SDG Indicator 6.3.2 Technical Guidance Document No. 4:

Level 2 Reporting

This document provides guidance on Level 2 reporting for SDG indicator 6.3.2. It is a companion document to the Step-by-Step Methodology and forms part of a series that provide detailed technical guidance on specific aspects of the indicator methodology. These technical documents were created in response to feedback received following the baseline data drive of 2017. These resources are available on the Indicator 6.3.2 Support Platform (https://communities.unep.org/display/sdg632).

This document is aimed at practitioners seeking further information on how to implement the methodology in their own country:

1. It expands on the Level 2 concept presented in the step-by-step methodology.
2. It describes examples of Level 2 data.
3. It provides guidance on how to report Level 2 data.

What is Level 2 Reporting?

Level 2 is both optional and unconstrained. Reporting at Level 2 may include any type of water quality monitoring data that are not captured by the simple physico-chemical parameter groups of Level 1 (oxygen, salinity, nitrogen, phosphorus and acidification). Level 2 reporting may include reporting on parameters such as heavy metals or approaches such as biological methods. These are summarised, but not limited to, those shown in Figure 1 below.

Whereas Level 1 reporting covers the parameters that are relevant at the global scale, Level 2 goes further and provides the opportunity to report any data of national relevance. Level 1 monitoring maintains the global comparability of the indicator and, although it provides good information, it is limited in scope and cannot represent all pressures to freshwater quality. The impacts from these pressures include oxygen depletion, salinization, nutrient enrichment and acidification. Level 2 gives flexibility to countries to report beyond these simple measures, and provides the mechanism to report on parameters and approaches that may match more clearly the national capacity to monitor freshwaters, and to focus on impacts on water quality that may be significant locally, nationally or regionally.

The indicator methodology requests that water bodies are classified as either good or not good. These spatial hydrological units are nested into reporting basin districts (RBDs) which are derived from river basins. Countries are encouraged to report at Level 2 using the same water body and RBD spatial units that are used for Level 1 wherever possible. If data are available for certain water bodies (for example a single river, lake or aquifer), reporting at this partial scale will still provide useful information on the ongoing monitoring activities, and will contribute to a global picture of water quality status and trends.

This document was prepared by Stuart Warner and Philipp Saile of the UN Environment Programme's Global Environment Monitoring System for Freshwater (GEMS/Water). April 2020.

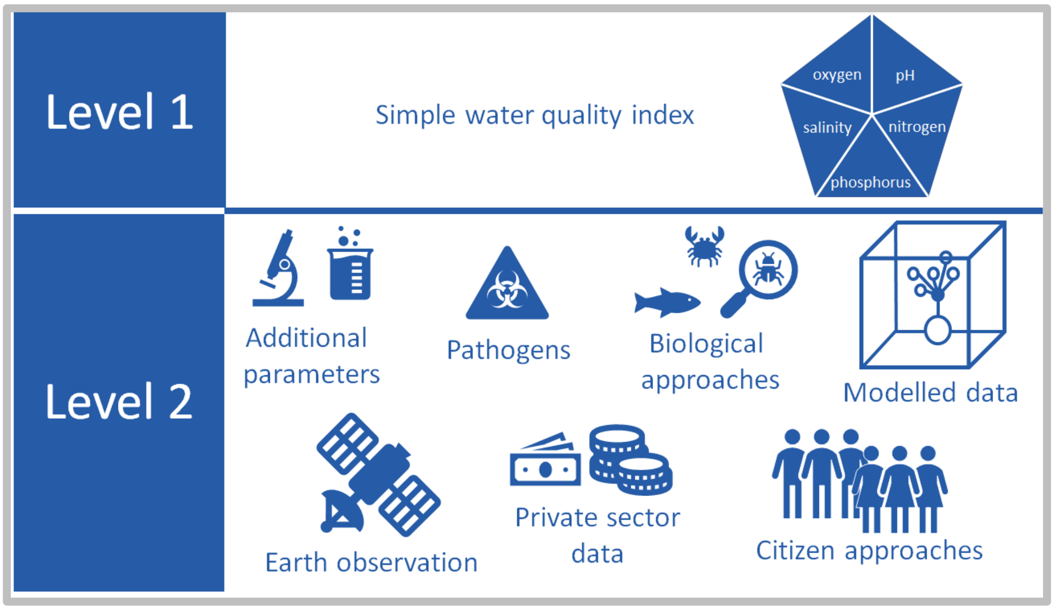


Figure 1: Example of Level 1 and Level 2 data and approaches that can be used for SDG indicator 6.3.2 reporting

Level 2 Report Submission

Countries that choose to report at Level 2 will be asked to complete a questionnaire (Annex 1) that is designed to make clear the type, coverage and format of the Level 2 data available. Based on the questionnaire responses, Level 2 data can be categorised according to the type and spatial coverage of Level 2 data which will inform the most suitable way to integrate Level 2 data with Level 1. They may:

1. **supplement** existing Level 1 data;
2. remain discrete, but used in a "**one out, all out**" approach of classification; or
3. they can remain **separate** from Level 1 data and not integrated.

These three options are described in more detail below.

Supplement Level 1 Data

Level 1 data may be supplemented by two mechanisms: the list of parameters used to classify a water body can be expanded or, alternatively, Level 2 data can be used to increase spatial coverage and fill gaps in the data record.

Expanding the list of parameters increases the scope of the classification beyond the five core parameter groups. For example, it may be possible to include analyses of additional parameters from the same sample events used to collect Level 1 data. These extra parameters can simply be added, and the binary "pass or fail" classification method applied. *Table **1*** shows how suspended solids and chlorophyll could be added. In this case, the Level 1 parameters would result in a good classification because the proportion of measurements meeting the compliance ratio exceeds 80 per cent. If the Level 2 data were included, the water body would be classified as not good.

Table 1: Example of how additional parameters can be used to supplement Level 1 parameters

	Level 1					Level 2	
	Dissolved oxygen	**Electrical conductivity**	**Nitrogen**	**Phosphorus**	**pH**	**Suspended solids**	**Chlorophyll**
Number of measurements	12	12	12	12	12	12	12
Number of measurements meeting target	11	12	8	10	10	4	8
Proportion of measurements meeting target	91.7	100	66.7	75	83.3	50	33.3
Level 1	**Total = 51 of 60 values meet targets**						
	Indicator Score = 85% = good						
Level 2	**Total = 63 of 84 values meet targets**						
	Indicator Score = 75% = not good						

Expanding spatial coverage: Level 2 data can also supplement Level 1 data spatially by filling gaps in the data record. For example, there may be extensive river and groundwater monitoring programmes, yet no monitoring of lakes and reservoirs. In this case, satellite-based Earth observation data of lakes and reservoirs could be used to provide a more complete national indicator score which is based on all water body types rather than just the rivers and groundwaters alone.

Table 2: Example of how Level 2 data can be used to supplement Level 1 data to provide a more

Water body type	Level 1 (number of water bodies)	Level 2 (number of water bodies)	Total (number of water bodies)
River	100	0	100
Lake	0	20	20
Groundwater	10	0	10

ONE OUT, ALL OUT

Countries may choose a *one out, all out* approach (OOAO) to Level 2 data integration. For example, if both physico-chemical Level 1 data, and biological Level 2 data are available for the same river water body, a separate classification can be made using each approach, but both must return a "good" classification for the water body to be classified as good. If either one or both do not, the water body is classified as not good.

A limitation of this approach is that countries which are actively expanding their monitoring programmes over time, as the capacity to monitor increases and more parameters and approaches are added, it may appear that water quality is degrading. In reality, the apparent degradation may simply reflect the additional monitoring effort, an effect of "the more you look, the more you will find". This effect can be prevented if Level 1 reporting is maintained and considered separately. The robustness and simplicity of Level 1 reporting ensures that efforts to improve ambient water quality are reflected in the indicator score over time.

Table 3: Example of Level 2 data integration with Level 1 using a one out, all out approach

	Level 1 Classification	Level 2 Classification	Overall classification
Classification	Good	Good	Good
	Good	Not good	Not good
	Not good	Good	Not good

SEPARATE

The nature of some Level 2 data may mean that neither of the above two approaches are suitable. In these cases, it is suggested that the Level 2 data are reported, but they remain totally separate. These extra data may play an important role to help achieve Target 6.3 and Goal 6 by raising awareness of the importance of water quality, but they may not be suitable for calculating a numerical indicator score. For example, a citizen-based project may collect data on water quality that may not be directly compatible with the data of Level 1. These data may be useful and provide a mechanism to identify pollution hotpots where more conventional monitoring efforts could be directed, but they may be more difficult to combine with Level 1 data to classify water bodies as either good or not good.

EXAMPLES OF LEVEL 2 DATA

Below is a list of examples of data that can be used for indicator 6.3.2 Level 2 reporting. This list is not fully comprehensive.

ADDITIONAL PARAMETERS

Many countries routinely collect ambient water quality data on parameters beyond those required for Level 1 reporting. They may include physical and chemical parameters such as turbidity, colour, silicate or suspended solids. They may also include toxic substances that occur naturally from a geological origin, or that may be related to pollution from activities such as agriculture or mining. *Table* ***4*** below lists examples of parameters that are commonly included in monitoring programmes globally.

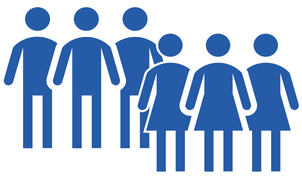
Table 4: Examples of additional parameters that may be reported at Level 2

Paramter or Parameter group	Examples
general parameters	temperature, colour, hardness, alkalinity, cations/anions
suspended particulate matter	total suspended solids, turbidity, organic carbon, transparency, chlorophyll
toxic compounds	arsenic , fluoride, mercury, cadmium
metals	zinc, copper, iron
organic pollutants	Pesticides, PCBs, PAH
radioactivity	^{137}Cs, ^{90}Sr
emerging contaminants	pharmaceutical residues, microplastics

Any other physical or chemical parameter can be included if it is routinely monitored by countries. The effect of the parameter on the freshwater ecosystem and human health, will determine whether and how the data are integrated. General physical and chemical parameters are best integrated by expanding the classification list. Parameters that are toxic are best suited to a OOAO approach because if toxic compounds exceed their target values, this exceedance may not be apparent if all other parameters meet their targets because the 80 per cent compliance ratio may still be met.

CITIZEN APPROACHES

Recent developments in information and communications technology have fuelled the growth and popularity of Citizen approaches to data collection. These allow data to be collected using simple kits and the accurate geolocation of the data collected with mobile devices. These citizen initiatives may lack the accuracy and precision of laboratory-based analyses but have the advantage of being able to collect data at many more locations and at a greater frequency than conventional monitoring (Quinliven *et al*., 2020).



There is significant interest in the potential of citizen science to deliver greater spatial and temporal coverage of water-quality monitoring data than that which is possible with traditional, laboratory-based monitoring networks. The five core parameters of indicator 6.3.2 can all be measured using a range of inexpensive and simple field techniques and there are examples of existing projects and organisations that have potential to provide data for indicator 6.3.2 reporting. Currently there are no national-scale projects in operation, but *Table **5*** below lists some examples of relevant projects.

Table 5: Examples of Citizen Science projects and initiatives

Citizen Science Programme	Notes
FreshWater Watch	Physico-chemical kit-based approach. Over 20,000 water quality samples. Also includes data collection on algae and land use at monitoring location. https://freshwaterwatch.thewaterhub.org/
Mini Stream Assessment Scoring System (miniSASS)	A macroinvertebrate approach for streams and wadeable rivers. Developed from the South African SASS5 method. http://www.minisass.org/en/
MONOCLE	Monitors water quality of inland and transitional waters. Includes citizen monitoring of lake water quality in conjunction with validation of satellite and drone monitoring https://monocle-h2020.eu/Home.
Adopt-a-River initiative Kenya	The initiative is a 'people-driven' wetlands monitoring and restoration project that is being piloted within Nairobi River Basin before up scaling to other parts of the country. http://www.nema.go.ke/index.php?option =com_content&view=article&id=48&Itemid=195
Akvo	A physico-chemical kit-based approach with option to include field spectrophotometer for more advanced analyses. https://akvo.org/
Groundtruth	Includes several Citizen Observatories in Europe and Africa. The most relevant for indicator 632 is in Sweden addressing Water Quality Management – Vatten Fokus. https://gt20.eu/ and https://vattenfokus.se/

Opal Water Survey	A biological approach looking at several taxa. Focus on small and/or urban ponds which are not usually surveyed https://www.opalexplorenature.org/watersurvey
Lake Observer	A mainly a US-based system for monitoring physical, chemical and biological quality of lakes. https://www.lakeobserver.org/
Drinkable Rivers	A physico-chemical and microbiological kit-based approach. https://drinkablerivers.org/

Whether data from CS approaches can be added to Level 1 data or kept separate will depend on the nature and objectives of the CS programme. Citizen data that are repurposed from an existing programme, may not be integrated as easily as data from a programme designed specifically for indicator 6.3.2 reporting. It may be possible to combine citizen physico-chemical data directly with Level 1 data collected by conventional means, if the five core parameter groups are represented and the data are suitably accurate and precise. Due to the diversity of citizen initiatives, each one will have to be considered separately for its strengths and limitations.

In addition to the precision and accuracy of the data collected, there are several other important considerations. The type of data collected, how the programme was designed, the sustainability of the CS project, and the spatial and temporal resolution of the data, are all important factors. Agenda 2030 and the SDGs offer a timely opportunity to test the numerous approaches that are currently in use and under development globally.

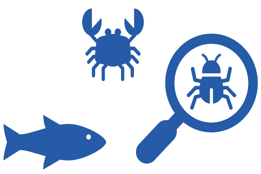
Pathogens

Untreated domestic sewage effluent is one of the most serious and prevalent forms of water pollution globally. Pathogens carried in the wastewater can lead to serious health issues and contribute to high child mortality rates in many least-developed countries. Access to safely managed drinking water services is measured by SDG indicator 6.1.1. In 2017, the indicator team found that only 71 per cent of the world's population had access to a safely managed drinking water supply (UNICEF and WHO, 2019).

There are many bacterial, viral and protozoan pathogens that can be found in freshwaters. Some of these are included in routine monitoring of drinking water sources but not necessarily in dedicated ambient water monitoring programmes. Microbiological approaches may look for the presence or absence of indicator bacteria that suggest the presence of bacteria that may be harmful to humans. Examples are thermotolerant coliforms, such as *Escherichia coli*, which can be used as an indicator of faecal contamination of water.

Where water bodies are used directly for drinking water without treatment, inclusion of microbiological parameters is highly recommended. Combining pathogen data with Level 1 should follow the 'one out all out' approach of classification. If a waterbody does not meet good status due to pathogenic contamination it should be classified as not good.

Biological approaches



There are many biological and ecological approaches to monitoring ambient water quality, but no single method has been tried and tested globally. Most have been developed for a country or region, and then adapted for use in another country. For example, the Biological Monitoring Working Party (BMWP) method developed in the UK (Department of the Environment, 1976) was adapted for the South African Scoring System (SASS) and developed into the most recent version SASS5 (Dickens and Graham, 2002).

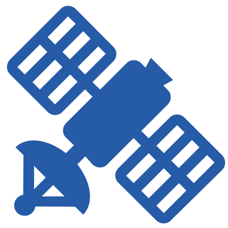
Many biological methods work on the principle that aquatic organisms respond to changes in their environment in measurable ways. In response to poor water quality, species may not be able to survive or will move to a different location to avoid the unfavourable conditions. Less severe responses include a reduction in reproduction or growth rates (Friedrich *et al.*, 1996). Macroinvertebrates are commonly used to monitor the quality of streams and wadeable rivers. Some methods rely on the identification of indicator species (presence/absence) or look at the diversity and abundance of the species found. Certain species are more sensitive to poor water quality and are not found where oxygen levels are continuously or periodically low, whereas the abundance of more tolerant species is higher.

When biological approaches have been established, they are often more economical to operate than those that employ techniques that measure physical and chemical characteristics of water. They are not useful for providing information on whether specific parameter target values have been exceeded or not, but they provide a better overall assessment of water quality if implemented correctly.

The European Water Framework Directive 2000/60/EC (WFD) uses multiple quality elements to classify water body status, including biological approaches. Each element is considered separately and a OOAO approach is applied (EEA, 2018). A water body is assigned an overall status based on the lowest status for the quality elements monitored within that water body. This approach is recommended for combination of biological data with Level 1 general physico-chemical data.

Earth Observation

The most common interpretation of the term "Earth Observation" is restricted to remotely sensed, satellite-derived data and products. Strictly speaking the term has a much broader definition that includes data collected by *in situ* instruments and manual methods as well as by aerial remote sensing methods which use planes or drones.



Earth Observation satellite data are increasingly being used for water-quality monitoring. However, they are limited to optically-detectable water quality parameters, such as turbidity, chlorophyll and total suspended solids; and to date no single method has been adopted as the global standard. The technology, is currently most suitable for relatively large bodies of water, such as lakes and wide rivers, because the spatial resolution available from current satellite images for global applications is not fine enough for smaller water bodies. Given the extensive spatial and temporal coverage of current and upcoming satellite missions, satellite data could prove to be an important additional data source for monitoring large rivers and lakes in the near future.

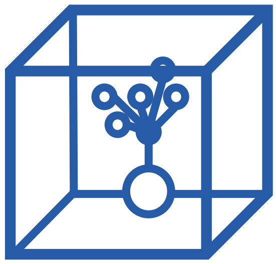
The Copernicus Global Land Service provides historic (2002-2012) and operational (since 2016) lake water quality monitoring data products for about 1000 medium and large-sized lakes for lake surface reflectance, turbidity and a chlorophyll-based trophic state index at spatial resolutions of 300 and 1000 meters.

Note: SDG indicator 6.6.1 on freshwater ecosystem extent, currently uses a satellite-based EO method to provide a global dataset of water quality of large lakes[2].

Modelled data

Mathematical models have been used to estimate pollutant concentrations and distribution for several decades, and can be used to assess the effectiveness of management measures aimed at improving water quality. The complexity of models has increased considerably over the last 50 years (Whitehead *et al.*, 2019), with some addressing pollutant fate, transport and degradation of a compound within a water body, while others model

[2] https://www.sdg661.app/productsmethods#h.p_dOf2pvbqxnNw



the movement of pollutants from land-based sources to a water body. Calibration and validation using real-world data are essential steps for any model to ensure that it gives an accurate representation of the situation or scenario.

Water quality models use data on variables such as climate, population, ground/surface water interactions, reaction kinetics of the compound being modelled, land use characteristics and topography. The quality of the model output is entirely dependent on the quality of the data used in the model.

Models can be specific and applied to national-scale for individual parameters. For example, a map of fluoride concentrations in groundwater in India was produced using a combination of real-world data and information on geology, climate and soil types. The model predicts areas where the fluoride concentration is likely to be over 1.5 mg L^{-1} (Podgorski *et al*., 2018).

Alternative Classification Methods

The method used to classify water bodies as good or not at Level 1 is a simple binary method, where a compliance rate of 80 per cent qualifies a water body as “good”, and less than 80 per cent as “not good”. Countries can choose to apply more complex methods of classification that provide more information on water body status. This does not change the indicator score, but, helps to categorise water bodies based on their status. For example, the WFD uses five categories: high, good, moderate, poor and bad. Using this example, water bodies classed as either “high or “good” would qualify as “good” for indicator 6.3.2.

Level 1 also uses a binary approach when comparing measured values to targets. How frequently, or to what degree, a target is missed is not considered. This binary approach was adopted for Level 1 in order to keep the method simple. For Level 2, countries can choose to adopt more complex methods if they wish, such as the proximity-to-target (PTT). The PTT scores are scaled to range between 0 and 100, where 100 indicates that the target is met and decreasing scores indicate an increasing distance from the target. A description of the method can be found in Carr and Rickwood (2008)

The simple water quality index used for Level 1 reporting treats each parameter group equally and no weighting is applied to any particular group. Countries can apply a more advanced classification method, such as the one developed by the Canadian Council of Ministers of the Environment (CCME, 2017). This index calculator which is available for download (CCME calculator), includes measures of by how much a parameter misses its target, how many times the target is missed, and how many parameters miss their targets for a particular monitoring site.

Regardless of the classification method used for Level 2 reporting, countries are requested to apply the simple binary method for Level 1 reporting to maintain the greatest degree of global comparability of the indicator as possible.

Summary

Level 2 reporting is optional and unconstrained, allowing countries the freedom to report additional data if they have the resources available to do so. This provides countries with the facility to report the quality of their freshwaters beyond the scope possible with Level 1. It allows additional parameters or approaches to monitoring to be included that may reflect better impacts on water quality and that may be locally, nationally or regionally relevant.

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