoring System

One of the principles that should guide the NbS Monitoring Strategy is that it should be tailored to the cities' vision, ambition and objectives, and specificities.

This implies that the Monitoring Strategy should be co-created, integrating the local knowledge as the

basis together with a scientifically robust pool of KPIs.

In order to assure this co-creative approach, it is utterly important that all the relevant stakeholders are involved in the configuration process and also that the process is operational.

## Operational Groups

In order to make the Monitoring Strategy operational, it is important to set up two groups of stakeholders:

## Thematic Experts

The identification of the Thematic Experts, mainly academia and technicians/ practitioners, on the challenges that are considered in the project to

provide guidance (from the scientific point of view) and to assure a robust basis of common KPIs to be evaluated in the project.

## Local NbS Monitoring Team

The Local NbS Monitoring Teams include all the stakeholders (with different skills and knowledge) who will contribute to obtain the metrics to assess the defined KPIs. To ensure that the relevant questions for monitoring are considered, a Local NbS Monitoring Plan must be developed including variables to be measured for each of the KPIs, location of sensors infrastructure/data gathering spots, methods and matrix to be measured and timeline. Defining a coordinator for this group is key

to ensure the coherence of the different activities facilitating the collection of data during a period of time that is useful for the impact assessment.

The Local NbS Monitoring Teams will adapt the Thematic Experts proposals about KPIs to create a Local NbS Monitoring Plan. In addition, a specific process for metrics assessment should be discussed between the two groups to create the more robust monitoring strategy to the extent possible.

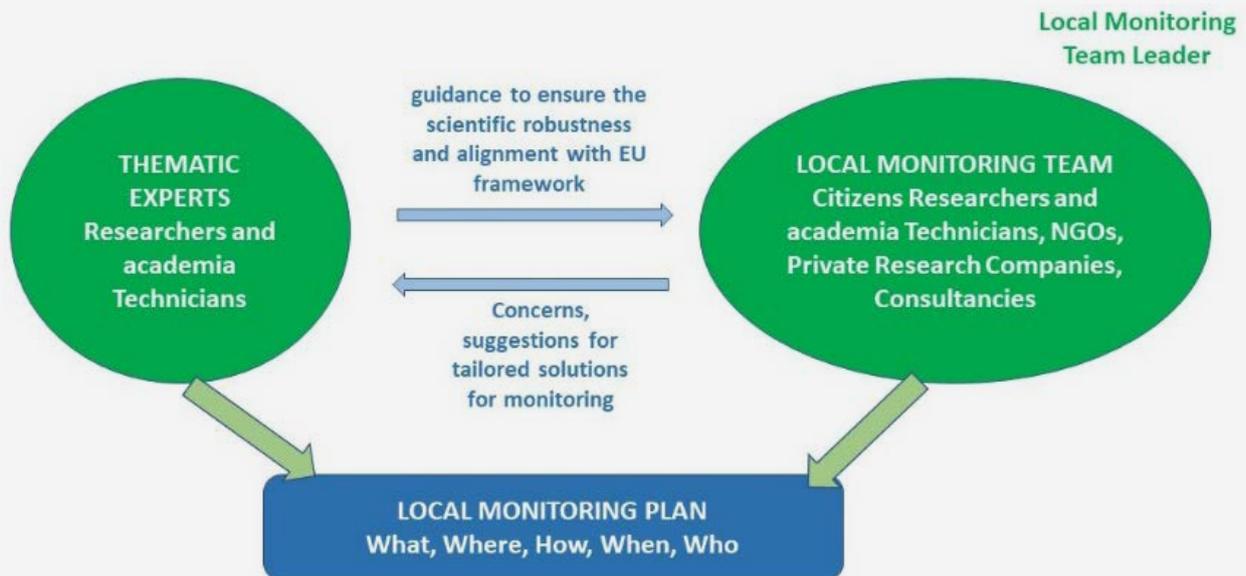


Fig 1: Operational groups for NbS Monitoring in Grow Green project

## Local Monitoring Plan

To make the NbS Monitoring Strategy applicable, it is mandatory to elaborate a Local Monitoring Plan in place, in which the monitoring activities, in terms of spatial and temporal scales, will be defined as well as the roles and responsibilities of who is going to develop the different required activities.

This tool provides the answer to the following questions for the planning of monitoring:

- **What?** The metrics that should be gathered to assess the KPIs must be identified. These variables will be post process and combined to deliver the impact assessment aligned with the expected outcomes.
- **Where?** The specific location of the place in which data should be gathered must be defined. For this decision, not only the monitoring requirements (based on the methodological requirement of the KPI) will be considered but also more practical ones related with the real possibilities. For instance, if a sensor must be placed, the location must be protected from vandalism.
- **How?** The monitoring infrastructure is a key element to be defined. Some of the metrics will be gathered using sensors (environmental variables), others through observations or questionnaires and interviews (social parameters). Apart from the real data gathering, that can include co-monitoring, modelling, there is also a possibility to be explored that can be useful to evaluate future scenarios or theoretical situations and evaluate the potential effects of upscaling some solutions.
- **When?** As previously mentioned, the NbS impact assessment requires on-going monitoring. Since the evaluation of the effectiveness is the main goal, a baseline monitoring phase should be planned to be compared with the results after the NbS implementation. The frequency of the data gathering is also crucial to obtain all the data that are required for a valid evaluation of the impacts.
- **Who?** The already presented Local NbS Monitoring Team will be in charge of the coordination of this Local NbS Monitoring Plan. The launching activities around the Plan will use many resources and the maintenance of these monitoring activities should be planned in a way that optimises the data and monitoring requirements with funding.

## The relevance of the scale to plan an NbS Monitoring Strategy

The NbS Monitoring Strategy should be designed to respond to city's strategies and actions.

In terms of scales, not only the spatial but also the temporal dimension must be considered. The main criteria in each dimension are:

- **Spatial Scale:** monitoring results are required at site, district or city level depending on the reporting mechanism in which these data will be applied. To develop an NbS Monitoring Plan adapted to each scale, the variable that is sensitive to the intervention at the planned scale should be selected. The variable to be measured should contribute to the assessment of a KPI that feeds the NbS impact assessment for the reporting requirements.

- **Temporal Scale:** some of the impacts of NbS are dependent on the temporal scale. For example, the impact of NbS thermal stress relies on hourly data and it is sensitive to the seasons. Whereas social benefits of NbS could be assessed with a broader time scale. From a more holistic point of view, the future impacts of NbS, applying climate change scenarios, are key elements for reporting and presenting the added value of these solutions versus the traditional ones.

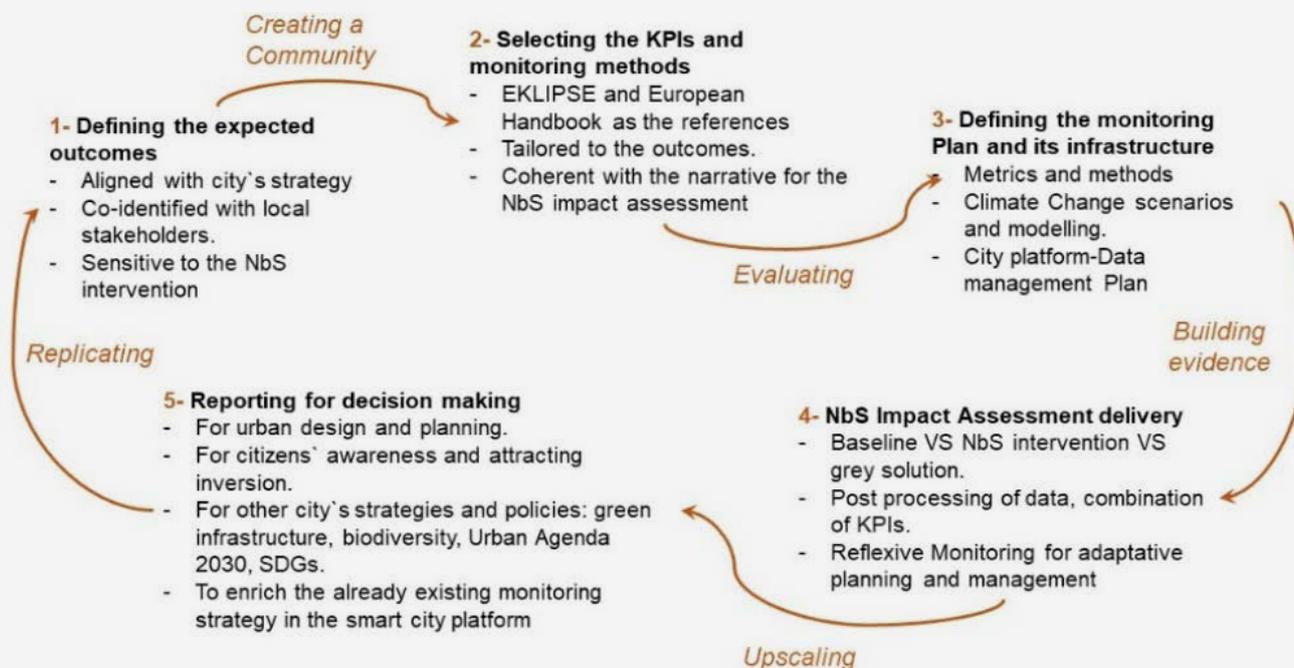
Monitoring activities play a relevant role in motivating the upscaling and replicability actions around NbS. As far as NbS are integrated in more urban projects, the potential benefits of these solutions increase, not only by each NbS itself but also because the synergies between them contribute to amplify the positive impacts.

## NbS impact assessment for decision making

A five-step method can be identified to deliver the NbS impact assessment for decision making.

In Figure 2, these 5 steps are illustrated with the main criteria that must be considered. A driver or expected main outcome of each step is shown:

- **Creating a Community:** stakeholders should participate in the definition of the monitoring system and their participation will contribute to their engagement and awareness about NbS.
- **Evaluating:** representative metrics and methods must be defined to assure the provision of accurate data to evaluate the impact of NbS.
- **Building evidence:** the NbS impact assessment will use different methodologies and tools to contribute, jointly to other interventions, to the evidence of the positive impact of NbS compared to traditional solutions.
- **Upscaling:** the information obtained for monitoring is devoted to influence decision-making processes including urban design, planning and policies and city's strategies.
- **Replicating:** the integration of the NbS monitoring results into policies and urban processes will create the context to replicate the interventions to increase urban nature.



**Fig 2: Steps for the development of a monitoring system. GrowGreen 2021. @TECNALIA**

### Step 1: Defining the challenges and expected outcomes

The Monitoring Strategy should be built on the main city challenges and the expected outcomes of the NbS intervention. These outcomes should be co-defined with the local stakeholders considering two main aspects:

- They should be aligned with the city's strategies or challenges to build a coherent narrative around NbS.
- They must be sensitive to the intervention and its real possibility to be delivered by the NbS

### Step 2: Selecting the KPIs and monitoring methods

The identified outcomes will inspire the identification or definition of the KPIs through the identification of the main topics or variables that are expected to be improved, considering the NbS potential benefits and co-benefits.

For this task, the existing European framework should be considered: EKLIPSE<sup>3</sup> and the handbook for practitioners for evaluating the impact of nature-

based solutions<sup>4</sup>, a result of a joint action of the EU H2020 NbS projects regarding their NbS monitoring strategies. Considering these two references, the areas of societal challenges addressed by NbS to build the KPIs around are the following: *Climate Resilience, Water Management, Natural and Climate Hazards, Green Space Management, Biodiversity Enhancement, Air Quality, Place Regeneration, Knowledge and Social Capacity Building for Sustainable Urban Transformation, Participatory Planning and Governance, Social Justice and Social Cohesion, Health and Wellbeing and New Economic Opportunities and Green Jobs.*

### Step 3: Defining the NbS Monitoring Plan and its infrastructures

The selection of metrics and methods should be accurate and based on already existing standards. The selected option will influence the infrastructure for monitoring: devices, questionnaires, observations, etc.

In combination with this real data gathering, modelling should also be considered for some variables. Climate change scenarios should be

3 [https://www.eclipse-mechanism.eu/nbs\\_report](https://www.eclipse-mechanism.eu/nbs_report)

4 [https://ec.europa.eu/info/news/evaluating-impact-nature-based-solutions-handbook-practitioners-2021-may-06\\_en](https://ec.europa.eu/info/news/evaluating-impact-nature-based-solutions-handbook-practitioners-2021-may-06_en)

highlighted as a very relevant variable when considering the impact of NbS on resilience.

A management Plan definition is part of this step, to feed the Smart City Platform. In this repository, historical data can be analysed and it will facilitate the communication of NbS activities and the comparison of the monitoring results across interventions and with NbS experiences in other cities.

#### **Step 4: NbS Impact Assessment delivery**

The impact assessment is the main result of monitoring. Gathering the impact assessment of different NbS interventions will contribute to create a robust evidence of the benefits of NbS in comparison with traditional solutions.

This step will require the post processing and/ or combination of different KPIs and metrics. In addition, the expert interpretation of the results is required since this information will be used in making decisions. The process will be fed with new monitoring results in a process of reflexive monitoring for adaptive planning and management.

## **The example of Grow Green – monitoring of NbS**

This factsheet presents the lessons learned about monitoring during the GrowGreen project.

In this section, the specific details related to the project experiences are presented, including the main expected outcomes.

As the starting point, the expected challenges and outcomes for the interventions were defined to ensure the alignment of the NbS intervention outcomes with the cities' challenges and strategies. These main outcomes were translated into metrics to define the KPIs monitoring System with a very deep collaboration between all the involved stakeholders (not only administrations, policy makers and the scientific community or academia, but also citizens and the private sector). Therefore, it is relevant to consider the existing literature (mainly EKLIPSE

#### **Step 5: Reporting for decision making**

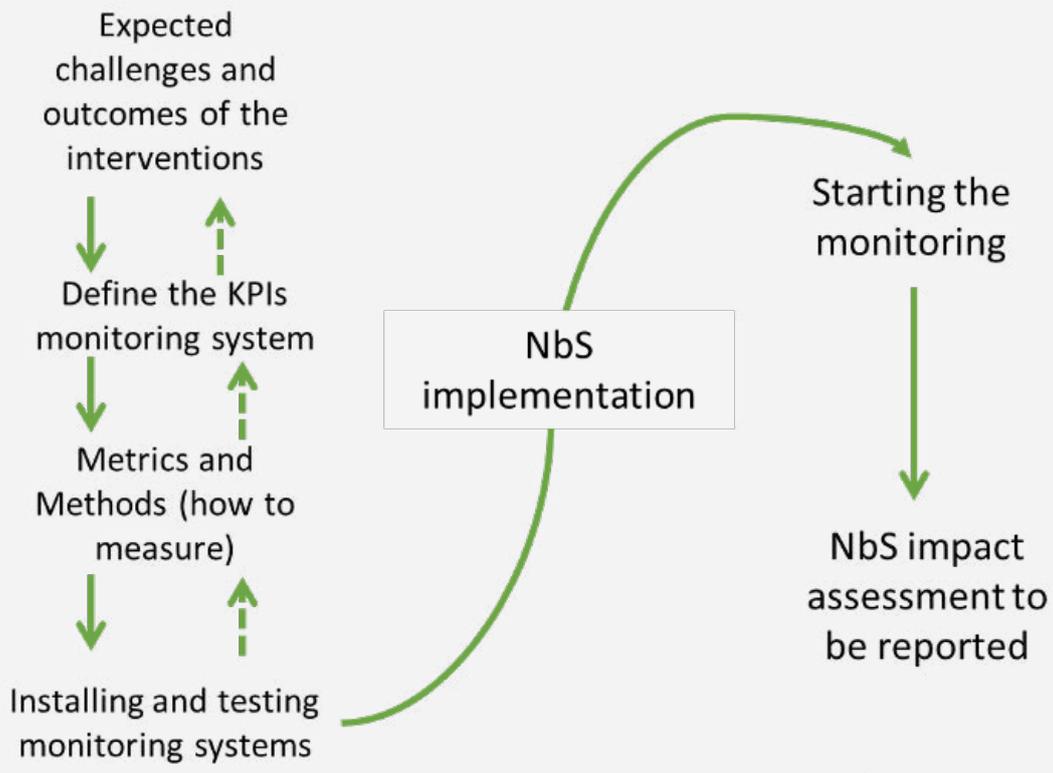
The final goal of monitoring is providing useful information for decision making at different scales and sectoral levels, as well as for different target audiences. The most relevant examples of this reporting are:

- Evidence about the benefits of NbS in urban design and planning.
- Key messages for citizens to be aware of urban nature and engage with NbS.
- Contribution of NbS to comply with policy goals: urban agenda 2030, Biodiversity Strategy, SDGs and Green Infrastructure Strategies, among others.
- Filling the gaps of already existing monitoring strategies and smart city platforms in cities to integrate variables which are sensitive to NbS interventions.

as the most updated reference during the project timeline).

The definition of the procedures (specific metrics and methods) to develop the measurements was concluded with the installment and testing of the monitoring systems. It was critical to follow the existing standards defining not only the required sensors (mainly related to environmental variables) but also other tools such as modeling or social impact assessing methodologies.

During the process to define the Monitoring Framework, dominant directions (continuous rows) were identified as well as steps that can be re-thought or re-fed in the following steps (discontinuous rows).



**Fig3: Monitoring Framework Flow in Grow Green**

In the following paragraph the project challenges and key drivers for the NbS impact assessment are presented.

The economic dimension is a key component of the GrowGreen impact assessment towards the definition of successful business cases supporting NBS deployment. In this context, the assessment of effectiveness entails several aspects:

- whether the deployed NbS achieve their objectives (e.g. reducing flood risk) at an equal or lower cost than other (grey) alternatives (*cost-effectiveness*);
- assessing costs avoided as a result of NbS implementation (e.g. avoided costs of run-off water in the sewerage treatment system);
- assessing whether economic objectives of the NbS projects, such as stimulating local economic activity, have been met.

<b>Climate adaptation and mitigation</b>	<i>Heat stress</i>
	<i>Water management Flooding</i>
	<i>Water management Scarcity</i>
	<i>Carbon emissions</i>
<b>Urban Environmental Quality</b>	<i>Water quality</i>
	<i>Access to nature</i>
	<i>Air quality</i>
	<i>Noise quality</i>
<b>Urban Challenges</b>	<i>Biodiversity</i>
	<i>Social cohesion</i>
	<i>Social justice</i>
	<i>Human health and well-being</i>
	<i>Inclusions and equality</i>
	<i>Stakeholder participation</i>
	<i>Connectivity/accessibility</i>
<i>Rapid growth densification</i>	

**Table 1 Summary of GrowGreen cities challenges**

Effectiveness can be analysed from the perspectives of a) the outcomes of NBS in achieving specific objectives and b) of the process of their implementation and management (Ford et al., 2013; Noble)

## Recommendations

- Monitoring is key for better decision making to assess the benefits of NbS compared to traditional solutions, and to promote the NbS integration into cities' projects, planning and strategies.
- Building a robust evidence of NbS impacts and benefits requires a Monitoring Strategy tailored to the city.
- Involving all the stakeholders related with the different steps and defining the specific outcomes that are expected with the interventions is mandatory.
- Ensuring the coherence with the scale and reporting needs is key to identify the appropriated KPIs.



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