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4.23 Rainfall storage capacity of NBS

Project Name: CONNECTING Nature (Grant Agreement no. 730222) and PHUSICOS (Grant Agreement no. 776681)

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Rainfall storage (water absorption capacity of NBS) (Applied and EO/RS combined)	Water Management
Description and justification	Indicators of Effects on Water Quantity sub-criterion will assess the effects of project scenarios on water quantity: Cities typically place water resources under stress and increase pressure on the quality and quantity of water resources. Changing precipitation patterns due to climate change are expected to exacerbate problems, for instance more intense rainfall events that exceed existing sewage system capacity. NBS can help tackle flood risk, and water quality and scarcity for instance by increasing infiltration

	and evapotranspiration and/or through phytoremediation. Applied approaches can provide a coarse measure of the performance of nature-based solutions, such as Sustainable Drainage System (SuDS) basins, under storm conditions. Remote sensing and GIS technologies coupled with computer modelling are useful tools in providing a solution for future water resources planning and management, especially in formulating policy related to water quality. Data on the stormwater performance of nature-based solutions collected in these ways can be used to: • provide approximated values for total rainfall diverted from storm drains; • monitor performance of SuDS systems in relation to original designed-for capacity; • assess the potential for any additional capacity in SuDS features and therefore potential for additional catchment areas to be diverted into existing SuDS systems; • assess long-term performance and inform management requirements; • provide proof-of-concept for testing new/novel systems; • assess infiltration rates in soils beneath SuDS features; • provide easily accessible data/demonstrations to communities and decision-makers to change perceptions of SuDS.
Definition	The Indicator describes the water storage capacity in terms of volume of NBS and Green Solutions: Calculating/predicting stormwater performance of NBS, for example run-off coefficients in relation to precipitation quantities measured in mm/% from NBS (e.g., green roofs, tree pits, grass etc).
Strengths and weaknesses	**Applied methods:** Strong evidence in terms of local performance but tends to be of a more binary nature (i.e., enough capacity to cope with storm event or not) compared to quantification of peak flows and delays (Env 09). A good simple basis for production of infographics and figures to influence opinion. They are less valuable as methods for generating precise flowrate measurements to be embedded into flood management models. **EO/RS methods:** it is relatively easy to delineate inundation areas using optical remote sensing data, but it is difficult to characterise the water storage of natural lakes or man-made reservoirs using traditional field surveys or remote sensing methods. Water levels can be assessed using gauged hydrological stations, but this is difficult at

	large scales and in less developed regions where hydrological stations are not available. Satellite radar altimetry provides a complementary means of obtaining water surface elevations. However, the sparsely distributed data constrain the large-scale application of this technique. With synoptic and frequent observations, optical remotely sensed images are able to delineate water/land the boundaries, where the water surface elevations can be determined based on their overlap with boundaries and the bottom typography. Conversely, determining the bathymetry of a lake or reservoir tends to be more challenging, requiring special equipment and considerable labour and money. Thus, the bottom topographical measurements of hundreds of large water bodies in the YRB appear to be practically unfeasible.
Measurement procedure and tool	A variety of methods exist from applied/public participation techniques through to earth observation/remote sensing approaches. *Applied/Participatory methods*: Basic measures of stormwater storage volume can be calculated without detailed analysis of flowrates. Such metrics can provide a coarse measure of the performance of nature-based solutions, such as Sustainable Drainage System (SuDS) basins, under storm conditions. Typically, a weather station or weather radar data are used to calculate total rainfall during a rain event. Data on the stormwater performance of the nature-based solution during the event is then generated using cameras (Connop et al. 2018; Connop and Clough 2016; Clough and Newport 2017), soil moisture sensors (Alves et al. 2014), and/or pressure sensors (Connop et al. 2018; Connop and Clough 2016; Clough and Newport 2017). This data is then analysed to monitor how long after the initiation of the rain event the nature-based solution began to fill, whether the capacity was ever exceeded resulting in the release of stormwater to storm drains, and how long it took to empty following the cessation of the rain event. If duration of monitoring is a limitation (i.e., waiting for a 1 in 100 year storm can, by definition, take a long time), simulation of storm events can also be carried out (Alves et al. 2014; Connop et al. 2018; Connop and Clough 2016; Clough and Newport 2017). By doing so, it is possible to assess the performance of the nature-based solution during rain events of known magnitude without having to wait for such events to occur naturally. Such a method is not only a

	useful tool for testing the SuDS performance of nature-based solutions, it can also be an effective tool for engagement and understanding of SuDS for communities not familiar with the practice. **Earth Observation/Remote Sensing methods**: The use of remote sensing and GIS in water monitoring and management has been long recognized. Potential application and management is identified in promoting the concept of sustainable water resource management. In conclusion remote sensing and GIS technologies coupled with computer modelling are useful tools in providing a solution for future water resources planning and management to government, especially in formulating policy related to water quality. Different studies have extracted flood extent from satellite images available for flood events that occurred in a specific period. That can then be compared with the flood extent derived from the flood extent obtained for the annual rainfall using HEC-HMS and HEC-RAS. Based on the flood extent, it is possible to develop, demonstrate and validate an information system for flood forecasting, planning and management using remote sensing data with the help of Flood Hazard Maps for different return periods (10, 20, 50 and 100 years). This supports the assessment of the population vulnerability and physical vulnerability of the lowest administrative division prone to floods.
Scale of measurement	**Applied methods:** Typically on a component or site level. It can be scaled-up to much larger scales through replication **EO/RS methods:** Possible at various geographical scales, but tends to be better suited to larger scales than micro-scales
Data source	
Required data	Required data will depend on selected methods, for further details on applied and earth observation/remote sensing metrics refer to Connecting Nature Environmental Indicator Metrics Review Report
Data input type	Data input types will be depend on selected methods, for further details on applied or earth observation/remote sensing metrics refer to Connecting Nature Environmental Indicator Metrics Review Report
Data collection frequency	Data collection frequency will be depend on selected methods, for further details on applied or earth

	observation/remote sensing metrics refer to Connecting Nature Environmental Indicator Metrics Review Report
Level of expertise required	**Applied methods:** Some expertise required for instrument installation. Data analysis/interpretation can be very basic once systems are in place. **EO/RS methods:** Expertise in mapping and interrogation of data using GIS software is typically required. Level of expertise required is greater with increasing complexity of software processing.
Synergies with other indicators	**Applied methods:** Very inexpensive and effective approach to provide long-term monitoring to inform management requirements. Aspects of the method could also form the foundation of evaporative cooling monitoring. **EO/RS methods:** Data generated in this way have synergies with other mapping indicators, most specifically flood risk indicators.
Connection with SDGs	SDG1, SDG2, SDG3, SDG4, SDG6, SDG8 through to SDG17: Reduced impact of flooding; Better irrigation for food production; Reduction of health impacts of flooding; Links to environmental education; Clean water and sanitation co-benefit; Job creation; More sustainable infrastructure; Social equality in relation to water management; Sustainable urban development; More sustainable water management; Climate change adaptation; Improvements in water management and quality; Habitat enhancement/creation; Environmental Justice; Opportunities for collaborative working.
Opportunities for participatory data collection	Model/Survey: **Applied methods:** Community/stakeholder participation in terms of data downloading, stewardship of equipment or nature-based solution, appointment of SuDS champions to monitor and report on any evidence of basins being overloaded. Storm simulation on SuDS features can also be an excellent mechanism to demonstrate performance to local communities and decision-makers. In so doing, it represents a mechanism for breakdown barriers to delivery and upscaling. **EO/RS methods:** A methodology for identifying the suitability for different rainwater harvesting interventions using a participatory GIS approach and field survey was proposed by Ziadat et al. (2012). Options for implementing different rainwater harvesting interventions can be identified with the participation of local communities. Field investigations indicated that the applied approach helped to select the most promising fields. The approach showed that participatory GIS approaches may be used to integrate

	socio-economic and biophysical criteria and facilitate the participation of farmers to introduce rainwater harvesting interventions in dry rangeland systems to mitigate land degradation.
Additional information	
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4.24 Quantitative status of groundwater

Project Name: UNaLab (Grant Agreement no. 730052)

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Quantitative status of groundwater	Water management
Description and justification	Water covers ca. 71 % of the Earth's surface but only 2.5 % of it is fresh, stored as groundwater and in glaciers. Water is vital for living organisms, and it enables a multitude of human activities such as agriculture, manufacturing and transportation of goods. Available water resources are being extensively used for a variety of purposes, and ensuring that the water quality is monitored and the degraded water bodies are enhanced is essential for protecting the water resources. EU Water Framework Directive (2000/60/EC) sets forth the framework for integrated management of surface waters and groundwater resources in the EU Member States, which are presented as River Basin Management Plans.
Definition	The degree to which a body of groundwater is affected by direct and indirect abstractions (good, poor)
Strengths and weaknesses	+ A comparable EU-wide applied assessment - Requires arrangements on Member State-level
Measurement procedure and tool	The following procedure is based off the requirements set by the Water Framework Directive (2000/60/EC): 1. Define groundwater bodies within a river basin area