Measurement procedure and tool	Model/Survey. In situ sampling.
Scale of measurement	Various
Data source	
Required data	Various
Data input type	Quantitative and semi-quantitative
Data collection frequency	
Level of expertise required	High
Synergies with other indicators	
Connection with SDGs	6
Opportunities for participatory data collection	
Additional information	
References	http://echo2.epfl.ch/VICAIRE/mod_2/chapt_2/main.htm http://wgbis.ces.iisc.ernet.in/energy/monograph1/Methpage1.html

4.51 Total polycyclic hydrocarbon (PAH) content of NBS effluents

Project Name: Connecting Nature (Grant Agreement no. 730222)

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Total polycyclic aromatic hydrocarbon (PAH) content of NBS effluents	**Water Management**
Description and justification	Polycyclic aromatic hydrocarbons (PAHs) are a group of more than 100 chemicals that are persistently toxic in the environment. In areas of contamination, PAHs can be found in water, soils, sediments and plants. Bioremediation is one of the mechanisms that has been identified as a potential method for reducing/removing

	PAHs in natural systems (Samanta et al. 2002). As such, nature-based solutions represent a mechanism for intercepting PAHs from source, or remediating PAHs in-situ. Assessing the level of PAHs in water released from nature-based solutions represents a mechanism for evaluating the perfomance of the nature-based solution in terms of increase/decrease in PAHs.
Definition	Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous environmental pollutants that possess carcinogenic and mutagenic properties (Menzie and Potokib1992). Whilst PAHs can come from natural sources, they are also formed during incomplete combustion, pyrosynthesis, or pyrolysis of hydrocarbons (petrogenesis) (Li et al. 2010). As such, PAH release into the environment is associated with anthropogenic sources and urbanisation (Menzie and Potokib1992).
Strengths and weaknesses	+ Well established protocols exist for analysing PAHs in water - Results can be heavily influenced by sampling frequency. - Depending on sampling methodology, regular sampling visit might be required
Measurement procedure and tool	Typically, PAH analysis is carried out through laboratory analysis of water samples. For information on general water sampling procedures, see indicator 1.2 Water Quality General and the Connecting Nature Environmental Indicator Metrics Review Report. However, in-situ methods are emerging (Felemban 2019). Once water samples have been collected, laboratory analysis typically comprises the use of analytical methods such as gas chromatography/mass spectrometry (GC/MS), including chemical ionization MS, ion trap MS, TOF/MS, and isotope-ratio MS (IRMS), and high-performance liquid chromatography (HPLC) with fluorescence detection or ultraviolet detection (HPLC/UV) (Molaei et al. 2016; Felemban 2019). In addition to PAH concentrations, it can be advisable to calculate change in flow rates due to NBS also. By doing so, it may be possible to calculate PAH loading in addition to pollutant level. This is a worthwhile consideration as, it is possible that concentrations in water could increase whilst overall pollutant load can decrease (due to a significant reduction in water flow over time).

Scale of measurement	Typically carried out on a site scale, but could be combined with city-wide water quality monitoring if NBS is sufficiently scaled-up.
Data source	
Required data	Spatial data in relation to water flows and sampling methodologies
Data input type	Quantitative and spatial
Data collection frequency	Regular sampling/continuous sampling is recommended to avoid missing pollution spikes/first flush events. However, if background levels are the target for evaluation, less frequent sampling may be adequate.
Level of expertise required	Water sampling does not necessarily require a high degree of expertise. Laboratory analysis does however require technical expertise.
Synergies with other indicators	Improved water quality can have correlations with nature, health and social value of a waterways, particularly in relation to biodiversity indicators.
Connection with SDGs	SDG3, SDG4, SDG6, SDG8-SDG12; SDG14-SDG17: Clean water supply; Links to environmental education; Clean water; Job creation; Cleaner water supply; Social equality in relation to water quality; Sustainable urban development; More sustainable water management; Improved water quality (for life below water); Improved water quality (for life on land); Environmental Justice; Opportunities for collaborative working
Opportunities for participatory data collection	Opportunities are available for participatory processes, particularly in relation to taking water samples for subsequent analysis. Automated dataloggers offer less opportunity for such participation with participation limited to observing and processing the data produced. There are also opportunities for stewardship of equipment or nature-based solution, etc.
Additional information	
References	Felemban, S, Vazquez, P and Moore, E (2019) Future Trends for In Situ Monitoring of Polycyclic Aromatic Hydrocarbons in Water Sources: The Role of Immunosensing Techniques. *Biosensors 2019, 9*, 142. Li, J., Shang, X., Zhao, Z., Tanguay, R. L., Dong, Q., & Huang, C. (2010). Polycyclic aromatic hydrocarbons in water, sediment, soil, and plants of the Aojiang River waterway in Wenzhou, China. *Journal of hazardous materials, 173*(1-3), 75–81. Menzie CA, Potokib B. (1992) Exposure to carcinogenic PAHs in the environment. *Environ. Sci. Technol. 26*,1278–1284. Molaei, S, Saleh, A. and Ghoulipour VSeidi, S (2016) Centrifuge-less Emulsification Microextraction Using Effervescent CO2

	Tablet for On-site Extraction of PAHs in Water Samples Prior to GC–MS Detection. *Chromatographia 79*, 629–640. Samanta, S, Singh, OV and Jain, RK (2002) Polycyclic aromatic hydrocarbons: environmental pollution and bioremediation. *Trends in Biotechnology 20*(6), 243-248.

4.52 Total organic carbon (TOC) content of NBS effluents

Project Name: Connecting Nature (Grant Agreement no. 730222)

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Total organic carbon (TOC) content of NBS effluents	Water Management
Description and justification	Total Organic Carbon (TOC) is a measure of the total amount of carbon in organic compounds and is a key parameter for accessing the organic load of water. Organic carbon occurs as the result of decomposition of plant or animal material in both surface and groundwater. It is an extremely important part of the carbon cycle (and hence carbon calculation of nature-based solutions) and a food source in aquatic ecosystems. Total organic carbon (including dissolved organic carbon - organic matter that can pass through a filter no larger than 0.45 µm) can also contribute to the acidity water bodies and can increase the turbidity of aquatic systems, impacting phototrophic organisms. Nature-based solutions can play a key role in the carbon cycle and in relation to the total organic carbon balance. As such, understanding their role in relation to total organic carbon in water released from the nature-based solution is a key part of understanding their wider benefits, co-benefits and dis-benefits.
Definition	Total organic carbon in a water sample (mg/L C). Carbon load (mg/L over time) is also a critical part of the understanding of this indicator (mean concentration of carbon mg/L)
Strengths and weaknesses	+ Well established protocols exist for analysing Total Organic Carbon in water - Results can be heavily influenced by sampling frequency.